~~EH~~
AW

Inter-office memo

TENNECO CHEMICALS, INC.

To P. F. Albanese At Flemington Date February 19, 1969

From L. Medeiros At Burlington Copy to P. F. Albanese
H. B. Carr
R. S. Cole
H. H. Duhamel
E. Farber
J. C. Fisher
G. W. Leach ✓
G. I. Rozand
P. R. Scarito
D. H. Weintraub
M. W. Williams

Subject Allied and PPG Monomer Evaluation

Burlington Resin plant has received a scheduled 42,000 gallon Allied tank car and the first of ten 31,000 gallon PPG cars of vinyl chloride monomer. The following is a program for evaluation of the Allied and the PPG monomer in production.

A. Allied VCM Program

1. In a scheduled 18 batch run of Tenneco 315, charge one 9 batch lot using Tenneco VCM from storage (no recovery). Follow this lot with a 6 batch lot utilizing Allied VCM (no recovery) charged directly from the Allied tank car.
2. When transferring batches of the above two lots to the slurry tank do not add soda ash. After the last batch of each lot has been transferred to the blend tank during drying; dry for 1 hour more and take special 5 lb. drier sample. Estimate amount of slurry left in the blend tank and make soda ash addition of 25 lbs./batch. After 2 hours more of drying take 2nd special 5 lb. sample from each lot. All four samples are to be used for heat stability and light absorbance evaluation.
3. Run out one PVC monomer storage tank (number 1 or 2) and unload the remainder of the Allied monomer into it. Have a sufficient level in the other tank to take up any delay in charging of the Allied VCM.
4. The Allied VCM is to be charged in Tenneco 225 type (H-3120) as follows:
   a. Prior to charging of the Allied VCM run recovered monomer inventory empty.

b. Charge three lots of Tenneco 225, preferably in a schedule of four 7 batch lots as follows:

Lot 1: 7 batches, Allied VCM, scheduled so as to use all Tenneco recovery generated in previous lot processed (may have some Allied blended in).

Lot 2: 7 batches, Allied VCM, No recovery

Lot 3: 7 batches, Allied VCM, with minimum of 1,000 lbs./batch of Allied recovery.

Lot 4: (if scheduled) 7 batches, Allied VCM, No recovery.

If scheduling of lot 4 is not possible at time of run, charging of this lot should be included in the next Tenneco 225 run. Take vapor and liquid samples of the Allied recovery.

B. PPG VCM Program

The PPG monomer is to be used in all three resin plants as follows. Use of the PPG monomer once commenced should continue till all 10 cars are depleted. Check schedule of arrivals of these cars before start of evaluation.

1. Empty one PVC monomer storage tank (number 1 or 2) and fill with PPG monomer.
2. PPG monomer may be charged on all PVC types. Repeat evaluation run in part A above using the same Tenneco 225 formulation, with the exception of the one virgin lot using Tenneco monomer (lot 4). In this evaluation enough PPG monomer is available so that charging may commence on any formulation preceding the 225 run.
3. Based on acceptable kinetics in the PVC plant, empty one copolymer storage tank and fill with PPG monomer (numbers 3 or 4). Charge at least one 9 batch lot of Tenneco 315 using all virgin PPG monomer, repeating the procedure of soda ash add during drying.
4. Take vapor and liquid samples of the PPG recovery.

All batches charged with competitive monomer will be evaluated for kinetics, processing, and resin quality. If possible, recovered monomer from all batches charged should be weighed.

I-IM (50M)

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

X-Copy (EJH, GLF, AVL, LM)

MAR 04 1969

To M. W. Williams At Piscataway Date February 27, 1969

From H. B. Carr At Flemington Copy to P. F. Albanese
E. Farber
J. C. Fisher
F. W. Kanzler
G. I. Rozand
P. R. Scarito

Subject ALLIED AND PPG MONOMER

The tank car of Allied MVC and the first two of the scheduled ten cars from PPG were received in Burlington the week of 2/17/69. As part of the program involving Production, Process Engineering, and Polymerization Research to evaluate this monomer, Quality Control has analyzed the initial shipments on its gas chromatograph. The results are shown below along with the range of recent Houston monomer shipments.

	Allied (GCX714601)		PPG SACX9902			Range of Houston Shipments Feb.
	Burlington Q.C.	Allied Analysis	Burlington Q.C.	PPG Analysis	Tentative Tenneco Spec.	
Propylene	5	3	<1	Not Available	20	4-15
Methyl Chloride	146	ND	49			
1,3-Butadiene	2	3.1	6		1.5	2-8
Propane	<1		ND			
Isobutane	<1		<1			
Propadiene	<1	ND	<1		60	84-157
Butane	<1		<1			
Butene-1	<1	2	<1		4	2-8
Methyl Acetylene	<1	ND	<1		4	25-44
cis-trans Butene-2	ND	0.9	ND			

ND = Not Detected

As seen in the table, both the Allied and PPG monomers are much cleaner than the Houston monomer shipments for February. Only butadiene, in each case, exceeds our tentative specifications. With the exception of butadiene, the PPG monomer appears to be better, based on light end impurities, than the Allied monomer.

Allied was contacted concerning methyl chloride, which they list as not detected (ND). The explanation for this is that they have not, as yet, optimized their gas chromatographic conditions for the determination of this impurity. They do, however, realize that methyl chloride is present in their monomer.

FEB 27 1969

I-184 (50M)

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

APR 10 1969

TO M. W. Williams AT Piscataway DATE April 7, 1969

FROM P. F. Albanese AT Flemington COPY TO H. B. Carr, E. Farber, J. C. Fisher, J. B. Gottlieb, E. J. Hourihan, C. W. Johnston, G. W. Leach, L. Medeiros, M. K. Rosen, P. R. Scarito, A. C. Shah, A. C. Siegel, R. A. Vallette, A. V. Wagner, W. D. Wesely

SUBJECT MONTHLY REPORT - MARCH, 1969
PROCESS DEVELOPMENT

RAW MATERIALS

MVC

A 42,000 gallon tank car of Allied MVC and 9 tank cars of PPG monomer were processed through the Burlington site as part of a monomer evaluation program. All of the data gathered is still under review and at this point, the PPG monomer is comparable to good Tenneco monomer. The major significant effect noted was the quality of the Allied recovered monomer which gave a noticeable improvement in reaction kinetics over the Tenneco monomer. A report will be issued shortly with a detailed list of savings that could be expected with a better quality monomer.

In-process monomer sampling, to more closely relate to process performance, is being delayed because of the heavy load of monomer samples resulting from the Allied and PPG evaluations.

A memo was issued detailing the cost savings that could be ascribed to a decrease in propadiene level which was noted during the early part of February. The cost savings reported was based on the improvement in reaction times noted for 1730 and calculated to represent an addition to annual profits of approximately $75,000.

P.E. has been monitoring the storage life of Lupersol-11 and catalyst storage facilities in Burlington. After one month storage, the Lupersol-11 was in specification for activity and the storage temperature was held below 28°F. It is planned to continue with this study.

It was reported in the last report period of the number of unusual occurrences in PVC reaction behavior at the Burlington site; poor reactions and long dry blend times. Observations to date have noted some improvement and more consistent homopolymer quality; coarser particle size, low SHDBT and higher bulk densities which also coincides with the dispersion resin plant using their own recovered monomer.

DHW-80

No change in status.

MC-15 Makeup

Centrifuge studies were completed and an interim report (LOP 729) was issued. The data shows an overall reduction in gel level and a reduction in the number of large "fibers" but not appreciably affecting the total number of "fibers." Data is still being collected to determine if the improved filtration of water has also had an effect on the gel level.

Solution cooling of MC-15 is still being considered for a trial run at Burlington. Engineering has been requested to estimate the cost of providing the Methocel make-up tank with "brine" water.

PRODUCTIVITY IMPROVEMENTS

Suspension

2-EHP - Two single-batch runs were made this period; the first into a cleaned reactor followed by a second into the same reactor uncleaned. Both batches were sluggish and were dumped early with the prime suspect being the activity of the 2-EHP. Q.C.'s evaluation of the catalyst showed a 25% reduction in activity. Although the data may be meaningless, the most critical property, gels, was in spec, 2 and 8, respectively. Large-scale runs will be made using 7-batch lots as soon as a new shipment of 2-EHP is received.

IPP - A program was started in the Flemington plant on evaluating the use of IPP as a possible raw material savings in catalyst cost. It is planned to conduct the IPP program in Flemington whereas the 2-EHP will be studied in Burlington. Information and data on the Flemington runs will be reported during the next report period.

Aposet 435 - No change in status. Apogee was notified of the Lucidol patent on Lupersol-11. We have not heard Apogee's comments on the patent, and at this point, if the patent is valid, there is not sufficient incentive to replace Lucidol with Apogee's material.

EHP - Reflux - No change in status. It is not planned to conduct any development work in this area pending the return of Tenneco Plastics personnel from Tenneco Oil.

Increased Reactor Loading - Burlington and Flemington Production are continuing with their programs via LOP to increase reactor loading. The monomer charge for the 315 formulation was increased, however, due to excessive vibration in the copolymer centrifuge, the charge was lowered again. At this point, we have no reason to believe higher monomer loading is the cause.

250-2 - No lumpy batches were encountered this period.

Dispersion Resin

Sodium Bisulfite - At 0.03 phm of sodium bisulfite in our 1740 formulation, induction times were eliminated and cycle times correspondingly reduced. A memo was issued reporting a savings of $63,000 per year based upon the current 1740 production rate. The evaluation is still in progress on an every-other-batch basis for the 1740 formulation. The program has not been started for the 1730 formulation or on the addition of sodium bisulfite to the emulsifier.

Recovered Monomer - LOP 746 was approved to evaluate the effect of recovered monomer on dispersion reaction kinetics and product properties; a maximum usage of 2,000 lbs. per batch is authorized. Samples of the recovered monomer will be submitted for G.C. analysis and bottle polymerizations.

Two vs. Three Stage Homogenization with 1740 - LOP 725 was issued to evaluate two vs. three stage homogenization and the effect on resin properties, especially Brookfield viscosity. Although all data has not been evaluated, three stage appears to produce resin with one day Brookfield viscosities approximately 5 poise higher than that produced with two stage.

Lots 939011 thru lot 939014 have been evaluated. None of the eight pallets produced via three stage had one day Brookfield viscosities lower than 45 poises, while five of seven pallets produced via two stage had one day Brookfield viscosities lower than 45 poises. As soon as time permits, a report on this LOP will be written.

Antifoam DF-190 - No action this month.

DRY BLEND RESIN PROCESS

A status report is being prepared and will issue the first week of April. Results to date and recommendations for future work will be included. It is now apparent that large particles alone do not produce a dry blend resin. Agglomeration of fines caused by the presence of a surfactant is required to produce the required dry blend and dry flow properties.

The program was expanded to also include a 200 type resin primarily to obtain a less expensive resin for Elm Coated Fabrics. There is insufficient data available at this time to base any conclusions.

VP-631

The second batch charged during the present plant VP-631 program did not initiate and had to be recovered. Complete coverage of the batch was provided by R & D and the reason for not initiating is not known. A follow-up batch, the third in the series, was charged after taking certain precautions of eliminating only traces of recovered monomer entering the charge. This batch failed to initiate during the prescribed time period but did initiate after raising the temperature ten degrees. The resulting latex gave acceptable blending resin properties after being processed in the modified 10MM line, however, after 3 days, it had to be scrapped because of poor latex stability. A more detailed report will follow during the next report period.

BLENDING RESINS

Copolymer Blending Resin

Nine batches of copolymer blending resin were run under NPI Extension 733-1. This run was our first attempt to dry and screen this product through the large copolymer line. Two batches of lot 799004 started processing using a 100 mesh screen, but screen rejects ran high at approximately 30%. The balance of this lot was dried into a bin and held until later when it was screened through production's standard 50 mesh screen.

The seven batch lot (799005) was processed through 80 mesh to reduce tailings and provide Wheaton with a truckload of resin. We had 16% tailings and an average drying rate of 2,700 lbs. per hour. An Interim Report (NPI Extension 733-1 Copolymer Blending Resin dated March 25, 1969) was issued. Slurry samples from each batch have been forwarded to the Pilot Plant for drying and subsequent evaluation by Surface Coatings Group.

Based on the low production rate and the screening problem on the 40MM line, it is recommended future development work be done on the 10MM line.

Additional runs are planned pending Wheaton's evaluation of this latest resin and their subsequent orders. As time permits, classifying and screening studies will be conducted on the resin produced during this latest run.

The addition of silicone to a copolymer formulation has shown a tendency towards a finer particle with less agglomeration taking place. This was also evaluated in the Pilot Plant using a copolymer blending resin formulation with the expectation this would improve the fineness and decrease the amount of agglomeration. Samples were submitted to Product Development for evaluation.

Medium Particle Size, PD-03333

No change in status.

Coarse Particle Size, PD-03334

It was also planned to evaluate processing on the 40MM lb. line with PD-03334. However, based on our recent experience, development work for this resin should be done on the 10MM lb. line. NPI Extension 677-3 is circulating for approval to run four batches. This will be done following the copolymer runs.

Fine Particle Size

No change in status. No additional work is planned in the Pilot Plant pending the return of A. C. Shah from Tenneco Oil or until the modified 380 resin program progresses to a satisfactory end point.

AMP's

The rough draft covering the formulations and process conditions for the Flemington plant is completed. This draft will be reviewed with Production within the next report period.

The 1716 AMP was modified so that unless a special request is made, lauryl alcohol will be used. For a specific non-FDA use, Production will be specifically requested to use tridecanol. Each of the variations are on separate AMP's with different formulation numbers.

NEW PRODUCTS

Dispersion

No work was done in this area at the Plant or Pilot Plant level.

1738 - Polymerization work is pending Product Development's evaluation of a 1738-type resin by means of an intermediate reaction temperature and TAIC.

0565 - Samples were submitted to Product Development representing 0565 that was polymerized at a lower temperature. This approach was taken to improve the rheological properties since previous work on 1738 had shown an increase in gel time with a decrease in polymerization temperature.

Suspension

Modified 380 - NPI 737 was issued to produce a faster fluxing resin than the previous attempt, NPI 695. A stringent clean-out, a reduction in Methocel level and the elimination of a forced heat kick were incorporated as an attempt to lower the fusion time. Product Development found the resulting resin to be an improvement over the previous run as far as cross-contamination was concerned, however, the fusion time was not significantly improved to the point where it would be acceptable. The Pilot Plant is presently studying the effect of agitation and colloid level on particle size, bulk density and fusion time to determine if this will lead to further improvements in fusion time.

An additional program was initiated to develop an absorptive α-olefin modified 380 by way of a surfactant/colloid system. Runs made to date have given comparative fusion times to Escambia 6180Y and at times has surpassed the Escambia resin. Work is needed to optimize the formulation in terms of reproducibility, reactor cleanliness and process controllability. Agglomeration at certain formulation conditions is a problem. Also, for some unknown reason, kinetics appear to be poorer with the surfactant system.

Film Grade Resin - 17F - TAMI's evaluation of the 6,000 lb. sample of 17F (589008) showed it to be within tolerable limits for their "Rolla-Glass" operation. They requested a 10,000 lb. sample of another lot of 17F in order to make a final decision based on our ability to reproduce. A second attempt to make this resin resulted in over 150,000 lbs. of resin (lots 589013 and 589014) comparable in properties to lot 589008 based on Q.C. properties. Product Development is presently evaluating this lot along with in-process samples.

Twenty-four thousand lbs. of lot 589008 was shipped to Edison Plastics after this resin was released by CSL and P.D.

Polymix - No change in status.

Tenneco 10R - No change in status.

Solution Grade Resin (VYHH type) - No additional work will be carried out until the FDA status of the Ganex V-816 is clarified. A 10 lb. sample of batch 10-3120-C has been sent to C. W. Johnston for transmittal to GAF for extraction studies.

Fast Flowing 150 Resin - A scaleup to a 200 gallon reactor was made to provide sufficient quantities of a fast flowing low relative PVC resin for customer evaluation. Although the relative viscosity was the same as a previously-accepted batch, the resin had twice the melt flow expected. Additional runs are needed at a revised level of TCE to provide the desired melt flow.

16RS - Reduction of Fines - No change in status.

Graft Copolymers - A graft copolymer with 10% Hypalon 20 was attempted in the Pilot Plant. It is planned to go to a 5% graft since a considerable amount of undissolved and unreacted Hypalon 20 was present in the final product.

PVC 300 - No change in status. No further work is planned until receipt of the expected orders for this resin.

180/11R - NPI 742 was issued to produce a resin with properties somewhere between 10R and 12R plus improved heat stability and a slightly coarser resin. This resin is expected to meet the requirements for FDA bottle formulations. All target properties were met with the exception of heat stability, 98% vs. 100%. Resin is presently being evaluated by CSL and Product Development.

PRODUCT REFINEMENTS

Tenneco 389 - Two SPA extensions were issued, 735-1 and 735-2. The primary objectives were to better define the particle size requirement at Capitol and to also lower the relative viscosity so as to lessen the dependence of extrusion time on particle size. The resin objectives were met and we are presently waiting for an evaluation at Capitol.

Modified 12R (SPA 728) - We have not received any feedback on the special resin prepared for a compound shipment to Sloane.

Modified 315-2 (SPA 743) - Marketing requested a finer particle size version of Tenneco 315-2 so as to sample to GAF. Approval at GAF would mean an additional 5MM lbs./year of business at GAF. The SPA was issued and approved, however, because of the tight scheduling in the copolymer plant, this resin has not been made.

PVC 200 (SPA 724) - SPA (724-1) was extended so as to produce a lower cost resin by reduced venting. The extension covered the period from 2/25/69 to 3/25/69 during which 25 lots were produced in the No. 3 Plant, exclusively. Since there have been no customer complaints on this resin, it is expected that the longer dry blend times will remain in effect.

NEW DISPERSION RESIN PLANT

Process Engineering has advised Production on the excessive surge resin capacity in their dispersion resin bagger hoppers. The capacity of the new hopper is 800 lbs. vs. 200 lbs. in the old bagger. As a result, the additive system can only be checked within ±40%. The recent erratic resin rheology could be the result of our inability to check the additive levels. An attempt will be made to lower the high level alarm to the halfway mark. However, even at this level, we could only expect to be able to control the additive system within ±20%. If control continues to be a problem, a more expensive modification may be necessary, e.g., install a hopper scale.

P. F. Albanese

PFA:em

INTER-OFFICE COMMUNICATION

TENNECO HYDROCARBON CHEMICALS DIVISION

DATE April 14, 1969

TO: TPD - PISCATAWAY

FOR: MR. D. H. WEINTRAUB

FROM: MR. R. E. SIMMONS

RE: PPG AND DOW VCM SHIPMENTS

We have committed for 4.0 MM pounds of VCM to be shipped by PPG Industries from Lake Charles, Louisiana, to Burlington, New Jersey, during April, 1969 according to the following schedule:

ARRIVAL DATE	DATE SHIPPED	NUMBER OF CARS	WHOSE CARS
April 23	April 14	4	PPG - 26 or 31,000 gallon
April 25	April 15	1	THCD - 38,000 gallon
April 26	April 16	3	
April 28	April 18	3	
April 29	April 19	3	
May 1	April 21	2	
Totals		16	4.0 MM Pounds

We will attempt to use our cars when at all possible as our volume rate of 68¢/cwt only applies for 38,000 gallon 6 axle cars.

The freight rate on PPG's smaller cars is 82¢/cwt.

Our Chief Chemist, Mr. Paul Reed, had a meeting with PPG personnel on April 9 to discuss and clarify the VCM specifications to be met and analyses to be furnished by PPG. Mr. Reed has reported the results of this meeting in a memo dated April 10, a copy of which has been sent to Mr. M. W. Williams.

It is especially important that Tenneco's 38,000 gallon VCM tank cars loaded by PPG are unloaded properly such that only the 3 pounds of VCM per 100 gallon car capacity allowed as a vapor heel remains in each car.

We have requested that Dow return the VCM borrowed from Tenneco according to the following schedule:

May, 1969	3.2 MM pounds
June, 1969	1.9 MM pounds

We understand that this material should be sent to Flemington. We will provide you with a schedule as soon as feasible.

RES/bw

Dick

cc: Messrs. Moore, Williams, Rozand (Piscataway)

1-184 (500M)

X-Copy G.L. file; R.M. Mac

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

MAY 05 1969

TO	P. F. Albanese / J. C. Fisher	AT	Flemington	DATE	4/28/69
FROM	M. W. Williams	AT	Piscataway	COPY TO	H. B. Carr

SUBJECT PPG VCM

We will have received a reasonable amount of the April shipments of PPG monomer at Burlington by May 9th or so.

If there's anything dramatically wrong with it (i.e., we're being caused real problems in its use) I'd like the point brought up right away, of course.

Other than that, we should be reviewing the performance and suitability of the product vs specifications -- to see whether any changes in the latter are needed or warranted.

May I have a report please, by May 13th, pulling together plant productivity and product quality effects plus tabulation of analytical results as a guide toward answering these questions.

M. W. Williams

gm

APR 30 1969

Inter-office Memo

TENNECO CHEMICALS, INC.

To P. F. Albanese At Flemington Date May 13, 1969

From G. W. Leach At Burlington Copy to H. B. Carr
H. H. Duhamel
J. C. Fisher
G. I. Rozand
M. K. Rosen
M. W. Williams
File

Subject PPG Monomer Performance

Since the 28th of April, the Burlington plant has been charging PPG monomer. Precautions were taken to minimize contamination of Tenneco and PPG monomer. In general, the performance of the PPG monomer has been quite satisfactory as compared to past performance of Tenneco monomer. For example, the light absorbance quality of 315 copolymer made with PPG monomer is superior to 315 made with Tenneco monomer to the extent that the addition of soda ash is no longer necessary. The percent I-grade record for suspension lots made with PPG MVC is superior to the year to date percentage published in the Monthly Quality Control Summary Report. For example, 14% of the homopolymer lots were E-grade as compared to 19.5% for the year-to-date average (3 of the 4 lots were graded E because of a freak catalyst mistake). 9.5% of the copolymer lots were E grade as compared to the yearly average of 31.3%.

PPG monomer has apparently had a slightly detremental effect on average reaction times. This could be due to the high level of unidentified heavy end contaminants present. For instance, the average reaction times for 250-12, 225/16R, 315 and 385 resins made with PPG monomer, appear to be lengthened by 15 to 30 minutes per batch (Fig. 1). Overall, however, the performance of PPG monomer must be rated as similar to Tenneco MVC, since the resin quality improvement is counterbalanced by lengthened reaction times.

G. W. Leach

GWL/rjl

Attachment

Inter-Office Memo

May 13, 1969

To PFA
From GLL

cc: HBC
H.R.D
J.C.F
G.I.P
M.K.R
M.W.W

Subject: PPG monomer performance.

Since the 28th of April, the Burlington plant has been charging PPG monomer. Precautions were taken to minimize contamination of Tenneco and PPG monomer. In general, the performance of the PPG monomer has been quite satisfactory as compared to past performance of Tenneco monomer. For example, the light absorbance quality of 315 copolymer made with PPG monomer is superior to 315 made with Tenneco monomer to the extent that the addition of soda ash is no longer necessary. The percent A-grade record for suspension lots made with PPG MVC is superior to the year to date percentage published in the Monthly Quality Control Summary Report. For example, 14% of the homopolymer lots were E-grade as compared to 19.5% for the years to date average (3 of the 4 lots were graded E because of a peak catalyst mistake). 9.5% of the copolymer lots were E grade as compared to the yearly average of 31.3%.

PPG monomer has apparently had a slightly detrimental effect on average reaction times. This could be due to the high level of unidentified heavy end contaminants present. For instance, the average reaction times for 250-12, 225/16R, 315 and 385 resins made with PPG monomer, appear to be lengthened by 20 & 30 minutes per batch. (Fig 1) Overall, however, the performance of PPG monomer must be rated as

similar to Tennico NVC, since the resin quality improvement is counterbalanced by lengthened reactor times.

GW

FIG 1

AVERAGE REACTION TIME COMPARISON

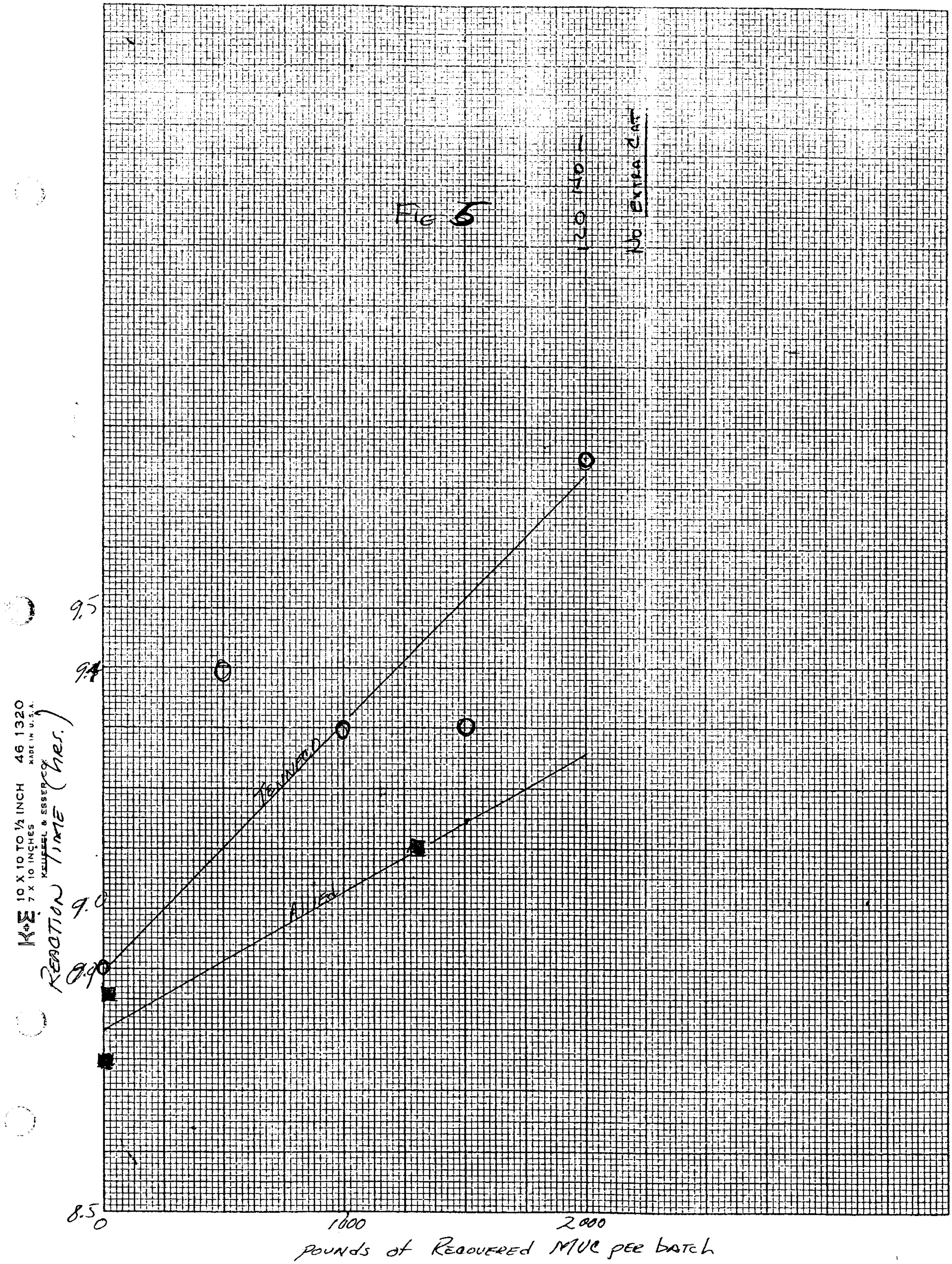
Homopolymer

Average R4 - Time

Resin Type	250-12	250-1	225/16K	150
Tenneco MVC	10.25 hrs	10.6 hrs	9.35 hrs	9.1 hrs
PPG MVC	10.57 hrs	10.6 hrs	9.75 hrs.	7.27 hrs

Copolymer

Resin Type	315	385
Tenneco	7.50 hrs	7.77 hrs
PPG	7.15 hrs	7.54 hrs



COLORITE 005667

@ 1300 lb of recovered / batch

Δ reaction time = 20 minutes 13 batches / day

4 hrs / day extra

1 batch every 2 days. 4¢/pound

$\frac{365}{2}$ 182 batches / year . 9100 lb / batch

1,650,000 lb / year

assume 120 type

9.0 hrs / batch - 13 batches / day : .3 hrs / batch

3.9 hrs / day × 365 days / year

1420 hrs / year 9100 lb / batch

9 hrs / batch

14,350,000

1,435,000 lb / year extra prod.

year

overhead 72.0198 12. 40

Labor 2.6326 Batch

Reactor hour

Allied recovered as good — or better than Tenneco virgin
high limit of experimental error ~~not enough for dow test~~

Allied reco raid 60%
Tenneco virg 46%

Allied rec
suspension —

TEANECO

Methyl Cl
2 Butane
3 propane } 20-50 X

3 propylene
allene
Butene-1
Me Acetyl } 10x

Buta diene } allused

Allied

3 Propane
2 allene
2 Butane
Meth acetylene } 30x

3 propylene & ~~Methy~~
Methyl Chloride } 10x

Buta diene } allused

PPG

1 Propane
2 allene
Butene-1
Methyl Acetylene } 100x

Methyl Chloride
Butane
propylene } 25 x

A.K.W.
G.W.L.
L.M.

Inter-Office Memo

TENNECO CHEMICALS, INC.

To H. B. Carr At Burlington Date December 10, 1969

From E. L. Kanyok At Burlington Copy to R. S. Cole
H. H. Duhamel
J. C. Fisher
E. J. Hourihan
C. W. Johnston
F. W. Kanzler
R. D. Richards
G. I. Rozand
P. R. Scarito
M. W. Williams
P. E. - Burlington
File

Subject Raw Material Received - Burl. Plant
Week of 12/1/69 - 12/7/69

Methyl Acetylene in the Vinyl Chloride monomer is steadily increasing towards the high side of the specification.

The shipment of Sipex received on 12/7/69 was disapproved by Quality Control for ferro magnetic contamination. Purchasing was contacted to notify the vendor that this shipment was being returned and that a clean shipment was needed as soon as possible. Test and specifications of Sodium Lauryl Sulfate are currently being reviewed.

Date	Vendor	Car No. Lot No.	Material	Disposition
12/1	Tenneco	38045	MVC	Approved
12/1	Tenneco	38029	MVC	"
12/2	Tenneco	38046	MVC	"
12/2	Tenneco	38049	MVC	"
12/3	Gulf		Tridecanol	"
12/3	U. Carbide	22363	MVAc	"
12/3	Tenneco	38026	MVC	"
12/5	Tenneco	38005	MVC	"
12/5	Tenneco	38007	MVC	"
12/7	Tenneco	38032	MVC	"
12/7	Alcolac	AC 2693K9	Sipex	Disapproved

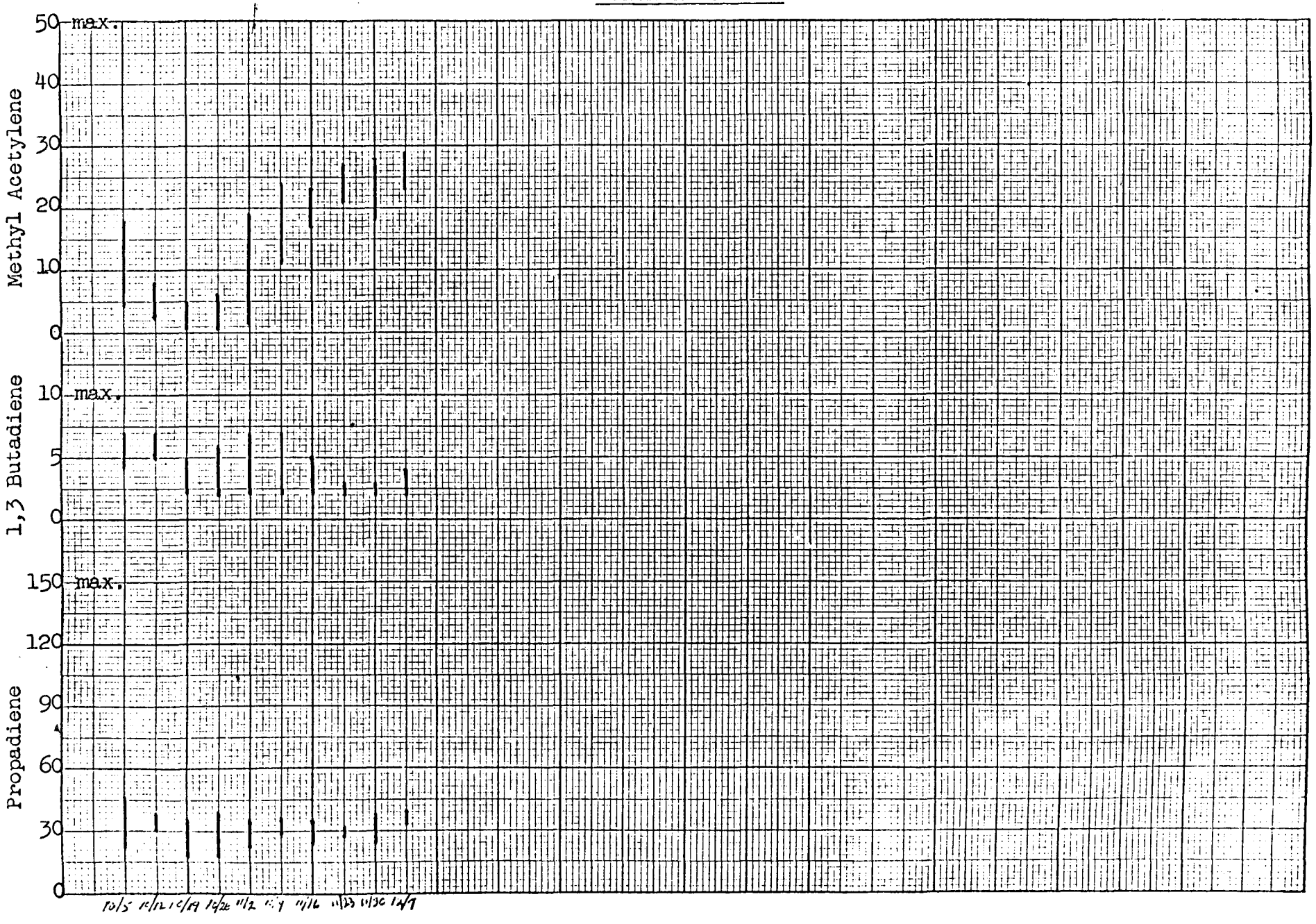
Earl Kanyok
E. L. Kanyok

ELK/rjl

Attachment

K&E 20 X 20 TO THE INCH 46 1242
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

MONOMER SUMMARY



COLORITE 012128

Inter-Office Memo

TENNECO CHEMICALS, INC.

To H. B. Carr At Burlington Date December 3, 1969

From E. L. Kanyok At Burlington Copy to R. S. Cole
H. H. Duhamel
J. C. Fisher
E. J. Hourihan
C. W. Johnston
F. W. Kanzler
R. D. Richards
G. I. Rozand
P. R. Scarito
M. W. Williams
P. E. - Burlington
File

Subject Raw Material Received - Burl. Plant
Week of 11/24/69 - 11/30/69

The impurities in the vinyl chloride monomer received over the past week have been maintained at approximately the same level as received over the previous week. However, the trend on methyl acetylene is still on the high side and if this trend continues, Houston will be contacted for corrective action. On the plus side is the trend towards tighter control of 1,3 butadiene noted over the past three weeks.

Date	Vendor	Car No. Lot No.	Material	Disposition
11/24	Tenneco	38019	MVC	Approved
11/24	Tenneco	38018	MVC	"
11/24	Tenneco	38047	MVC	"
11/25	Tenneco	38002	MVC	"
11/25	Tenneco	38022	MVC	"
11/25	Tenneco	38024	MVC	"
11/25	Tenneco	38050	MVC	"
11/26	Borden	12332	MVAc	"
11/26	Std. Chemical	4022	DHW 80	"
11/26	Tenneco	38034	MVC	"
11/27	Tenneco	38040	MVC	"
11/28	Tenneco	38011	MVC	"
11/28	Tenneco	38013	MVC	"
11/29	Tenneco	38042	MVC	"
11/29	Tenneco	38037	MVC	"
11/30	Tenneco	38036	MVC	"

Earl Kanyok

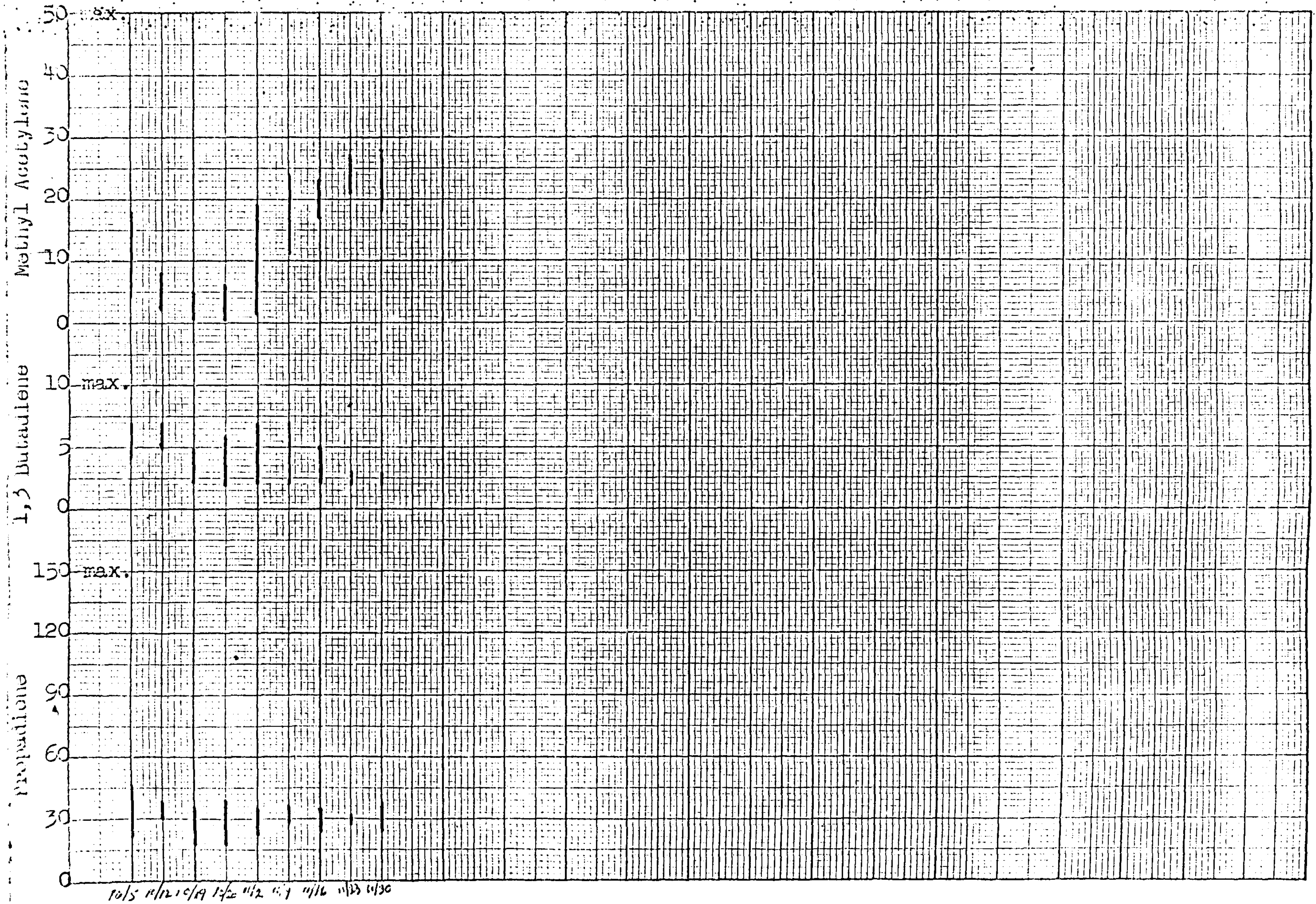
E. L. Kanyok

ELK/rjl

Attachment

K•E 20 X 20 TO THE INCH 46 1242
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

MONOMER SUMMARY



Inter-Office Memo

TENNECO CHEMICALS, INC.

To: H.B. Carr At Burlington Date December 19, 1969

From: E.L. Kanyok At Burlington Copy to: R.S Cole
H.H. Duhamel
J.C. Fisher
E.J. Hourihan
C.W. Johnston
F.W. Kanzler
R.D. Richards
G.I. Rozand
P.R. Scarito
M.W. Williams
P.E. - Burlington
File

Subject: Raw Material Received
Burlington Plant
Week of 12/8/69 - 12/14/69

Methyl Acetylene in the Vinyl Chloride monomer has leveled off at a high of 27 to 29 ppm.

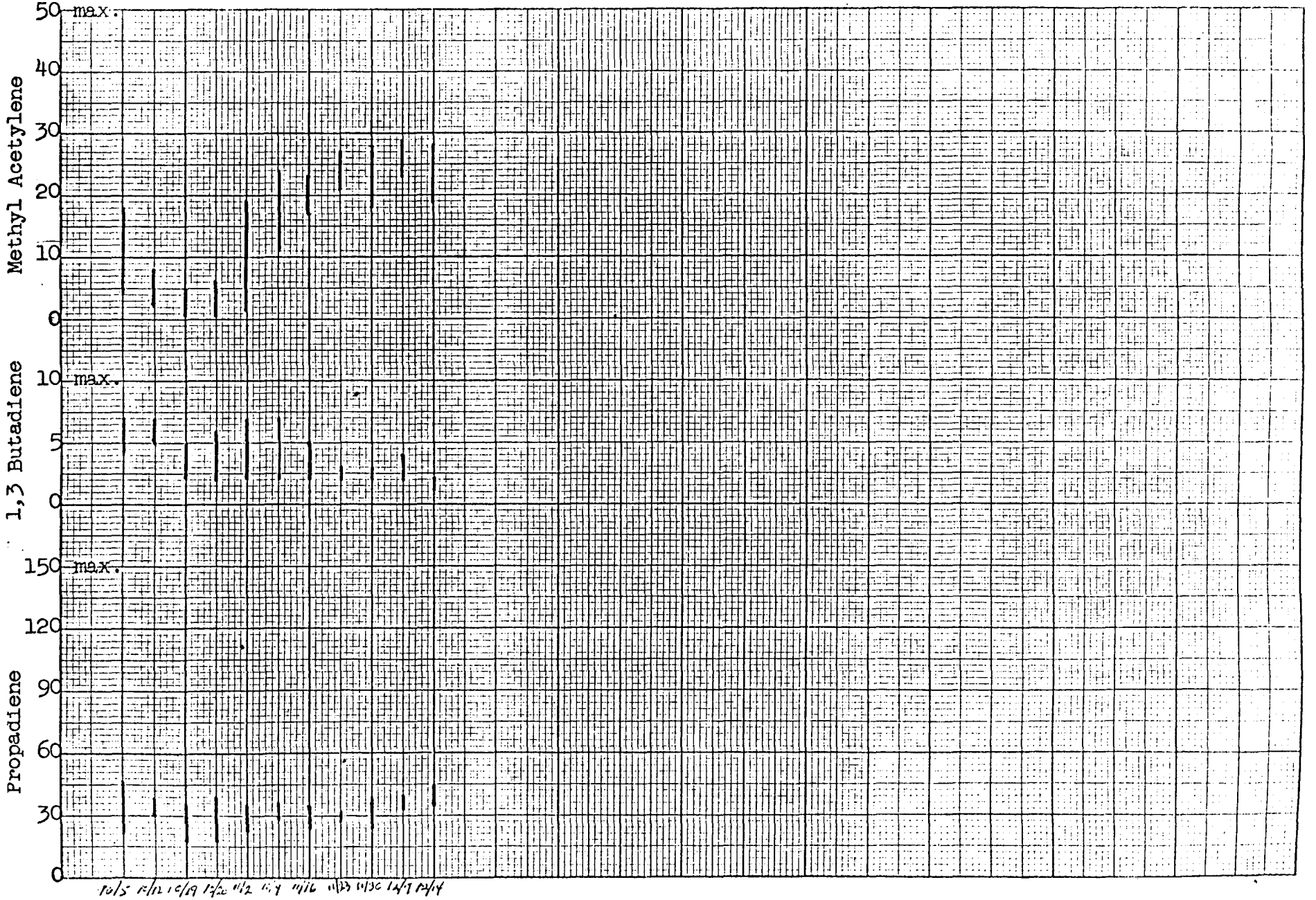
One of the two compartments of the truck load of Sipex received on 12/8/69 was disapproved by Quality Control for ferro magnetic contamination. Purchasing was contacted to notify the vendor that only 13,830 pounds of the shipment was approved and that the rest of the material was being returned.

Date	Vendor	Car No. Lot No.	Material	Disposition
12/8	Alcolac	6573	Sipex	Disapproved
"	National	-	Ammonia	Approved
"	Tenneco	38000	MVC	"
"	"	38054	"	"
"	"	38044	"	"
12/9	U. Carbide	12975	MVAC	"
"	American	-	TCE	"
"	Atlas Chem.	1295	Tween 20	"
"	Proctor & Gm.	48049	CO-1214-S	"
"	Atlantic	6929003	Rozic	"
"	"	6932301	Colic	"
"	Tenneco	38038	MVC	"
"	"	38001	"	"
12/10	"	38017	"	"
12/11	"	38023	"	"
12/12	Alcolac	-	Sipex	"
"	Std. Chem.	-	DHW-80	"
"	Tenneco	38024	MVC	"
"	"	38048	"	"
12/14	"	38051	"	"
"	"	38021	"	"

E.L. Kanyok

Attachment.
ELK/jt

MONOMER SUMMARY



Inter-Office Memo

TENNECO CHEMICALS, INC.

To: H.B. Carr At Burlington

From: E.L. Kanyok At Burlington

Subject: Raw Material Received
Burlington Plant
Week of 12/15/69 - 12/21/69

Date: December 22. 1969

Copy to: R.S. Cole
H.H. Duhamel
J.C. Fisher
E.J. Hourihan
C.W. Johnston
F.W. Kanzler
R.D. Richards
G.I. Rozand
P.R. Scarito
M.W. Williams
P.E. - Burl.
File

Methyl Acetylene in the Vinyl Chloride monomer has decreased slightly over the past week. Propadiene and 1,3 Butadiene have been in good control for the past several weeks.

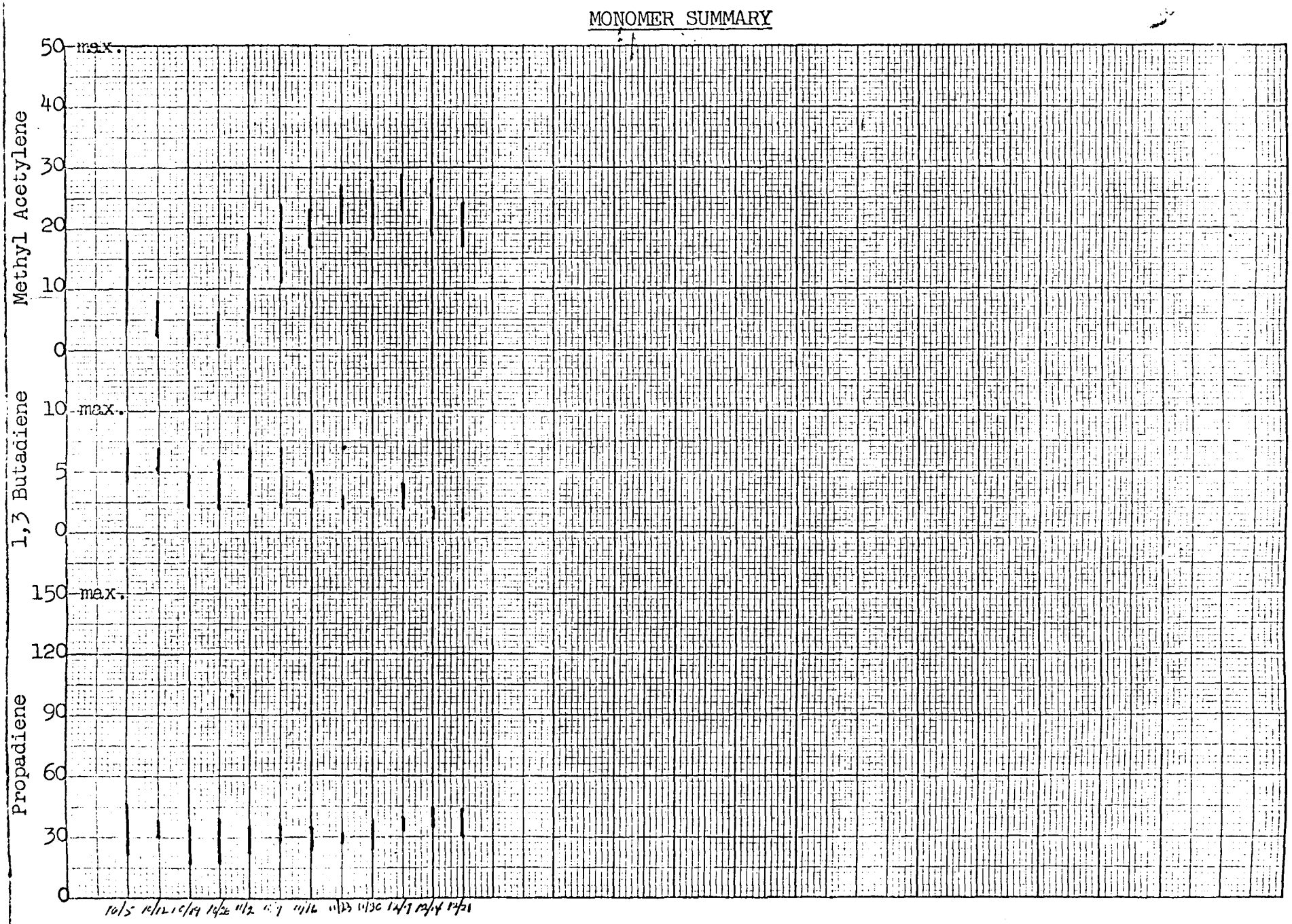
Date	Vendor	Car No. Lot No.	Material	Disposition
12/15	Tenneco	38022	MVC	Approved
12/16	U. Carbide	T-36	MVAC	"
"	Tenneco	38028	MVC	"
"	"	38020	"	"
12/17	U. Carbide	21957	MVAC	"
12/18	Tenneco	38009	"	"
12/19	"	38039	"	"
12/20	"	38034	"	"
"	"	38014	"	"
"	"	38018	"	"
"	"	38040	"	"
12/21	"	38050	"	"

Earl Kanyok
E.L. Kanyok

Attachment.

ELK/jt

K&E 20 X 20 TO THE INCH 46 1242
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



COLORITE 012124

HBC

M. G. Caine	Piscataway	10/2/68
M. W. Williams	Piscataway	E. Rad G. I. Rozand C. G. Thompson
VCM		

Some recent data compiled on VCM by R&D will be helpful in our own operations, as well as providing some suitable information for Fauji:

1. Section A of Attachment 1 shows the differences in % conversion obtained with different monomers in the Dow (emulsion polymerization) poly rate test.

   Conoco, Ethyl & Stauffer monomer are excellent. Our analytic data on Conoco & Stauffer monomer indicate it to be very low in unsaturate impurities.

   Goodrich & Tenneco virgin monomers are fairly similar in % conversions, with Tenneco VCM having a slight advantage. However, recovered BFG monomer is appreciably superior to recovered Tenneco monomer.

2. Section B of Attachment 1 shows that in a typical Tenneco 225 suspension resin polymerization, virgin Tenneco VCM gives a better conversion rate than BFG virgin VCM. However, when recovered monomer is used in conjunction with virgin VCM, Tenneco conversions drop off faster — as shown on Attachment 2.

3. Goodrich's Calvert City Lab has done some GC analyses for us (Attachment 3). Needless to say, they did not know the identity of any of the samples.

   Conoco/Stauffer VCM is very low in impurities. BFG's product is superior to recent Tenneco VCM in all respects except butadiene content.

   Tenneco VCM is rather high in impurities in comparison — and when these impurities are concentrated as they are in recovered monomer, the values get very high.

4. Fauji can be told that a typical good oxy-dehydrochlorination product would have an analysis of (in mol. ppm):

ethylene	—	trace (1.0)
propane	—	20 max.
propylene	—	5
butene-1	—	2
propadiene	—	1
acetylene	—	2
butadiene	—	10
methyl chloride	—	100
acetaldehyde	—	0
methyl acetylene/ trans butene-2	—	trace (1.0)

Also, other trace impurities of lesser significance.

Other normal VCM specs relating to water, iron, etc. naturally apply.

5. With respect to recovered monomer, I would suggest telling Fauji that the light end impurities found in virgin VCM tend to be concentrated in recovered VCM. The effects of these impurities are much more pronounced in emulsion and dispersion resin polymerizations than they are in suspension systems.

We have found, for example, that use of recovered monomer at the level of 10% will reduce conversion efficiency about 2% (i.e., a typical homopolymer reaction which would normally reach 87% conversion in ten hours using virgin VCM; an 85% conversion would be expected with 10% recovered VCM).

The latter statement is based on the use of recovered monomer which has impurity levels as high as (mol ppm):

propylene	—	200
butene-1	—	35
propadiene	—	440
acetylene	—	100
butadiene	—	20
methyl chloride	—	1500
acetaldehyde	—	100
trans 1-2 dichloroethane	—	100

It's probably questionable that Fauji would want to invest any significant amount of capital in purification equipment for such a relatively minor improvement in conversion efficiency.

6. In terms of our own operations, I think that the effects on suspension resin product quality (particularly with respect to color and heat stability) caused by use of recovered VCM, are significant and require further study. Also, since the quality of recovered VCM depends a good deal on the level of impurities in virgin VCM, we are going to closely follow our incoming monomer shipments in the next few months. I suspect the rather lenient specs we have given Tenneco Hydrocarbons will have to be tightened as a result of this program.

7. Our dispersion resin productivity has been found to vary appreciably with changing levels of virgin VCM quality. In view of the significantly higher levels of impurities in our recovered monomer, I don't think we can plan on use of recovered monomer in dispersion resin manufacture -- unless ways and means are established for appropriate purification.

8. GC analysis techniques are still in the "art" stage. Attachment 4 shows the analytic results obtained by Houston & Dow on Tenneco & Dow VCM, using Dow's GC test method. Comparison of these results on Tenneco monomer with the BFG results (Attachment 3) demonstrate some interesting differences.

M. W. Williams

gm

Attachments

ATTACHMENT 1

SECTION A

POLYMER (PVC) CONVERSION TEST

WITH DIFFERENT VCM SAMPLES

Reagents: To 75 cc. of 0.5% Sodium Lauryl Sulfate add 0.25 grams of $K_2S_2O_8$ in 10 cc. of H_2O and 25 grams of VCM.

Test Conditions: Polymerize for 5 hours at 40°C (104°F) and determine the percent conversion.

Monomer Source	% Conversion	Date
Conoco (CONX 9054 - Burlington)	80.0	8/1/68
Ethyl (UTLX 83804 - Burlington)	84.8	7/19/68
Pantasote (SACX 9015 - Burlington) PPG	55.6	8/8/68
B.F. Goodrich (GATX 21968 - Burlington)	62.0	8/9/68
Stauffer (GATX 98227 - Burlington)	81.6	7/68
B.F. Goodrich (UTLX 82521 - Flemington)	56.0	
B.F. Goodrich (Recovered - Flemington)	32.8	
Tennece ([redacted] 38053 - Burlington)	61.6	5/17/68
Tennece (Gar 38042 - Flemington)	66.4	9/68
Tennece (Recovered - Flemington)	18.8	9/68

ATTACHMENT 1

SECTION B

SUSPENSION POLYMERIZATION KINETICS

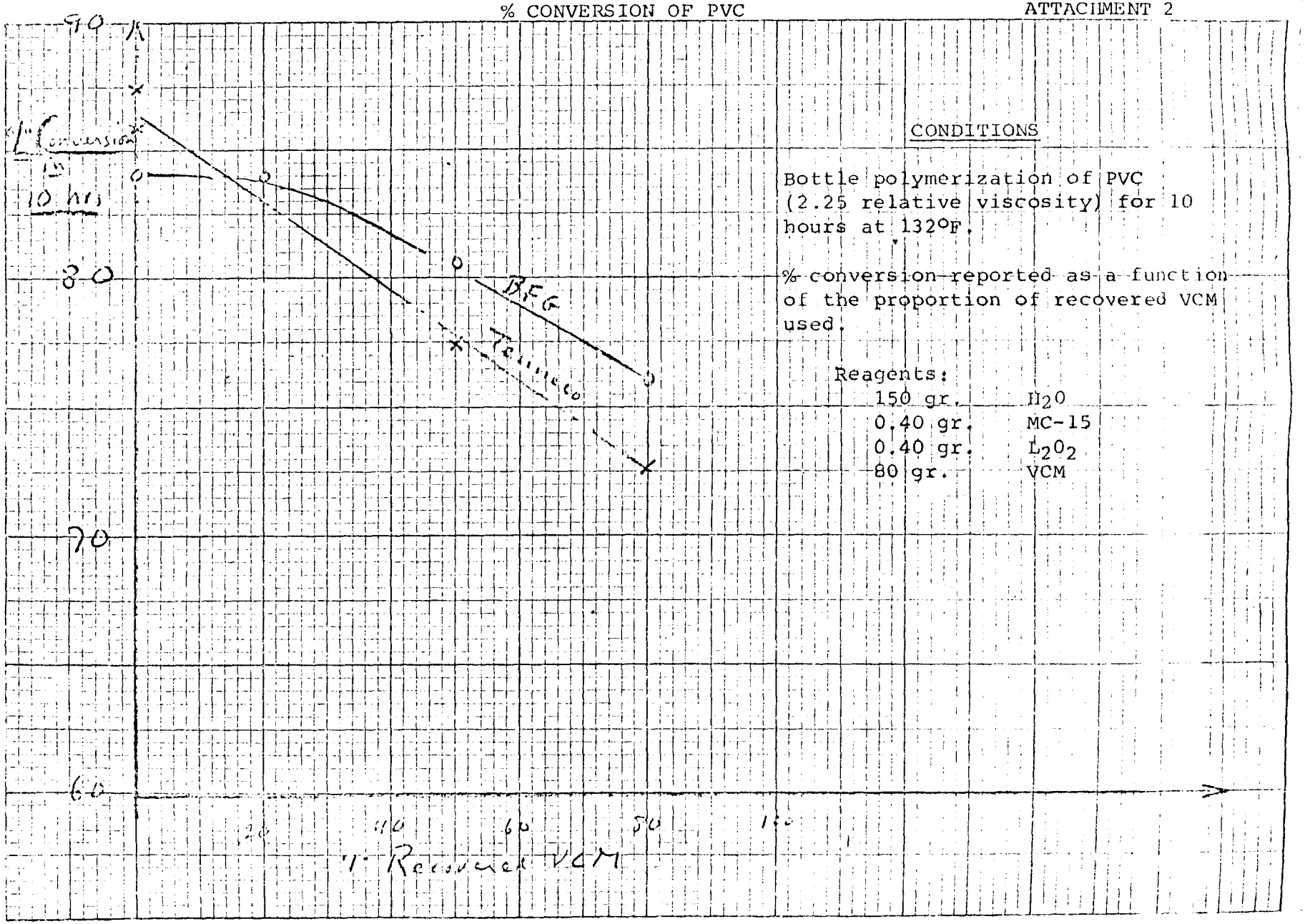
Reagents: 150 grams of H_2O + 0.40 grams MC-15 + 0.125 grams L_2O_2 + 80 grams VCM.

Test Conditions: Polymerize for 10 hours at 132°F (55.5°C) and determine the percent conversion.

Monomer Source	% Conversion
100% B.F. Goodrich (UTLX 82521 - Flemington)	84
80% B.F. Goodrich (UTLX 82521 + 20% Recovered Goodrich VCM	84
50% B.F. Goodrich (UTLX 82521 + 50% Recovered Goodrich VCM)	80.5
20% B.F. Goodrich (UTLX 82521 + 80% Recovered Goodrich VCM)	76
100% Tenneco (Car 38042 - Flemington)	87.5
80% Tenneco (Car 38042 + 20% Recovered Tenneco VCM)	----
50% Tenneco (Car 38042 + 50% Recovered Tenneco VCM)	77.5
20% Tenneco (Car 38042 + 80% Recovered Tenneco VCM)	72.5
100% Tenneco (Cars 38042, 38016, 38038, 38039)	86
50% Tenneco (Cars 38042, 38016, 38038, 38039) + 50% Recovered Tenneco VCM	80

EFFECT OF RECOVERED VCM ON
% CONVERSION OF PVC

ATTACHMENT 2



CONDITIONS

Bottle polymerization of PVC (2.25 relative viscosity) for 10 hours at 132°F.

% conversion reported as a function of the proportion of recovered VCM used.

Reagents:

150 gr.	H_2O
0.40 gr.	MC-15
0.40 gr.	L_2O_2
80 gr.	VCM

ATTACHMENT 3

Sample	1	2	3	4	5
Source	Tenneco Virgin Flemington	Tenneco Virgin MATX-18017	Goodrich Virgin GATX-21968	Conoco Virgin CONX-9054	Tenneco Recovered Flemington
Date	9/9/68	6/10/68	8/8/68	8/1/68	9/6/68
C_2H_4	0	0	0.2	0	151
Propane/propylene					427
Propane	26	18	0	0	[illegible]
Propylene	15	12	3.6	0.7	[illegible]
Butene-1	11	4	0.8	0	37
Butene-2 and/or propadiene	92	99	0.4	0	439
Acetylene	20	5	1.2	0	97
Butadiene	5	20	9.0	0.6	22
CH_3Cl	90	130	100	10	1570
Acetaldehyde	0	0	0	0	97
Trans 1-2 dichloroethane	0	0	0	0	87
?	0	0	0	0	93

mol ppm

ATTACHMENT 4

	North Sphere 8-19-68 Dow Results PPM		C-16 Hold Tank 8-19-68 THC Results	Dow VCM Dow Results ppm	Dow VCM THC Results ppm
methane	trace				
ethane	trace	0.1			
ethylene	trace	0.1			
propane	40		39	0.01	0.02
propylene	16.95		9	0.2	0.2
n-acetylene	0.05				
isobutane	2.4		1	6.48	14.4
propadiene	85.4		91	0.08	
n-butane	1.82		1	1.82	1.9
butene-1	3				
methyl acetylene/ trans butene-2	4.04			0.17	
methyl chloride	1.49			31.6	
cis butene-2	0.1				
1,3 butadiene	5.64			0.13	
ethyl chloride	0.82			0.21	
vinyl acetylene	0.95			0.36	
unknown			2		0.2

Inter-Office Memo

TENNECO CHEMICALS, INC.

To: H.B. Carr At Burlington

From: E.L. Kanyok At Burlington

Subject: Raw Materials Received
Burlington Plant
Week of 12/29/69 - 1/4/70

Date: January 9, 1970

Copy to: R.S. Cole
H.H. Duhamel
J.C. Fisher
E.J. Hourihan
C.W. Johnston
F.W. Kanzler
R.D. Richards
G.I. Rozand
P.R. Scarito
M.W. Williams
P.E. - Burlington
File

As can be seen on the attached graph, the impurities in the Vinyl Chloride monomer received over the past week have decreased to the lowest level since October, 1969.

DATE	VENDOR	CAR NO. LOT NO.	MATERIAL	DISPOSITION
12/29	Stnd. Chemical	4366	DHW-80	Approved
"	" "	S-3393	Avirol 101	"
12/30	Dow	MM112691	Methocel	"
"	"	MM112792	"	"
1/1	Tenneco	38001	MVC	"
"	"	38046	"	"
1/2	Alcolac	Ac-4271K9	Sipex	"
"	Tenneco	38005	MVC	"
"	"	38017	"	"
1/3	"	38023	"	"
"	"	38044	"	"
1/4	U. Carbide	22363	MVAC	"

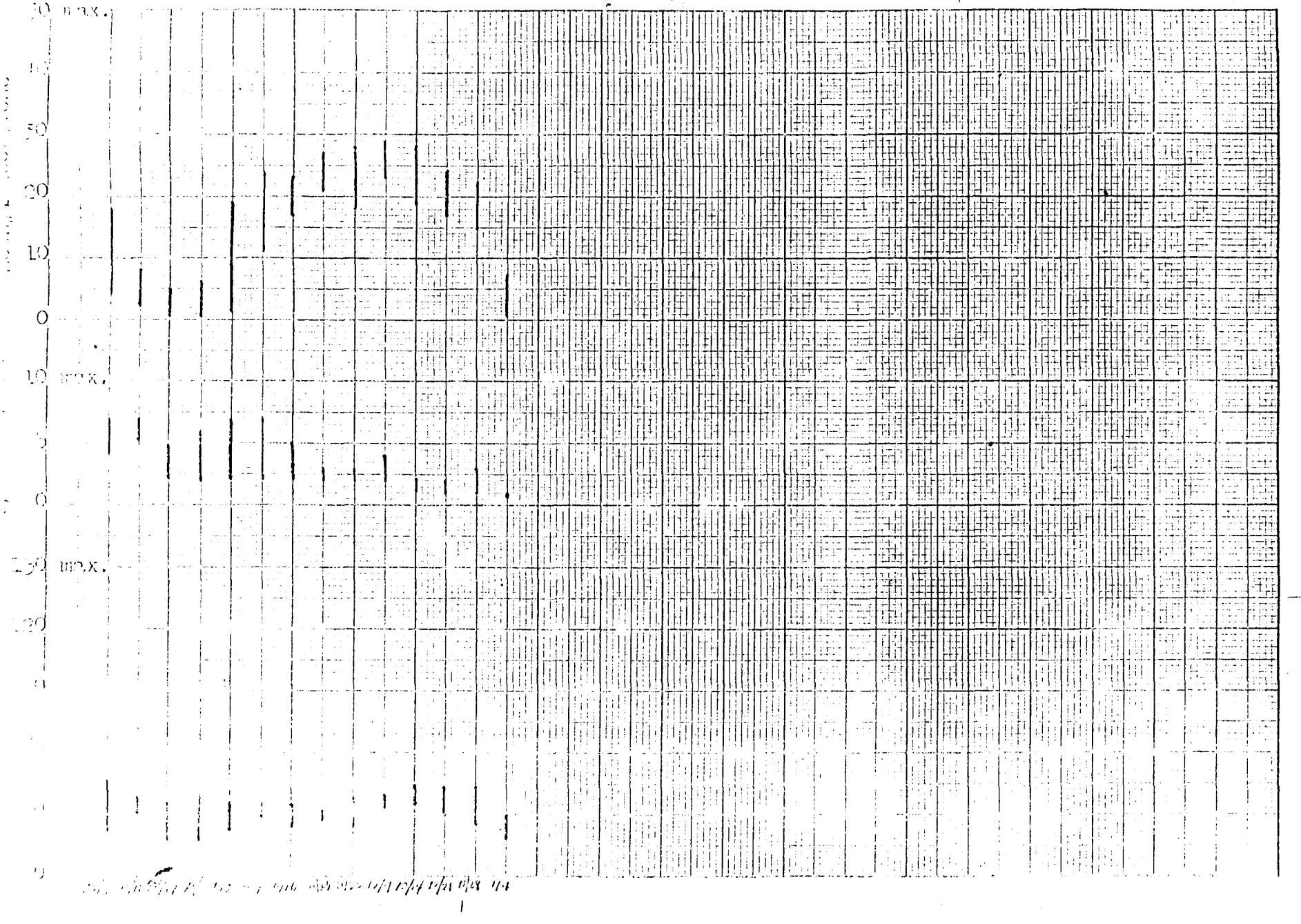
E.L. Kanyok

Attachment.

ELK/jt

KEUFFEL & ESSER CO.

MONOMER SUMMARY



COLORITE 012120

Inter-Office Memo

TENNECO CHEMICALS, INC.

To: H.B. Carr At Burlington Date: 12/30/69

From: E.L. Kanyok At Burlington Copy to: R.S. Cole
H.H. Duhamel
J.C. Fisher
E.J. Hourihan
C.W. Johnston
F.W. Kanzler
R.D. Richards
G.I. Rozand
P.R. Scarito
M.W. Williams
P.E. - Burlington
File

Subject: Raw Material Received
Burlington Plant
Week of 12/22/69 - 12/28/69

Methyl Acetylene in the vinyl chloride monomer has decreased slightly over the past two weeks. Propadiene and 1,3 Butadiene are still in good control.

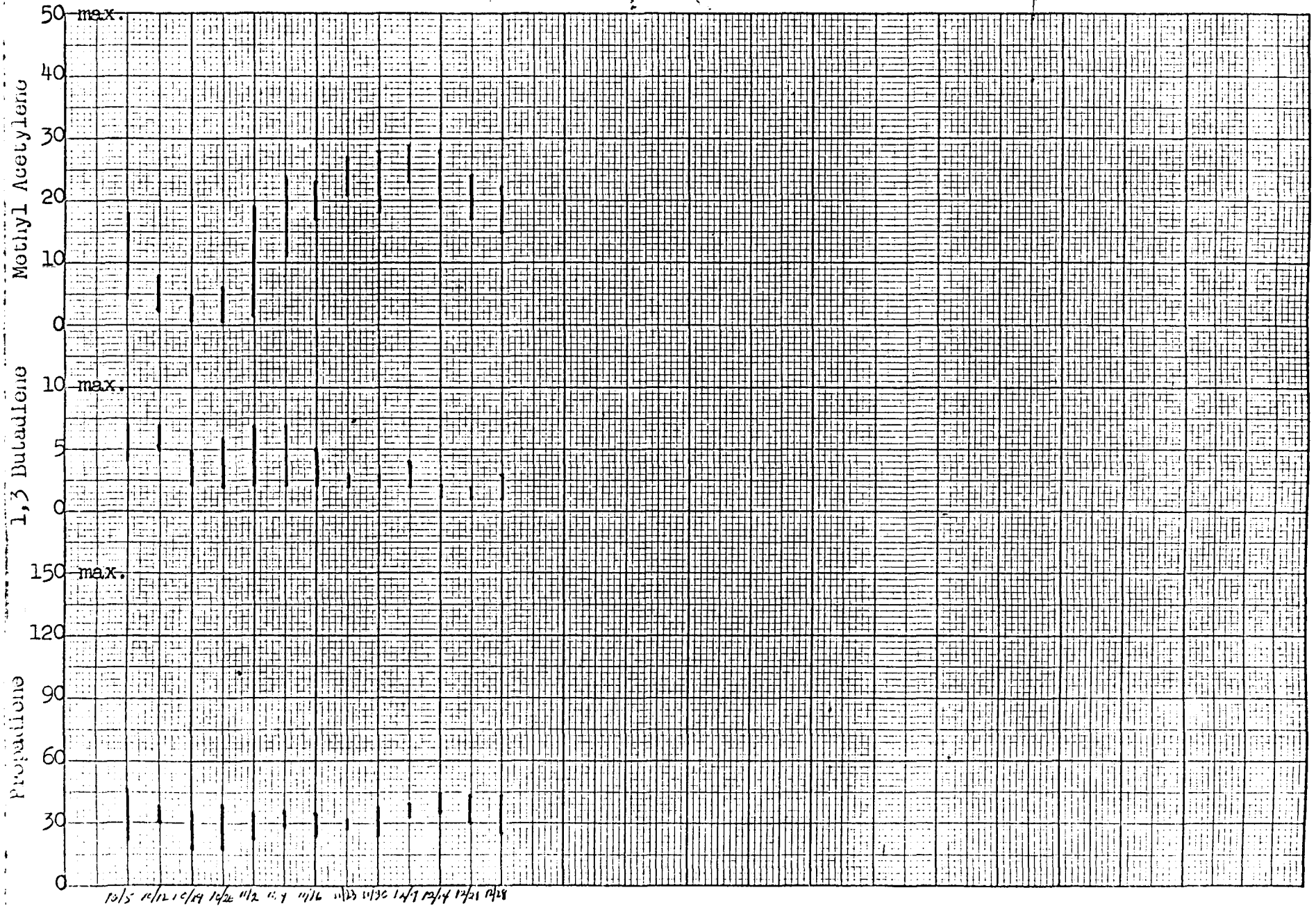
Date	Vendor	Car No. Lot No.	Material	Disposition
12/22	Lucidol	ADBX-286	L.P.	Approved
12/23	Tenneco	38042	MVC	"
"	"	38011	"	"
"	"	38052	"	"
12/24	"	38019	"	"
12/27	"	38036	"	"
"	"	38049	"	"
"	Borden	12302	MVAC	"
12/28	Tenneco	38047	MVC	"
"	"	38035	"	"

Earl Kanyok
E.L. Kanyok

Attachment.

ELK/jt

MONOMER SUMMARY



Inter-Office Memo

TENNECO CHEMICALS, INC.

To: H.B. Carr At Burlington

From: E.L. Kanyok At Burlington

Subject: Raw Materials Received
Burlington Plant
Week of 1/5/70 - 1/11/70

Date: January 14, 1970

Copy to: R.S. Cole
H.H. Duhamel
J.C. Fisher
E.J. Hourihan
C.W. Johnston
F.W. Kanzler
R.D. Richards
G.I. Rozand
P.R. Scarito
M.W. Williams
P.E. - Burlington
File

As can be seen on the attached graph, Methyl Acetylene has a large spread in the ppm level. This is due to one tank car (500001) which had a level of 22 ppm. The other cars received had the same level as reported last week. 1.3 Butadiene and Propadiene are still maintaining good control.

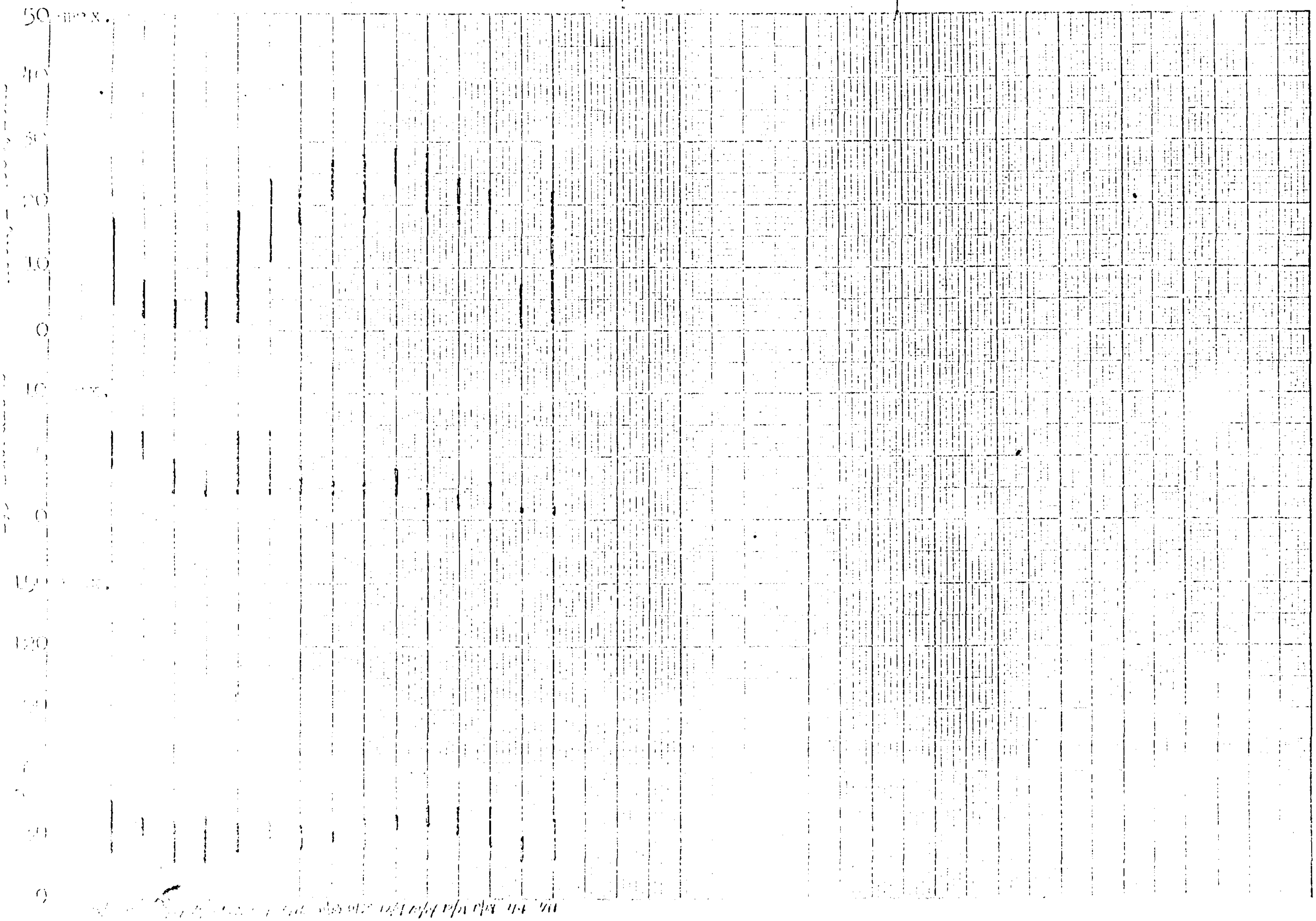
DATE	VENDOR	CAR NO. LOT NO.	MATERIAL	DISPOSITION
1/5	Tenneco	38021	MVC	Approved
"	"	38007	"	"
1/7	"	38015	"	"
"	"	38048	"	"
1/8	"	38002	"	"
"	"	38051	"	"
1/9	"	38016	"	"
"	"	38028	"	"
1/10	"	38000	"	"
"	"	38038	"	"
"	Stnd. Chemical	S-3420	Avirol	"
"	Tenneco	500001	MVC	"
1/11	Borden	12554	MVAc	"
"	Tenneco	38032	MVC	"

E.L. Kanyok

Attachment.

ELK/jt

MONOMER SUMMARY



Inter-Office Memo

TENNECO CHEMICALS, INC.

To: H.B. Carr At Burlington
From: E.L. Kanyok At Burlington
Subject: Raw Materials Received
Burlington Plant
Week of 1/12/70-1/25/70

Date: January 30, 1970

Copy to: R.S. Cole
H.H. Duhamel
J.C. Fisher
E.J. Hourihan
C.W. Johnston
F.W. Kanzler
R.D. Richards
G.I. Rozand
P.R. Scarito
M.W. Williams
P.E. - Burlington
File

Methyl Acetylene in the monomer received is still at variable levels. 1,3 Butadiene and Propadiene have maintained good control over the past several months. In a phone conversation with Houston on 1/28/70, we were informed of process difficulties at their plant and that we could expect monomer with Methyl Acetylene above the specification of 50 ppm max. and possibly as high as 100 ppm. Process Engineering and Production are hereby notified of this and they should monitor the data for possible effects on the resin when this monomer is being used. Quality Control will notify Process Engineering and Production when this monomer arrives at the plant site.

DATE	VENDOR	CAR NO. LOT NO.	MATERIAL	DISPOSITION
1/13	Tenneco	38022	MVC	Approved
"	"	38045	"	"
"	American Chem.	-	TCE	"
1/16	Tenneco	38025	MVC	"
"	"	38026	"	"
1/17	"	38010	"	"
"	"	38004	"	"
1/18	Celanese	2200	MVAc	"
1/20	Tenneco	38009	MVC	"
"	"	38047	"	"
1/21	"	38013	"	"
1/22	"	38012	"	"
"	"	38011	"	"
"	DuPont	9-9022	Elvanol	"
"	Tenneco	38036	MVC	"
1/23	Monsanto	91295	Gelvatol	"
"	Tenneco	38020	MVC	"
1/24	"	38040	"	"
"	"	38041	"	"
1/25	"	38037	"	"

Attachment.
ELK/jt

Earl Kanyok
E.L. Kanyok

I-184 (50M)

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

Quist

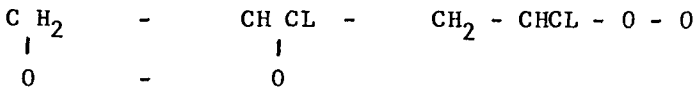
TO	Mr. M. G. Caine	AT	Piscataway	DATE	June 9, 1970
FROM	Mr. C. G. Thompson	AT	Piscataway	COPY TO	See List

SUBJECT: REVIEW OF NOTES TAKEN AT THE VINYL CHLORIDE SAFETY ASSOCIATION CONFERENCE AT PLEASANT POINT RESORT POINT PLEASANT, WEST VIRGINIA

1. Peroxides - J. T. Barr, Airco

1.1 Mr. Barr referred to the following publications on Peroxides by authors: Davies, Hawkins, K. Otthmeir

$$VCM + O_2 + Fe + H_2O = \text{Peroxide}$$



Cyclic Polymeric

Cyclic material normally does not separate out and will pass through a recovery system to storage.

Both types are volatile.

The use of iron-cyanide tests will indicate the presence of peroxides. Peroxides are unstable in strong acids or bases. Normally, they can be eliminated from a system, if a wash of 5% sodium hydroxide solution is employed. Their formation may be greatly reduced if adequate steps are taken to prevent the inclusion of O_2 into the system.

In answer to the question "Who has experienced peroxides in their recovery systems:"

M. G. Glenn of General Tire - have not experienced peroxides. They distill their recovered VCM. They also fill their reactors with water and pressure test hydrostatically prior to charging. The water is pressured out with VCM. They employ Nash compressors and Vacuum pumps.

G. Childs of Goodrich - use an oxygen analyzer on their vent gas system, and watch the storage temperature. They have little experience on peroxides.

R. S. Allan of Conoco Plastics - no peroxides - Nash units.

E. Lorfing - Borden - Use Nash units have experienced peroxides on one occasion.

W. W. Madden of Firestone Plastics - Add phenol to the recovery system and use hot water to wash-down their systems.

It was noted that an MCA bulletin, issued in March, 1969, presents an excellent article coverying the development of peroxides in recovery systems.

To: Mr. M. G. Caine
Piscataway

June 9, 1970

1.2 Some experiences discussed on initiators:

Airco - were using Pivalate. (Tri-butyl pivalate). On one occasion their delivery truck broke down. The material stored in dry ice chests were moved to a cold room. Some material was spilled on the masonary of the cold room. The salts in the masonary were sufficient to initiate a reaction and subsequent degradation of the pivalate.

Goodrich - were using IPP catalyst by placing a solution of same in a 2 gallon stainless steel pressure pot, rated at 250 psig, and transferring by N_2 pressure to the reactor. Due to inadequate nitrogen pressure, Vinyl Chloride vapors back-flowed into the pot. Within minutes, the tank ruptured and injured 3 people; one fatally, one maimed, and one scratched up. The nitrogen regulator employed to reduce the pressure from the Nitrogen bottle to the catalyst additive pot, was N_2 Regulator - Matheson 9-580. This was equipped with a rupture diaphragm.

**The additive pot in this case was not equipped with a relief valve or a rupture disc. Further laboratory tests, after the accident, proved that a back-flow of vinyl chloride vapors could react quickly with the IPP initiator. The time involved was 5 minutes at 110°F with a pressure of 200 psig on the additive tank.

**A check valve did not exist between the IPP bottle and the reactor. Tests for destruction on the remaining bottles showed a rupture pressure of 900 psig. These were bottles formerly used for oxygen in World War II airplanes.

1.2.2Goodyear-Niagra Falls:

Using Lupersol-11, experienced vinyl chloride vapors backing into the initiator additive container. Within three minutes, the vessel heated up and exploded.

1.2.3In storing the refrigerated catalysts, it is essential to provide the correct amount of air circulation around the containers. Spills must be cleaned up and must not be permitted to remain on the floor in contact with walls or floors.

Fires, normally start locally and will not create enough heat to set off the sprinklers immediately. When sufficient heat has been developed to energize the sprinklers, the degradation has usually advanced beyond the possibility for control via a water deluge.

It was recommended, the ion sensing sprinkler head elements be employed in catalyst storage buildings rather than using the standard heat-rise units.

Frequent monitoring of temperatures was recommended. Several sensing points should be employed.

2. Emergency Agitation & Termination:

Speaker - S. Schreiber of Allied Chemicals.

The following points were noted:

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Piscataway

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2.1a Allied evacuate above the roof of their building in preference to manifolding to a flare system. They provide emergency power sufficient to satisfy all agitators.

2.1b Pantasote provide an automatic start emergency generating system. They manually restart their agitators when power goes off and the emergency unit comes on. Pantasote run through their emergency start-up procedures twice per month. This includes a full test on the diesel engine driven generator.

2.2 S. Schreiber discussed the use of steam sparging of the relief valve vent pipes. This has been used in an attempt to reduce the difficulties which may be caused by static electricity. It is also used as a means of assuring dispersion of the vapors. (The writer questions the validity of steam ejection preventing the generation of static electricity. It is quite possible that the steam velocity could cause static electricity.)

2.3 General tire - use Isoprene, injected into the bottom of each vessel, to short stop their reactions. They have also used Alpha Methyl Styrene at Tennox BMT. Other members reported on the same materials.

3. Automatic Alarms for Spill Determination:

Speaker - M. Smith - Conoco

3.1 Goodyear - use a 10 point sequential system purchased from MSA. They are satisfied with it.

General Tire - report experiencing trouble with polymer build-up on the wire mesh screens or sintered metal screens used on the gas sensing heads. They have found it necessary to inspect and change the screens frequently (about every 6 weeks).

3.2 Ventilation:

A general discussion on the use of high volume ventilation brought out a "caution" which stated: "Be careful, when venting large quantities of VCM vapors from a building, that recirculation does not occur."

4. Reactor Cleaning - G. Schaap of B.F. Goodrich:

4.1a 31 cases of possible bone damage to the extremities have been reported. This phenomenon occurred with people who had been exposed to cleaning PVC vessels. A report has been issued on this by a Dr. Wilson, 500 South Main Street, Akron, Ohio, August 21, 1967, American Medical Journal.

b Hand diseases have been found in 3% of the men exposed to cleaning polymerizers. The incubation period is estimated to be 12 months. B. F. Goodrich xray their people on a yearly basis, also perform the cold-insol test.

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c The University of Michigan has performed work on the causes and effects of this disease. It was estimated that they will publish their report this fall.

d The M.C.A. is also carrying out a study.

e Work is also going on in France. At the present time, the French recommend a check on anyone exposed to vinyl chloride monomer vapors or liquid or polyvinyl chloride resins.

f Goodyear are examining their people for symptons of the disease but have not formulated a program.

g Goodrich now have a check system to cover new hirings. This is designed to determine if the person may have a tendency to contact the disease.

4.2 Most members use some form of high pressure water jet cleaning. B. F. Goodrich have a potential system which they will be pleased to sell on request. The equipment has been developed for bottom and top entry, 3700 gallon and 5000 gallon kettles.

4.3 Many members are testing solvent cleaning. No one would discuss this item. Most of the members admitted that they had been approached with the Japanese technology. No one admitted to using it.

4.4 Other notes on high pressure cleaning:

A. The International Rubber & Plastics session of the National Safety Council scheduled for October-November, 1970 plan to present several papers on this item.

B. Mr. Trowbridge of Goodyear indicated that his company had suffered a fatality, several years ago, as a result of mis-operating a high pressure water gun.

C. Goodrich are now willing to sell their system for a nominal cost. It is patented and has been employed successfully on homopolymers, solution and emulsion polymerizers. They employ a gear operated high pressure water nozzle which is lowered into the vessel through the manhole nozzle. They have reduced the need to enter the vessels to once per nine charges.

Their salesman for this item is:

Mr. A. L. Hastings
3135 Euclid Avenue
Cleveland, Ohio

D. Mr. Hastings also has the detail on their alarm cart designed to eliminate the need for a buddy system to watch over the man while he is in a vessel.

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5. Flow valves and remote cut-offs - Mr. Hopkins, Stauffer Chemicals:

Stauffer - store Vinyl Chloride Monomer in spherical tanks, located approximately 400 feet away from the operating area. They employ an excess flow valve rated for normal flow of 200 gpm. They employ two fire shut-off valves and one valve downstream of the pump which works manually or automatically with the excess flow valve or the fire shut-off valves. These latter units will shut the transfer system down when exposed to heat.

They use a coppus century valve with fixed orifices as flow sensing devices to shutdown operations when the flow exceeds deolyn conditions. Their remotely operated VCM valves are set up to be operated from outside their polymerization building and the fire wall of the tanks.

6. Writing Emergency Procedures - G. Speed, Escambia Chemical.

6.1 Their procedures were written by the Plant Manager, G. Speed, and the Process Engineer, as follows:

A. A list of procedure titles were made and divided into four parts, then assigned to their four shift supervisors who wrote up the procedures.

B. Each procedure was reviewed with the operators involved.

6.2 A map was made up to show the location of each deluge system trip, and the remote trips. The map when completed was posted throughout the Polymer Building.

6.3 A training review and procedure was developed to permit proper use of emergency fans in the case of a spill or fire.

6.4 One set of procedures were designed to handle small spills or fires and another set for major spills or fires.

6.5 The problems of losing process air, instrument air, and electrical power were reviewed and procedures to combat the situation were compiled. What to do for loss of air, loss of power, etc.?

6.6 A thorough organization procedure was written to inform all personnel as to exactly who was in charge for the direction and control of the emergency.

6.7 Locations have been set up for each member of the operating crews to go to in the event of an emergency. This procedure covers all shifts and all plant work areas. Each meeting area has been delegated a leader who takes charge. This also covers all shifts.

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6.8 Escambia employs a safety training meeting of one hour per week per man. They have issued training manuals. They go through the fire drills twice per year.

6.9 Need for Radios:

The writer listened to three reports on major spills from -

Escambia - G. Speed
Pantasote - E. Biehl
General Tire - M. Glenn

Each spill involved dumping the contents of a reactor to atmospheric conditions. The problem of evacuating the buildings on time were considered too slow in each case.

The need for radio communication (battery operated) outside the Polymer building area would have been helpful in each case. There was a need for further disciplined training such that operators do not become confused when attempting to leave the building. Some difficulty was observed in having sufficient visibility within the building after the spills.

Note:

DuPont has a film on Disaster Planning
Monsanto has an article on Disaster Planning Analysis

7. Control Rooms - Design and Location:

7.1 It was the general consensus of opinion that central control rooms, removed from the Polymer Building, provide the safest practical design.

Monsanto, Goodrich and Dow claimed to have this design.

The control rooms are either air conditioned and maintained under positive pressure or are built to an electric specification to match Class 1, Group D, Division 1.

7.2 Monsanto in Canada installed an electronic type control panel in a remote control room when they re-constructed their plant. Some difficulty has been experienced with communicating directions from the central control room to the operating floor. It is necessary to have an operator in the control room at all times. He is the one who makes decisions to control the reactions. Monsanto have achieved a high degree of automation but they have not eliminated the need for reactor operators in the polymer building.

7.3 The majority of the PVC producers do not have central control rooms. Approximately 50% operate with a main control panel mounted in the Polymer Building. The remainder employ locally mounted instruments at each reactor.

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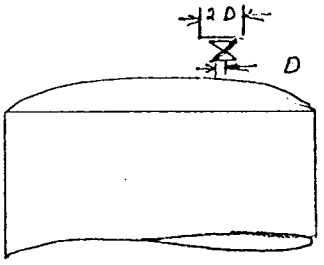
It was interesting to note, that as a general criticism the majority of the members expressed the need for greater area in their polymer building. The philosophy of cutting down on the size of the Polymer Building to trim capital dollar outlay is prevalent throughout the industry.

7.4 The need for adequate instrumentation and electronic checking was stressed where central control panels are employed. This design necessitates properly trained instrument and electronic mechanics who are employed at this type of work on a full time basis.

8. Rupture Discs and Relief Valves - W. Boyle, Monsanto:

8.1 Monsanto have been reviewing their design and calculations and recognize that the average kettle built 8 to 10 years ago was equipped with undersized relief valve nozzles. They have been correcting this error by re-arranging their piping to enclose two nozzles for relief valve purposes and have been making use of the principle of increasing the vent pipe diameter downstream of the relief valve; i.e.,



They recommend discharging as direct as possible straight-up above the roof. At their Springfield plant, they still employ their plant relief valve piping system to a flare. Extreme caution is exercised in examining all knock-out pots and checking the line for cleanliness after each use.

Monsanto employ a system whereby each relief valve is inspected for cleanliness and checked hydraulically on a yearly basis, or after each time it is caused to function on the vessel. They set their rupture discs to rupture at 150% of working pressure.

Both Hooker and Dow Chemicals indicated that they had removed their relief valves and are employing rupture discs only.

Goodrich expressed their intention of going to this design. The use of two rupture discs in series was reviewed. The danger of a pinhole leak in the first disc must be guarded against. There have been reports where pressure has accumulated between the two discs. At this point the first disc will not rupture until the pressure on the upstream side exceeds the design pressure of the disc plus the pressure exerted above it. Some of the members recommended the installation of a bleed pipe between the discs. Since this pipe is relatively small, frequent inspections against plugging are necessary. In general, it was concluded, that the use of a rupture disc and relief valve provided the better design for an emergent venting in restricted locations where the distance between the plant and

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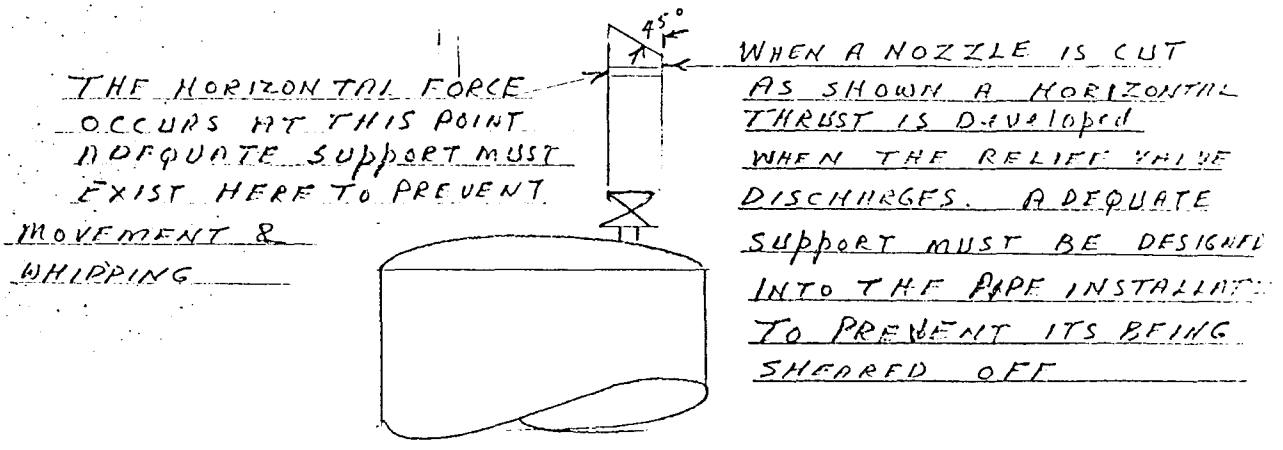
its borders would not permit adequate dispersion of vapor prior to its seeing a source of ignition.

The need to support vent piping was stressed repeatedly in particular the case of cutting the vent pipe at an angle of 45°; i.e.,

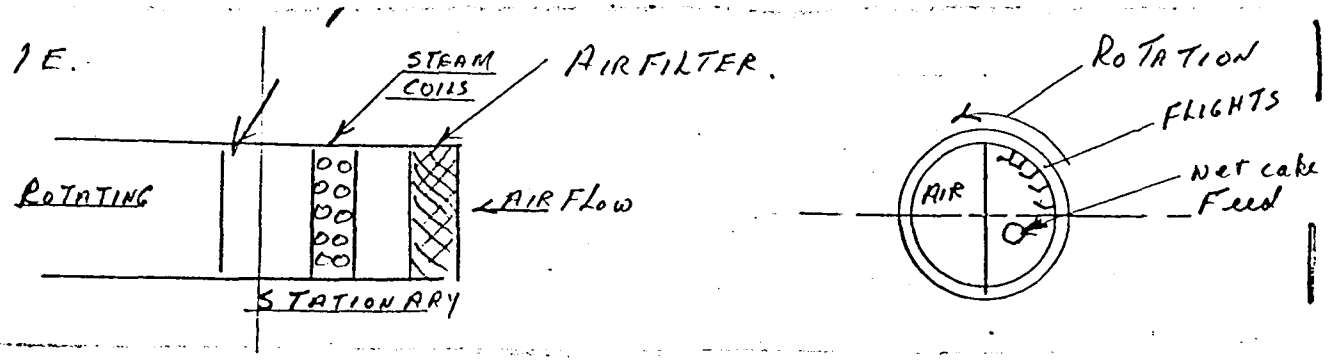


9. Drier Fires:

9.1 Airco, who previously had reported no experience with fires in their rotary drier, recently observed two such occasions. The story on the last occurrence is as follows:

Several weeks after cleaning their drier, they began to notice an increase in Δt across the drier, also an increase in the recorded temperature of the air entering the drier. A subsequent inspection in the drier resulted in the observance of a black smouldering carbon mass located upstream of the first baffle in the drier. The cause was attributed to plugging in the air inlet filters and heater from degraded polymer particles. This was the result of eddy current swirling resin particles in such a manner as to create a backflow toward the heating coils. Subsequent contact with t he coils created degradation. As the air flow was reduced, its temperature increased creating a higher inlet temperature to the drier. Hot air flowing across an atmosphere saturated in acetylhides (i.e.; cuprene) could create ignition and subsequent smouldering coupled with heat degradation.

Airco's drier is arranged such that the flights pick up the wet cake and drop it partially over the baffle into the air stream. The eddy currents around the baffle permit resin to build up behind it; i.e.,,



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9.2 Conoco - Marcus Smith:

They report the presence of fires in their driers. No one else other than Tenneco volunteered further information.

9.3 With regard to the inspection, frequency employed on driers, the following was reported:

Goodrich - once/week - inspection and clean-out
Airco - " " " "
General Tire- " " " "

10. Vessel Entry Procedures - P. Bogart of Tenneco:

10.1 Use of Oxygen and VCM Test Analysers:

A. P. Bogart indicated that Tenneco was in the process of installing permanent O_2 analysers to be used to check each vessel prior to entry. He also explained the use of the buddy-watch system.

B. Conoco rely on smell only. They do not employ an oxygen analysis.

C. Stauffer - cause their men to wear fresh air masks at all times when entering or remaining in their vessels.

D. American Chemicals - use the same procedures as described by Stauffer.

E. Allied Chemicals - blind all nozzles and employ a sketch of the vessel in their check list, then check to ascertain that the VCM content is below 50 ppm. No reference was made to assure adequate oxygen content.

F. Airco - employ hand operated explosive meters to check out their vessels for the presence of VCM.

G. Goodrich - checks for oxygen.

H. Panasote - checks for oxygen.

The analysers discussed were:

1. Johnson & Williams have a portable accurate VCM analyser capable of sensing 50 ppm.

2. Mine Safety Appliance Company provide a portable Halogen & Hydrocarbon analyser.

3. MSA also provide a set of test tubes which can be used to check for the presence of oxygen.

4. Davis provide an explosive meter suitable for testing for Vinyl Chloride vapors.

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10.2 The use of Coppus blowers to blow air into vessels was common to the majority of companies. Most companies employ the pressure principle; that of blowing fresh air into the polymerizing vessel and causing it to flow out through the bottom clean-out nozzle.

10.3 Safety Lights:

Some difficulty has been experienced with frayed extension cords used to supply 110 volt power to vessel entry 6 volt light units. The use of extension cord winders as manufactured by Protex was recommended. This type of safety light requires frequent inspection and maintenance to be sure that the 110V/6V transformer is in working order.

11.1 Deluge Systems by S. Schrieber of Allied Chemicals:

A. Allied use open head deluge systems per F.I.A. specifications which provide for 0.35 gpm of water per square foot of floor area.

B. Allied's plant is set such that the deluge system comes on automatically when the gas sensors, J&W type, indicate 50% concentration of L.E.L.

C. They have protected the sprinkler system's feed risers with blast walls of steel or concrete depending on their location.

D. S. Schrieber pointed out that F.I.A.'s District Engineer for the Eastern coast, Mr. W. Doyle, was looking for contributions from industry to finance a test program with the R. D. Little Company, to ascertain the value of a deluge system in dissipating vapors or vapor clouds. Allied has contributed and suggested that others do so.

11.2 As in all cases where machinery is employed, the preventive maintenance program employed with sprinkler heads is important to their success. Inspections of the heads, twice per year, is in order. This coupled with testing the system on a weekly basis will provide some assurance that it will function when required. The H.A.D.'s, must also be checked to see that they are in working order.

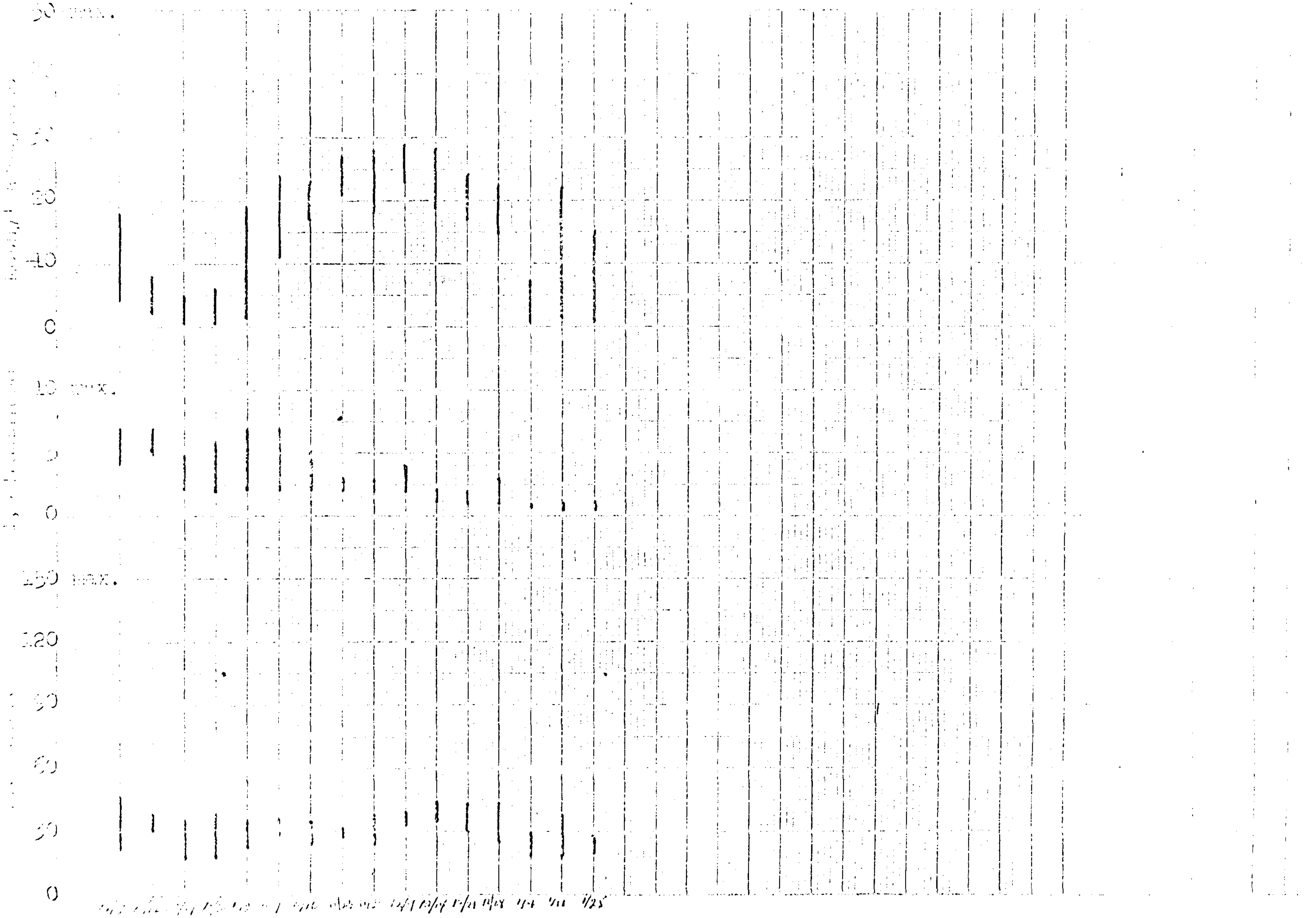
11.3 Goodrich do not employ a deluge system. They have equipped their plant with a fog system.

C. G. Thompson

CGT:rmr
Copy to: Messrs. Rozand, Scarito, Quist, Siegel, Snyder
Tarantula, Pytel, Schenke, Wilson, Polifroni, Knoll

20 X 20 TO THE INCH 46 1242
KEUFFEL & ESSER CO.

MONOMER SUMMARY



MATERIAL SAFETY DATA SHEET

166

(Approved by U.S. Department of Labor as "essentially similar" to FORM OSHA-20)

SECTION I IDENTIFICATION OF PRODUCT

MANUFACTURER'S NAME: Tenneco Chemicals, Inc. ORGANICS & POLYMERS DIVISION

EMERGENCY TELEPHONE NO.: (609) 386-9200

ADDRESS: TURNER PLACE, P.O. BOX 365, PISCATAWAY, NEW JERSEY 08854

TRADE NAME AND SYNONYMS: TENNECO PVC COMPOUND, WIRE AND CABLE 2022, 2022A, 2024, 2052, 2060, 2300, 2385, 2580, 2700, 2710C, 2710C4, 2712, 2714, 2730, 2775, 2800, 2803, 2804, 2814, 2814-1F, 2820, 2825, 2826, 2880, 2900, 2901-1, 2905, 2908, 2914, 2951

CHEMICAL NAME AND SYNONYMS: POLY(VINYL CHLORIDE) COMPOUND, PLASTICIZED (FLEXIBLE)

CHEMICAL FAMILY: CHLOROHYDROCARBON POLYMER

MOLECULAR FORMULA: $(CH_2CHCl)_n$

MOL. WT.:

SECTION II HAZARDOUS COMPONENTS OF MIXTURES

COMPONENT	%	THRESHOLD LIMIT VALUE (UNITS)	COMPONENT	%	THRESHOLD LIMIT VALUE (UNITS)
ANTIMONY COMPOUNDS	(0-2.5%)	0.5 mg/m^3	LEAD COMPOUNDS	(0-6%)	0.2 mg/m^3
BARIUM COMPOUNDS	(0-0.8%)	0.5 mg/m^3	MINERAL OIL	(0-0.3%)	5 mg/m^3
CARBON BLACK	(0-1.2%)	3.5 mg/m^3	TITANIUM DIOXIDE	(0-7%)	15 mg/m^3
DIETHYLHEXYL PHTHALATE	(0-30%)	5 mg/m^3			
DIGLYCIDYL ETHER	(0-0.2%)	0.5 ppm			

SECTION III PHYSICAL DATA

APPEARANCE AND ODOR: COLORLESS, WHITE, BLACK OR COLORED PELLETS, PRACTICALLY ODORLESS

BOILING POINT (DEGREES FAHRENHEIT): NOT APPLICABLE	MELTING POINT (DEGREES FAHRENHEIT): NOT APPLICABLE SOFTENS ABOUT 160-180°F.
VAPOR PRESSURE (MM. OF MERCURY): NOT APPLICABLE	SPECIFIC GRAVITY (WATER = 1): 1.22 - 1.48
VAPOR DENSITY (AIR = 1): NOT APPLICABLE	PERCENT VOLATILE (BY WEIGHT): ESSENTIALLY NON-VOLATILE
SOLUBILITY IN WATER: NEGLIGIBLE	EVAPORATION RATE (BUTYL ACETATE = 1): NOT APPLICABLE

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (SPECIFY METHOD) (DEGREES FAHRENHEIT): NOT APPLICABLE
Plasticizer generally over 400°F, COC

FLAMMABLE LIMITS (PERCENT BY VOLUME): LOWER / UPPER: NOT APPLICABLE

FIRE EXTINGUISHING MEDIA: Water spray, carbon dioxide or dry chemical

SPECIAL FIRE-FIGHTING PROCEDURES: Water spray or fog may be helpful in reducing flame intensity and absorbing irritating fumes. Shut off current in electrical equipment or wiring.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NFPA lists ignition temperature of 608°F. for PVC-plasticizer dust cloud and minimum concentration of 0.035 oz/cu. ft. Fire conditions produce hydrogen chloride, requiring protective equipment.

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
SEE SECTION II

EFFECTS OF OVEREXPOSURE None expected in normal handling. (Processing at high temperatures produces fumes irritating to eyes and respiratory tract, requiring local exhaust.)

EMERGENCY AND FIRST AID PROCEDURES
Ordinary measures of personal hygiene. (See Section IX.)
(In case of exposure in hot processing move to fresh air, flush eyes with water.)

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Normal processing temperature, about 350°F, causes slow darkening and decomposition. Higher heat increases rate and evolution of HCl.
	STABLE	X	

INCOMPATIBILITY *(Materials to avoid)*
None in ordinary use. Soluble in certain ketones and organic solvents.

HAZARDOUS DECOMPOSITION PRODUCTS
Thermal decomposition produces HCl, and CO and CO_2 (above 570°F).

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID None in ordinary use.
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Sweep up and remove to disposal container.

WASTE DISPOSAL METHOD
Bury in an approved landfill.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*
None required in ordinary handling. See Section IX.

VENTILATION	LOCAL EXHAUST For hot processing.	SPECIAL Vent to stack or scrubber.
	MECHANICAL *(General)* For ordinary handling.	OTHER Ventilate enclosed spaces.

PROTECTIVE GLOVES Cotton gloves for hot processing.	EYE PROTECTION Safety glasses.

OTHER PROTECTIVE EQUIPMENT None required for ordinary handling. For hot processing, local exhaust, safety glasses and gloves are recommended.

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING OSHA Standard 1910.1017 (.93q) on vinyl chloride limits exposure to 1 ppm (8 hour av.) and requires monitoring and other precautions in storage, handling and use of polyvinyl chloride, including labeling "Contains Vinyl Chloride -- Vinyl Chloride is a Cancer-Suspect Agent", excepting "fabricated products" not subject to "mass melting," as defined. New, low monomer content PVC compounds simplify operation below the OSHA 0.5ppm action level and compliance, assuming normal conditions and ventilation in a processor's work area. Further developments on resins and regulations are pending.

DATE	NAME AND TITLE	SHEET NUMBER
6/17/75	T. R. Aalto, Manager, Product Safety Services	166

MS DS PVC-Homo polymer

MATERIAL SAFETY DATA SHEET

156

(Approved by U.S. Department of Labor as "essentially similar" to FORM OSHA-20)

SECTION I IDENTIFICATION OF PRODUCT

MANUFACTURER'S NAME	EMERGENCY TELEPHONE NO.
Tenneco Chemicals, Inc., ORGANICS & POLYMERS DIVISION	609 386-9200 713 479-3411

ADDRESS
TURNER PLACE, P.O. BOX 365, PISCATAWAY, NEW JERSEY 08854

TRADE NAME AND SYNONYMS
Tenneco PVC Resin
175,200-2, 225, 225 PG, 250, 250-3, 10R, 501

CHEMICAL NAME AND SYNONYMS
Poly(Vinyl Chloride), PVC Homopolymer

CHEMICAL FAMILY	MOLECULAR FORMULA	MOL. WT.
Chlorohydrocarbon Polymer	$(CH_2CHCl)n$	

SECTION II HAZARDOUS COMPONENTS OF MIXTURES

COMPONENT	%	THRESHOLD LIMIT VALUE	COMPONENT	%	THRESHOLD LIMIT VALUE

OSHA Standard 1910.93q (.1017) on vinyl chloride sets a permissible exposure limit of 1 ppm averaged over any 8 hour period and 5 ppm over any 15 minute period. On the basis that polyvinyl chloride may contain and release small amounts of monomer, the Standard applies to the manufacture, reaction, packaging, repackaging, storage, handling, use or transportation of PVC, but not to handling or use of "fabricated products", as defined, if not subject to processing sufficient in time or temperature to cause mass melting.

SECTION III PHYSICAL DATA

APPEARANCE AND ODOR
White powder, odorless

BOILING POINT (DEGREES FAHRENHEIT)	MELTING POINT (DEGREES FAHRENHEIT)
Not applicable	Not applicable. Softens about 160-180°F.
VAPOR PRESSURE (MM. OF MERCURY)	SPECIFIC GRAVITY (WATER = 1)
Not applicable	1.4
VAPOR DENSITY (AIR = 1)	PERCENT VOLATILE (BY WEIGHT)
Not applicable	Approx. 1% (Moisture)
SOLUBILITY IN WATER	EVAPORATION RATE (BUTYL ACETATE = 1)
Negligible	Not applicable

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (SPECIFY METHOD) (DEGREES FAHRENHEIT)	FLAMMABLE LIMITS (PERCENT BY VOLUME)	LOWER	UPPER
Auto-ignition about 850°F Ignition about 735°F (ASTM D-1929)		Not applicable	

FIRE EXTINGUISHING MEDIA
Water spray, carbon dioxide or dry chemical.

SPECIAL FIRE-FIGHTING PROCEDURES
Water spray or fog may be helpful in reducing flame intensity and absorbing irritating fumes.

UNUSUAL FIRE AND EXPLOSION HAZARDS
NFPA lists ignition temperatures of 752°F for layer and 1220°F for PVC dust cloud. Produces combustible gases above 570°F.
Fire conditions produce hydrogen chloride, requiring protective equipment.

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

SEE SECTION II

EFFECTS OF OVEREXPOSURE None expected - inert resin. See Section IX. Prolonged breathing of concentrated dust may be harmful. (Processing at high temperatures produces fumes irritating to eyes and respiratory tract requiring local exhaust.)

EMERGENCY AND FIRST AID PROCEDURES

Ordinary measures of personal hygiene.

In case of exposure in hot processing move to fresh air, flush eyes with water.

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Normal processing temperature, about 350°F, causes slow darkening and decomposition. Higher heat increases rate and evolution of HCl.
	STABLE	x	

INCOMPATIBILITY *(Materials to avoid)*

None in ordinary use. Soluble in certain ketones and organic solvents.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition produces HCl, and CO and CO_2 (above 570°F)

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	x	None in ordinary use.

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Sweep up and remove to disposal container.

WASTE DISPOSAL METHOD

Bury in an approved landfill.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)* In case of concentrated dust, use Bureau of Mines approved dust respirator (NIOBM TC-21C-132 or equivalent). See Sections II and IX.

VENTILATION	LOCAL EXHAUST: For hot processing	SPECIAL: Vent to elevated stack.
	MECHANICAL *(General)*: For ordinary handling.	OTHER: Ventilate enclosed spaces.

PROTECTIVE GLOVES: Not ordinarily required	EYE PROTECTION: Safety glasses

OTHER PROTECTIVE EQUIPMENT None required for ordinary handling. For hot processing local exhaust, safety glasses and gloves are recommended.

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OSHA Standard 1910.93$_q$ (.1017) requires monitoring and other precautions in storage, handling and use of polyvinyl chloride, and also labeling of PVC "Contains Vinyl Chloride--Vinyl Chloride is a CAncer-Suspect Agent."

New PVC resins with a low monomer content make it easier to operate below the OSHA action level of 0.5 ppm in a processor's work area, assuming normal conditions and ventilation, simplifying compliance with some of the regulatory requirements. Further developments on resins and on regulations are pending.

DATE	NAME AND TITLE	SHEET NUMBER
6/5/75	T. R. AALTO, MANAGER, PRODUCT SAFETY SERVICES	156

MSDS PVC/PVAc Copolymer

MATERIAL SAFETY DATA SHEET

NUMBER 158

(Approved by U.S. Department of Labor as "essentially similar" to FORM OSHA-20)

SECTION I IDENTIFICATION OF PRODUCT

MANUFACTURER'S NAME	EMERGENCY TELEPHONE NO.
Tenneco Chemicals, Inc., ORGANICS & POLYMERS DIVISION	609 386-9200 201 782-4011

ADDRESS
TURNER PLACE, P.O. BOX 365, PISCATAWAY, NEW JERSEY 08854

TRADE NAME AND SYNONYMS
314, 315, 382, 388, 389, 390, 391, 521 Tenneco PVC Copolymer Resin

CHEMICAL NAME AND SYNONYMS
Vinylchloride - Vinyl Acetate Copolymer, VC/VAc Copolymer

CHEMICAL FAMILY	MOLECULAR FORMULA	MOL. WT.
Chlorohydrocarbon copolymer	$\{CH_2CHCl\}_x\{CH_2CHOCOCH_3\}_y$	

SECTION II HAZARDOUS COMPONENTS OF MIXTURES

COMPONENT	%	THRESHOLD LIMIT VALUE	COMPONENT	%	THRESHOLD LIMIT VALUE

OSHA Standard 1910.93$_q$ (.1017) on vinyl chloride sets a permissible exposure limit of 1 ppm averaged over any 8 hour period and 5 ppm over any 15 minute period. On the basis that polyvinyl chloride may contain and release small amounts of monomer, the Standard applies to the manufacture, reaction, packaging, repackaging, storage, handling, use or transportation of PVC, but not to handling or use of "fabricated products", as defined, if not subject to processing sufficient in time or temperature to cause mass melting.

SECTION III PHYSICAL DATA

APPEARANCE AND ODOR
White powder, faint ester odor

BOILING POINT (DEGREES FAHRENHEIT)	MELTING POINT (DEGREES FAHRENHEIT)
Not applicable	Not applicable. Softens about 140-160°F
VAPOR PRESSURE (MM. OF MERCURY)	SPECIFIC GRAVITY (WATER = 1)
Not applicable	1.35 - 1.4
VAPOR DENSITY (AIR = 1)	PERCENT VOLATILE (BY WEIGHT)
Not applicable	Approx. 1% (moisture)
SOLUBILITY IN WATER	EVAPORATION RATE (BUTYL ACETATE = 1)
Negligible	Not applicable

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (SPECIFY METHOD) (DEGREES FAHRENHEIT)	FLAMMABLE LIMITS (PERCENT BY VOLUME)	LOWER	UPPER
Ignition about 735°F for PVC (ASTM D-1929)		Not applicable	

FIRE EXTINGUISHING MEDIA
Water spray, carbon dioxide or dry chemical.

SPECIAL FIRE-FIGHTING PROCEDURES
Water spray or fog may be helpful in reducing flame intensity and absorbing irritating fumes.

UNUSUAL FIRE AND EXPLOSION HAZARDS
NFPA lists ignition temperature of 1274°F. for dust cloud. Produces combustible gases above 570°F. Fire conditions produce hydrogen chloride, requiring protective equipment.

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

SEE SECTION II

EFFECTS OF OVEREXPOSURE None expected.- inert resin. See Section IX. Prolonged breathing of concentrated dust may be harmful. (Processing at high temperatures produces fumes irritating to eyes and respiratory tract requiring local exhaust.)

EMERGENCY AND FIRST AID PROCEDURES

Ordinary measures of personal hygiene.
In case of exposure in hot processing move to fresh air, flush eyes with water.

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Normal processing temperature, about 350°F, causes slow darkening and decomposition. Higher heat increases rate and evolution of HCl.
	STABLE	x	

INCOMPATIBILITY *(Materials to avoid)*

None in ordinary use. Soluble in certain ketones and organic solvents.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition produces HCl, and CO and CO_2 (above 570°F)

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	x	None in ordinary use.

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Sweep up and remove to disposal container.

WASTE DISPOSAL METHOD

Bury in an approved landfill.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)* In case of concentrated dust, use Bureau of Mines approved dust respirator (NIOBM TC-21C-132 or equivalent). See Sections II and IX.

VENTILATION	LOCAL EXHAUST: For hot processing	SPECIAL: Vent to elevated stack.
	MECHANICAL *(General)*: For ordinary handling.	OTHER: Ventilate enclosed spaces.

PROTECTIVE GLOVES: Not ordinarily required	EYE PROTECTION: Safety glasses

OTHER PROTECTIVE EQUIPMENT None required for ordinary handling. For hot processing local exhaust, safety glasses and gloves are recommended.

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OSHA Standard 1910.93$_q$ (.1017) requires monitoring and other precautions in storage, handling and use of polyvinyl chloride, and also labeling of PVC "Contains Vinyl Chloride--Vinyl Chloride is a CAncer-Suspect Agent."

DATE	NAME AND TITLE	SHEET NUMBER
6/5/75	T. R. AALTO, MANAGER, PRODUCT SAFETY SERVICES	158

MSDS, PVC compound, Ridgid

MATERIAL SAFETY DATA SHEET

169

(Approved by U.S. Department of Labor as "essentially similar" to FORM OSHA-20)

SECTION I IDENTIFICATION OF PRODUCT

MANUFACTURER'S NAME: Tenneco Chemicals, Inc. ORGANICS & POLYMERS DIVISION

EMERGENCY TELEPHONE NO.: (609) 386-9200

ADDRESS: TURNER PLACE, P.O. BOX 365, PISCATAWAY, NEW JERSEY 08854

TRADE NAME AND SYNONYMS: TENNECO PVC COMPOUND, RIGID 3711, 3750, 4703

CHEMICAL NAME AND SYNONYMS: POLY(VINYL CHLORIDE) COMPOUND

CHEMICAL FAMILY: CHLOROHYDROCARBON POLYMER

MOLECULAR FORMULA: $(CH_2CHCl)_n$

MOL. WT.:

SECTION II HAZARDOUS COMPONENTS OF MIXTURES

COMPONENT	%	THRESHOLD LIMIT VALUE	COMPONENT	%	THRESHOLD LIMIT VALUE
CARBON BLACK (0-0.6%) - 3.5 mg/m^3					
LEAD COMPOUNDS (0-4%) - 0.2 mg/m^3					
MINERAL OIL (0-0.5%) - 5 mg/m^3					
TIN ORGANIC COMPOUND (0-2%) - 0.1 mg/m^3					
TITANIUM DIOXIDE (0-1%) - 15 mg/m^3					

SECTION III PHYSICAL DATA

APPEARANCE AND ODOR: WHITE, BLACK OR COLORED PELLETS, PRACTIALLY ODORLESS.

BOILING POINT (DEGREES FAHRENHEIT): NOT APPLICABLE	MELTING POINT (DEGREES FAHRENHEIT): Not applicable. Softens about 160-180°F.
VAPOR PRESSURE (MM. OF MERCURY): NOT APPLICABLE	SPECIFIC GRAVITY (WATER = 1): 1.32 - 1.42
VAPOR DENSITY (AIR = 1): NOT APPLICABLE	PERCENT VOLATILE (BY WEIGHT): Essentially non-volatile
SOLUBILITY IN WATER: NEGLIGIBLE	EVAPORATION RATE (BUTYL ACETATE = 1): Not applicable.

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (SPECIFY METHOD) (DEGREES FAHRENHEIT): Ignition about 735°F. Auto-ignition about 850°F (ASTM D-1929)

FLAMMABLE LIMITS (PERCENT BY VOLUME): LOWER UPPER — Not applicable

FIRE EXTINGUISHING MEDIA: Water spray, carbon dioxide or dry chemical.

SPECIAL FIRE-FIGHTING PROCEDURES: Water spray or fog may be helpful in reducing flame intensity and absorbing irritating fumes. Shut off current in electrical equipment or wiring.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NFPA lists ignition temperature of 752°F for layer and 1220°F for PVC dust cloud. Produces combustible gases above 570°F. Fire conditions produce hydrogen chloride, requiring protective equipment.

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
SEE SECTION II

EFFECTS OF OVEREXPOSURE None expected in normal handling. (Processing at high temperatures produces fumes irritating to eyes and respiratory tract, requiring local exhaust.)

EMERGENCY AND FIRST AID PROCEDURES
Ordinary measures of personal hygiene. (See Section IX.)
(In case of exposure in hot processing move to fresh air, flush eyes with water.)

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Normal processing temperature, about 350°F, causes slow darkening and decomposition. Higher heat increases rate and evolution of HCl.
	STABLE	X	

INCOMPATIBILITY *(Materials to avoid)*
None in ordinary use. Soluble in certain ketones and organic solvents.

HAZARDOUS DECOMPOSITION PRODUCTS
Thermal decomposition produces HCl, and CO and CO_2 (above 570°F).

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID None in ordinary use.
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Sweep up and remove to disposal container.

WASTE DISPOSAL METHOD
Bury in an approved landfill.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*
None required in ordinary handling. See Section IX.

VENTILATION	LOCAL EXHAUST For hot processing.	SPECIAL Vent to stack or scrubber.
	MECHANICAL *(General)* For ordinary handling.	OTHER Ventilate enclosed spaces.

PROTECTIVE GLOVES Cotton gloves for hot processing.	EYE PROTECTION Safety glasses.

OTHER PROTECTIVE EQUIPMENT None required for ordinary handling. For hot processing local exhaust, safety glasses and gloves are recommended.

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING OSHA Standard 1910.1017 (.93$_q$) on vinyl chloride limits exposure to 1 ppm (8 hour av.) and requires monitoring and other precautions in storage, handling and use of polyvinyl chloride, including labeling "Contains Vinyl Chloride -- Vinyl Chloride is a Cancer-Suspect Agent", excepting "fabricated products" not subject to "mass melting," as defined. New, low monomer content PVC compounds simplify operation below the OSHA 0.5ppm action level and compliance, assuming normal conditions and ventilation in a processor's work area. Further developments on resins and regulations are pending.

DATE	NAME AND TITLE	SHEET NUMBER
6/17/75	T. R. Aalto, Manager, Product Safety Services	169

MSDS, PVC/PVAC Compound, Record

MATERIAL SAFETY DATA SHEET

NUMBER 168

(Approved by U.S. Department of Labor as "essentially similar" to FORM OSHA-20)

SECTION I IDENTIFICATION OF PRODUCT

MANUFACTURER'S NAME: Tenneco Chemicals, Inc. ORGANICS & POLYMERS DIVISION

EMERGENCY TELEPHONE NO.: (609) 386-9200

ADDRESS: TURNER PLACE, P.O. BOX 365, PISCATAWAY, NEW JERSEY 08854

TRADE NAME AND SYNONYMS: TENNECO PVC COMPOUND, RECORD 3805D, 3806, 4716, CD-01252

CHEMICAL NAME AND SYNONYMS: VINYL CHLORIDE - VINYL ACETATE COPOLYMER

CHEMICAL FAMILY: CHLOROHYDROCARBON COPOLYMER

MOLECULAR FORMULA: $\{CH_2CH\ Cl\}_x\ \{CH_2CHOCOCH_3\}_y$ MOL. WT.

SECTION II HAZARDOUS COMPONENTS OF MIXTURES

COMPONENT	%	THRESHOLD LIMIT VALUE	COMPONENT	%	THRESHOLD LIMIT VALUE

CARBON BLACK (0.1 - 1%) - 3.5 mg/m^3

LEAD COMPOUNDS (0-2%) - 0.2 mg/m^3

TIN ORGANIC COMP. (0-2%) - 0.1 mg/m^3

SECTION III PHYSICAL DATA

APPEARANCE AND ODOR: BLACK PELLETS, PRACTICALLY ODORLESS

BOILING POINT (DEGREES FAHRENHEIT): NOT APPLICABLE	MELTING POINT (DEGREES FAHRENHEIT): NOT APPLICABLE SOFTENS ABOUT 140-160°F
VAPOR PRESSURE (MM. OF MERCURY): NOT APPLICABLE	SPECIFIC GRAVITY (WATER = 1): 1.35 - 1.39
VAPOR DENSITY (AIR = 1): NOT APPLICABLE	PERCENT VOLATILE (BY WEIGHT): ESSENTIALLY NON-VOLATILE
SOLUBILITY IN WATER: NEGLIGIBLE	EVAPORATION RATE (BUTYL ACETATE = 1): NOT APPLICABLE

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (SPECIFY METHOD) (DEGREES FAHRENHEIT): IGNITION ABOUT 735°F for PVC (ASTM-D-1929)

FLAMMABLE LIMITS (PERCENT BY VOLUME): LOWER UPPER NOT APPLICABLE

FIRE EXTINGUISHING MEDIA: WATER SPRAY, CARBON DIOXIDE OR DRY CHEMICAL

SPECIAL FIRE-FIGHTING PROCEDURES: Water spray or fog may be helpful in reducing flame intensity and absorbing irritating fumes. Shut off current in electrical equipment or wiring.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NFPA lists ignition temperature of 608°F. for PVC-plasticizer dust cloud and minimum concentration of 0.035 oz/cu ft. Fire conditions produce hydrogen chloride, requiring protective equipment

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
SEE SECTION II

EFFECTS OF OVEREXPOSURE None expected in normal handling. (Processing at high temperatures produces fumes irritating to eyes and respiratory tract, requiring local exhaust.)

EMERGENCY AND FIRST AID PROCEDURES
Ordinary measures of personal hygiene. (See Section IX.)
(In case of exposure in hot processing move to fresh air, flush eyes with water.)

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Normal processing temperature, about 350°F, causes slow darkening and decomposition. Higher heat increases rate and evolution of HCl.
	STABLE	X	

INCOMPATIBILITY *(Materials to avoid)*
None in ordinary use. Soluble in certain ketones and organic solvents.

HAZARDOUS DECOMPOSITION PRODUCTS
Thermal decomposition produces HCl, and CO and CO_2 (above 570°F).

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID None in ordinary use.
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Sweep up and remove to disposal container.

WASTE DISPOSAL METHOD
Bury in an approved landfill.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*
None required in ordinary handling. See Section IX.

VENTILATION	LOCAL EXHAUST For hot processing.	SPECIAL Vent to stack or scrubber.
	MECHANICAL *(General)* For ordinary handling.	OTHER Ventilate enclosed spaces.

PROTECTIVE GLOVES Cotton gloves for hot processing.	EYE PROTECTION Safety glasses.

OTHER PROTECTIVE EQUIPMENT None required for ordinary handling. For hot processing local exhaust, safety glasses and gloves are recommended.

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING OSHA Standard 1910.1017 (.93$_{Q}$) on vinyl chloride limits exposure to 1 ppm (8 hour av.) and requires monitoring and other precautions in storage, handling and use of polyvinyl chloride, including labeling "Contains Vinyl Chloride -- Vinyl Chloride is a Cancer-Suspect Agent", excepting "fabricated products" not subject to "mass melting," as defined. New, low monomer content PVC compounds simplify operation below the OSHA 0.5ppm action level and compliance, assuming normal conditions and ventilation in a processor's work area. Further developments on resins and regulations are pending.

DATE	NAME AND TITLE	SHEET NUMBER
6/17/75	T. R. Aalto, Manager, Product Safety Services	168

MATERIAL SAFETY DATA SHEET

NUMBER 168

(Approved by U.S. Department of Labor as "essentially similar" to FORM OSHA-20)

SECTION I IDENTIFICATION OF PRODUCT

MANUFACTURER'S NAME	EMERGENCY TELEPHONE NO.
Tenneco Chemicals, Inc. ORGANICS & POLYMERS DIVISION	(609) 386-9200

ADDRESS
TURNER PLACE, P.O. BOX 365, PISCATAWAY, NEW JERSEY 08854

TRADE NAME AND SYNONYMS
TENNECO PVC COMPOUND, RECORD 3805D, 3806, 4716, CD-01252

CHEMICAL NAME AND SYNONYMS
VINYL CHLORIDE - VINYL ACETATE COPOLYMER

CHEMICAL FAMILY	MOLECULAR FORMULA	MOL. WT.
CHLOROHYDROCARBON COPOLYMER	$\{CH_2CH\ Cl\}_x\ \{CH_2CHOCOCH_3\}_y$	

SECTION II HAZARDOUS COMPONENTS OF MIXTURES

COMPONENT	%	THRESHOLD LIMIT VALUE	COMPONENT	%	THRESHOLD LIMIT VALUE

CARBON BLACK (0.1 - 1%) - 3.5 mg/m^3

LEAD COMPOUNDS (0-2%) - 0.2 mg/m^3

TIN ORGANIC COMP. (0-2%) - 0.1 mg/m^3

SECTION III PHYSICAL DATA

APPEARANCE AND ODOR
BLACK PELLETS, PRACTICALLY ODORLESS

BOILING POINT (DEGREES FAHRENHEIT)	MELTING POINT (DEGREES FAHRENHEIT)
NOT APPLICABLE	NOT APPLICABLE SOFTENS ABOUT 140-160°F
VAPOR PRESSURE (MM. OF MERCURY)	SPECIFIC GRAVITY (WATER = 1)
NOT APPLICABLE	1.35 - 1.39
VAPOR DENSITY (AIR = 1)	PERCENT VOLATILE (BY WEIGHT)
NOT APPLICABLE	ESSENTIALLY NON-VOLATILE
SOLUBILITY IN WATER	EVAPORATION RATE (BUTYL ACETATE = 1)
NEGLIGIBLE	NOT APPLICABLE

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (SPECIFY METHOD) (DEGREES FAHRENHEIT)	FLAMMABLE LIMITS (PERCENT BY VOLUME)	LOWER	UPPER
IGNITION ABOUT 735°F for PVC (ASTM-D-1929)		NOT APPLICABLE	

FIRE EXTINGUISHING MEDIA
WATER SPRAY, CARBON DIOXIDE OR DRY CHEMICAL

SPECIAL FIRE-FIGHTING PROCEDURES
Water spray or fog may be helpful in reducing flame intensity and absorbing irritating fumes. Shut off current in electrical equipment or wiring.

UNUSUAL FIRE AND EXPLOSION HAZARDS
NFPA lists ignition temperature of 608°F. for PVC-plasticizer dust cloud and minimum concentration of 0.035 oz/cu ft. Fire conditions produce hydrogen chloride, requiring protective equipment.

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
SEE SECTION II

EFFECTS OF OVEREXPOSURE None expected in normal handling. (Processing at high temperatures produces fumes irritating to eyes and respiratory tract, requiring local exhaust.)

EMERGENCY AND FIRST AID PROCEDURES
Ordinary measures of personal hygiene. (See Section IX.)
(In case of exposure in hot processing move to fresh air, flush eyes with water.)

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Normal processing temperature, about 350°F, causes slow darkening and decomposition. Higher heat increases rate and evolution of HCl.
	STABLE	X	

INCOMPATIBILITY *(Materials to avoid)*
None in ordinary use. Soluble in certain ketones and organic solvents.

HAZARDOUS DECOMPOSITION PRODUCTS
Thermal decomposition produces HCl, and CO and CO_2 (above 570°F).

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID None in ordinary use.
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Sweep up and remove to disposal container.

WASTE DISPOSAL METHOD
Bury in an approved landfill.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*
None required in ordinary handling. See Section IX.

VENTILATION	LOCAL EXHAUST: For hot processing.	SPECIAL: Vent to stack or scrubber.
	MECHANICAL *(General)*: For ordinary handling.	OTHER: Ventilate enclosed spaces.

PROTECTIVE GLOVES: Cotton gloves for hot processing.	EYE PROTECTION: Safety glasses.

OTHER PROTECTIVE EQUIPMENT None required for ordinary handling. For hot processing local exhaust, safety glasses and gloves are recommended.

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING OSHA Standard 1910.1017 (.93$_q$) on vinyl chloride limits exposure to 1 ppm (8 hour av.) and requires monitoring and other precautions in storage, handling and use of polyvinyl chloride, including labeling "Contains Vinyl Chloride -- Vinyl Chloride is a Cancer-Suspect Agent", excepting "fabricated products" not subject to "mass melting," as defined. New, low monomer content PVC compounds simplify operation below the OSHA 0.5ppm action level and compliance, assuming normal conditions and ventilation in a processor's work area. Further developments on resins and regulations are pending.

DATE	NAME AND TITLE	SHEET NUMBER
6/17/75	T. R. Aalto, Manager, Product Safety Services	168

MSDS PVC/PVAc copolymer,
dispersion resin

MATERIAL SAFETY DATA SHEET

NUMBER 159

(Approved by U.S. Department of Labor as "essentially similar" to FORM OSHA-20)

SECTION I IDENTIFICATION OF PRODUCT

MANUFACTURER'S NAME: Tenneco Chemicals, Inc., ORGANICS & POLYMERS DIVISION

EMERGENCY TELEPHONE NO.: 609 386-9200

ADDRESS: TURNER PLACE, P.O. BOX 365, PISCATAWAY, NEW JERSEY 08854

TRADE NAME AND SYNONYMS: Tenneco PVC Copolymer Dispersion Resin 0565

CHEMICAL NAME AND SYNONYMS: Vinylchloride - Vinyl Acetate Copolymer, VC/VAc Copolymer

CHEMICAL FAMILY: Chlorohydrocarbon copolymer

MOLECULAR FORMULA: $\{CH_2CHCl\}_x\{CH_2CHOCOCH_3\}_y$

MOL. WT.:

SECTION II HAZARDOUS COMPONENTS OF MIXTURES

COMPONENT	%	THRESHOLD LIMIT VALUE	COMPONENT	%	THRESHOLD LIMIT VALUE

OSHA Standard 1910.93$_q$ (.1017) on vinyl chloride sets a permissible exposure limit of 1 ppm averaged over any 8 hour period and 5 ppm over any 15 minute period. On the basis that polyvinyl chloride may contain and release small amounts of monomer, the Standard applies to the manufacture, reaction, packaging, repackaging, storage, handling, use or transportation of PVC, but not to handling or use of "fabricated products", as defined, if not subject to processing sufficient in time or temperature to cause mass melting.

SECTION III PHYSICAL DATA

APPEARANCE AND ODOR: White powder, faint ester odor.

BOILING POINT (DEGREES FAHRENHEIT): Not applicable	MELTING POINT (DEGREES FAHRENHEIT): Not applicable. Softens about 140-160°F
VAPOR PRESSURE (MM. OF MERCURY): Not applicable	SPECIFIC GRAVITY (WATER = 1): 1.4
VAPOR DENSITY (AIR = 1): Not applicable	PERCENT VOLATILE (BY WEIGHT): Approx. 1% (MOISTURE)
SOLUBILITY IN WATER: Negligible	EVAPORATION RATE (BUTYL ACETATE = 1): Not applicable

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (SPECIFY METHOD) (DEGREES FAHRENHEIT): Ignition about 735°F for PVC (ASTM D-1929)

FLAMMABLE LIMITS (PERCENT BY VOLUME): LOWER Not applicable UPPER

FIRE EXTINGUISHING MEDIA: Water spray, carbon dioxide or dry chemical.

SPECIAL FIRE-FIGHTING PROCEDURES: Water spray or fog may be helpful in reducing flame intensity and absorbing irritating fumes.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NFPA lists ignition temperature of 1274°F. for dust cloud. Produces combustible gases above 570°F. Fire conditions produce hydrogen chloride, requiring protective equipment.

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

SEE SECTION II

EFFECTS OF OVEREXPOSURE None expected - inert resin. See Section IX. Prolonged breathing of concentrated dust may be harmful. (Processing at high temperatures produces fumes irritating to eyes and respiratory tract requiring local exhaust.)

EMERGENCY AND FIRST AID PROCEDURES

Ordinary measures of personal hygiene.

In case of exposure in hot processing move to fresh air, flush eyes with water.

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Normal processing temperature, about 350°F, causes slow darkening and decomposition. Higher heat increases rate and evolution of HCl.
	STABLE	x	

INCOMPATIBILITY *(Materials to avoid)*

None in ordinary use. Soluble in certain ketones and organic solvents.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition produces HCl, and CO and CO_2 (above 570°F)

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	x	None in ordinary use.

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Sweep up and remove to disposal container.

WASTE DISPOSAL METHOD

Bury in an approved landfill.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)* In case of concentrated dust, use Bureau of Mines approved dust respirator (NIOBM TC-21C-132 or equivalent). See Sections II and IX.

VENTILATION	LOCAL EXHAUST: For hot processing	SPECIAL: Vent to elevated stack.
	MECHANICAL *(General)*: For ordinary handling.	OTHER: Ventilate enclosed spaces.

PROTECTIVE GLOVES: Not ordinarily required	EYE PROTECTION: Safety glasses

OTHER PROTECTIVE EQUIPMENT None required for ordinary handling. For hot processing local exhaust, safety glasses and gloves are recommended.

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OSHA Standard 1910.93$_q$ (.1017) requires monitoring and other precautions in storage, handling and use of polyvinyl chloride, and also labeling of PVC "Contains Vinyl Chloride--Vinyl Chloride is a CAncer-Suspect Agent."

New PVC resins with a low monomer content make it easier to operate below the OSHA action level of 0.5 ppm in a processor's work area, assuming normal conditions and ventilation, simplifying compliance with some of the regulatory requirements. Further developments on resins and on regulations are pending.

DATE	NAME AND TITLE	SHEET NUMBER
6/5/75	T. R. AALTO, MANAGER, PRODUCT SAFETY SERVICES	159

INTER-OFFICE COMMUNICATION

TENNECO HYDROCARBON CHEMICALS DIVISION

(RES-496-70CD)

DATE NOVEMBER 6, 1970

TO: TENNECO PLASTICS DIVISION

FOR: MR. DON WEINTRAUB

FROM: MR. R. E. SIMMONS

CC: M. W. WILLIAMS ✓
H. E. O'CONNELL
D. R. KECK
C. W. WOLFE
C. A. GREIF

RE: VCM PURCHASED FROM PPG

Due to Plastics' forecast requirements for VCM, we have purchased an additional 4 MM lbs. of VCM from PPG to be shipped from their Lake Charles, Louisiana, Plant during November, 1970, to Burlington, New Jersey. Two MM lbs. to be shipped during period November 4-10 and remainder to be shipped during November 11-31, 1970. Hydrocarbon has thus purchased a total of 12 MM lbs. of VCM from PPG. The remaining 4 MM lbs. of VCM will be shipped during the period December 15, 1970/January 15, 1971, as required to meet Plastics' shipping schedule.

You have indicated that Conoco Plastics has about 1.6 MM lbs. of VCM in their storage tanks at Aberdeen, Mississippi, which belongs to Plastics. Conoco has indicated they would be willing to convert this to resin or to ship you the monomer from their Lake Charles VCM Plant. I understand that Plastics prefers that Conoco ship the monomer and not convert any additional monomer to resin.

With your cancellation of 4 cars to be shipped to Flemington, we do not believe that we will be able to take back the 1.6 MM lbs. of VCM from Conoco until first quarter, 1971. Please keep us advised of your discussions with Conoco concerning the return of the 1.6 MM lbs. of VCM.

Dick

R. E. SIMMONS

RES
RES:jem

I-184 (50M)

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO Route List AT DATE January 18, 1971

FROM F.W. Kanzler AT Burlington COPY TO C.H. Brower
H.B. Carr
W.W. Heal
H.R. Horton
R.L. Horvath
G.W. Leach
M.W. Williams
✓File
J. C. Fraser
C. J. Hawker

SUBJECT Microscopic Analysis of 1730 Dispersion Resin

Reference: Memo to W.W. Heal from F.W. Kanzler, dated 1/7/71

In support of the gel investigation task force and as a result of the findings outlined in the referenced memo, further microscopic analyses were performed on 1730 latex and resin samples. The following are steps taken with the results listed below:

1. Latex

In addition to the previous analyses of dryed lot samples, latex samples were subjected to microscopic analyses. Both blend tank samples and stripped batch samples were investigated. The latex samples were examined "as is" and after drying and subsequent preparation of a paste. In both instances, fibers were found. The stripped batch samples showed, in addition to normal relatively long fibers, short fiber particles (Figure 1) which were not observed in blend tank and/or finished lot samples. As shown in Figure 8 of the referenced memo, short fibers of about the same configurations like in Figure 1 can be seen. It can therefore be concluded that the short fibers originate from the Cuno filters.

In addition, floating particles were observed in the stripped batch samples. These floaters showed crystal formation after evaporation of the liquid. An investigation of this phenomena is pending.

2. Finished Resin

Lots 800043 and 801003 were picked as typical lots representing low and high gel count lots respectively. In both lots, fibers were found to be the cause of gels (Figures 3 through 6). It is noted that the cured (fused) sample showed a better outline of the fiber in the photomicrograph.

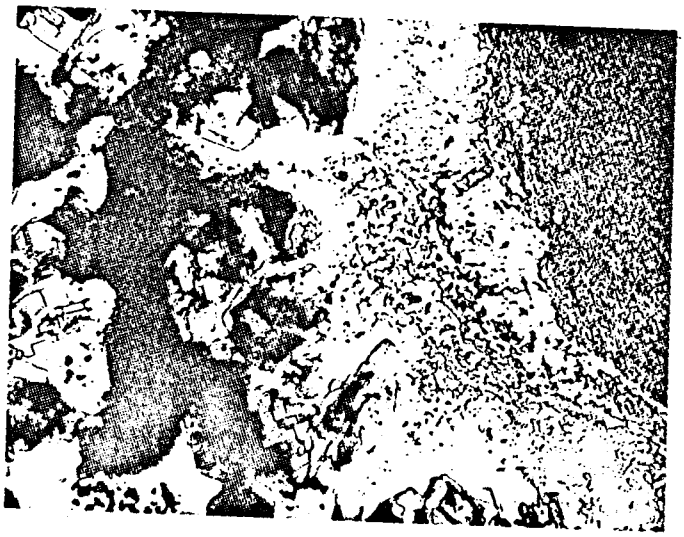
3. Raw Materials

Water, DHW-80, as well as the DOP used for the preparation of the paste were subjected to microscopic analysis. While the water showed no fiber contamination, the DHW-80 showed typical dust particles found in liquids exposed to open atmosphere at one time or another. The DOP showed one fiber on a drawdown area of 6 x 6 inches.

FIGURE 1

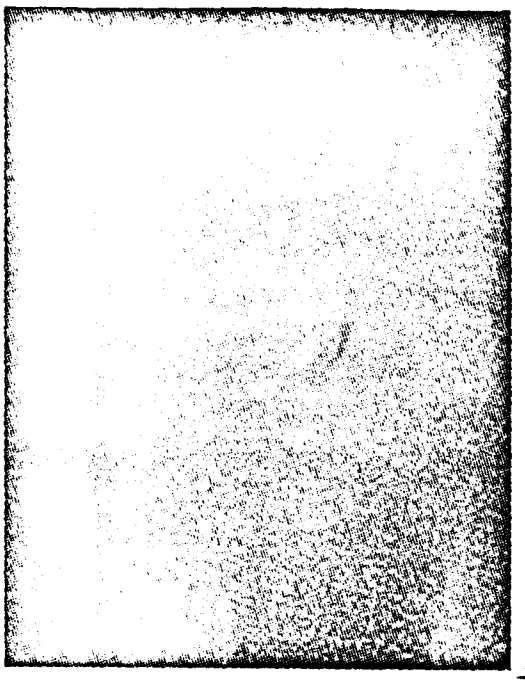
B-58-T-11 1730 100X
1-13-71 LATEX

FIGURE 2



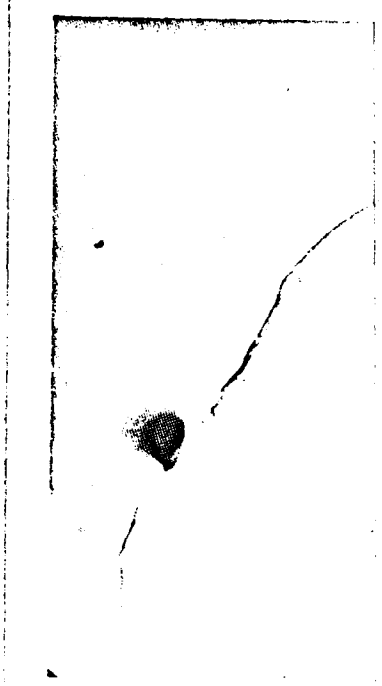
B-58-T-11 1730 200X
1-13-71 FLOATERS DRY

FIGURE 3



LOT # 800043 100X
PASTE

FIGURE 4

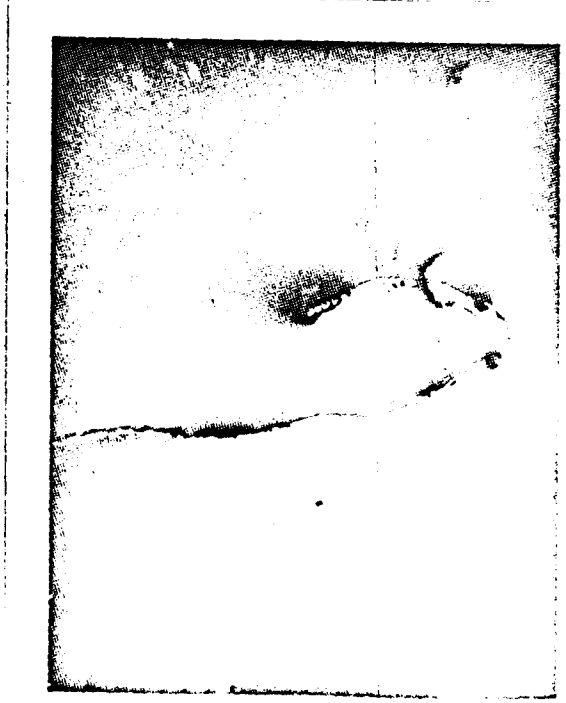


LOT # 800043 100X
FUSED

FIGURE 5

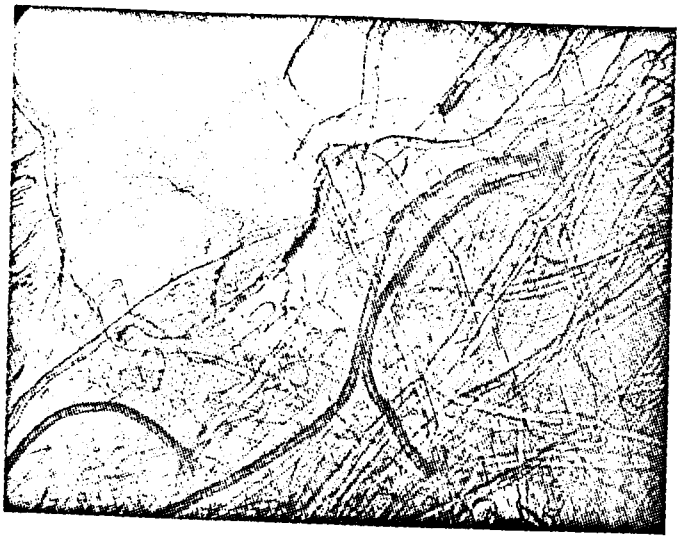
LOT # 801003 35X
PASTE

FIGURE 6



LOT # 801003 35X
FUSED

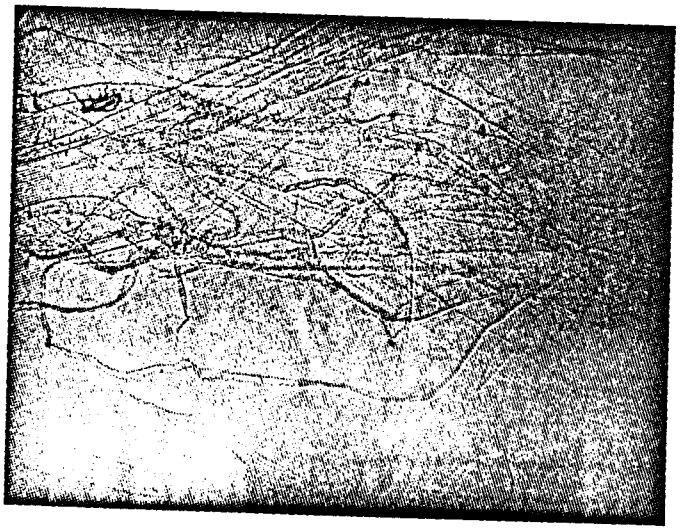
FIGURE 7



LOT # 801005
FLAKE PALLET 13

100X

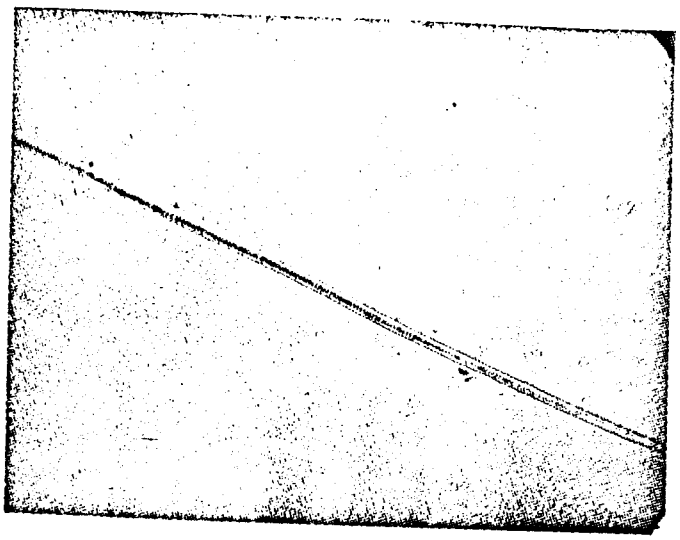
FIGURE 8



DOBPAK FIBERS

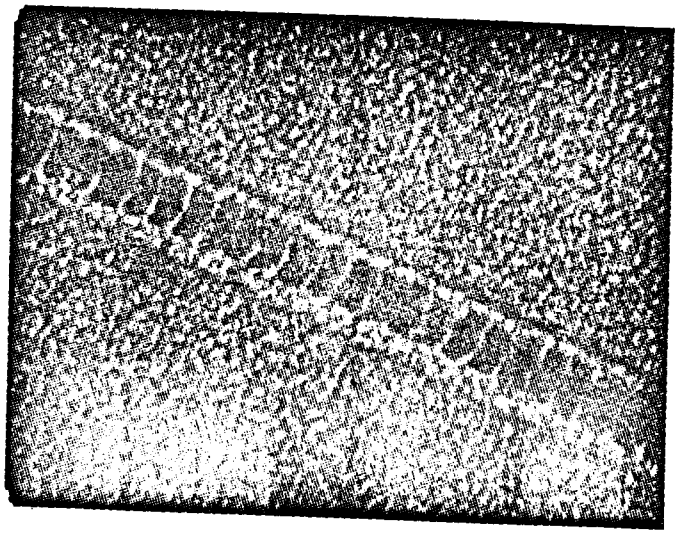
100X

FIGURE 9



Lot # 801004 100X ANGORA FIBER
PALLET 13 PASTE

FIGURE 10



Lot # 801004 860X
PALLET 13 PASTE

I-184 (50M)

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO G.J. Welch AT Nixon DATE June 29, 1971

FROM H.B. Carr AT Burlington COPY TO W.C. Champion
G.L. Lotz
H.G. Morse
M.C. Spalding
M.W. Williams
File

SUBJECT Bastian Bros.

H.G. Morse has requested that we write to Mrs. Redhead of Bastian Bros. disclaiming that vinyl seal caps fabricated from VCH-3101, white, 0.0075" initiates a fungus growth (Rhizopus mold) in face cream. Mrs. Redhead, in turn, requires this letter to convince "Charles of the Ritz" that Hudson Laboratories (opinion of Microbiologist) was incorrect in their conclusion that our vinyl was causing the problem.

As we discussed on 6/28/71, Gerry, the letter to Mrs. Redhead, in my opinion, should issue from your office. While we do not have a pat hand on this one, I feel we can state that our VCH-3101 stock will not initiate a Rhizopus mold, which is a bread mold spore, in face cream for the straightforward reason that our stock is not subjected to bread mold spores in manufacture, packaging or shipping.

After discussing the matter with W.C. Champion, we cannot say that VCH-3101 will not support growth of this mold because, as Hudson Laboratories has determined, it will support this growth. The difference is initiate vs. support. We may say then, that the vinyl seal caps were subjected to mold spores from the face cream which was the initiator and, only, supported the growth. It appears to be a known fact that unstabilized cold cream will promote "bug" growth (R.F. Zutic, Intermediates Division).

A letter of this type may work. However, Gerry, a tough reply to handle would be that -- "hey, we have stabilized our cold cream but when the "bugs" spotted your vinyl they had an easier route and a picnic". In this event, with our hand called, it will be your decision whether to pursue the matter further or to request from R&D that we incorporate a fungicide such as Fungitrol 11 (Intermediates) in the VCH-3101 formulation or utilize a substitute formulation prior to continued sales to this market.

H.B. Carr

HBC/jt

I-184 (50M)

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO M.W. Williams AT Piscataway DATE June 22, 1971

FROM H.B. Carr AT Burlington COPY TO ✓ File

bcc: F.W. Kanzler

SUBJECT Lummus VCM Specs

As you requested, Lummus VCM specs have been reviewed. We propose that the specifications be amplified with additional properties that we consider important and also that Lummus provide answers to a few questions.

Attached is a set of VCM specifications that we consider important in assuring top quality VCM. Comparing the Lummus specs to our specs, it will be noted that the Lummus specs do not include peroxide, oxygen and nitrogen - all of which we consider to be significant requirements. Additionally, light and heavy end impurities are not listed.

The questions raised by the Lummus specs are (1) what are the acetylenic compounds and, (2) what C_4 hydrocarbons are present in minor quantities?

Both the amplification of the specs and answers to our questions are required before we can say that the specs represent a quality level of VCM that we would want to use in our plants.

HBC

H.B. Carr

Attachments (2).

HBC/jt

VCM SPECIFICATION

Property	Specification
Appearance	Clear, free of suspended matter
Color	Colorless, water white
Acidity as HCl	5 ppm max.
Iron as Fe	0.5 ppm max.
Non-volatile residue	0.05% by wt. max.
Sulfur as SO_2	3 ppm max.
Acetaldehyde	5 ppm max.
Acetylene	2 ppm max.
Water	100 ppm max.
Peroxide	0.1 ppm max.
Propylene	3 ppm max.
Propadiene	2 ppm max.
Butene - 1	3 ppm max.
Methyl Acetylene	4 ppm max.
1,3 Butadiene	10 ppm max.
Methyl Chloride	100 ppm max.
Ethylene Dichloride	
2 Chloropropene - 1	
Ethyl Chloride	
O_2 in Vapor	500 ppm max.
N_2 in Vapor	1000 ppm max.

6/22/71

CLUMMUS

5-2328
May 11, 1971

DESIGN SPECIFICATION*
FOR
VINYL CHLORIDE MONOMER
FROM
TRANSCAT PROCESS

	Purity (Dry Basis)		99.9 % VCM
	Appearance		Clear and free of suspended matter
	Water		300 ppm maximum 100
	Acidity, as HCl	ok	1.0 ppm maximum
	Iron, as Fe	ok	0.5 ppm maximum
	Aldehydes, as acetaldehyde	ok	5.0 ppm maximum
	Sulfur, as S	ok	2.5 ppm maximum
	Acetylene	ok	2.0 ppm maximum
*	Acetylenic compounds ?		10 ppm maximum
	1, 3, Butadiene	Good	2 ppm maximum 10
	Non-volatile Content	ok	500 ppm maximum

*In addition to the above specification, the monomer contains minor quantities of C_4 hydrocarbons, which did not affect the polymerization characteristics.

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO See List AT DATE February 19, 1971

FROM Mr. C. G. Thompson AT Piscataway COPY TO

SUBJECT REPORT ON
VINYL CHLORIDE SAFETY MEETING
MEMPHIS, TENNESSEE, 2/10-11/71

Officers in attendance:

Chairman	-	R. Allen	- Plant Mgr.-Conoco
Vice Chairman	-	E. Bealle	- Pantasote
Program Chairman	-	G. D. Schaaf	- B. F. Goodrich
Secretary	-	W.W. Madden	- Firestone Plastics Co.
Treasurer	-	G. B. Speed	- Escambia Chemical Co.

1. First Order of Business:

1.1 Do the members of the Association wish to become a part of the Society of Plastics Industry, on the following basis:

1.2 The SPI will permit our closed meetings per the Association's By-laws, and abide by our rule of not inviting insurance company representatives to attend our discussion meetings.

1.3 It was understood that the SPI have no objection to the Association's By-laws.

1.4 All members present at the meeting accept the concept that the SPI would require a Secretary to be in attendance of all of the Association's meetings.

1.5 It was recognized that the SPI would assume the responsibility of arranging meeting times and places for the Association. This will relieve the load on the volunteers assigned to this work.

1.6 A formal letter will be required from the Association to the SPI, requesting admission to the SPI. This letter must be accompained with a copy of the Association's By-laws.

1.7 It was recognized that, if this plan is accomplished, it will be necessary for all members of the Vinyl Chloride Safety Association to become members of the SPI.

1.8 Recommend contacts in the SPI were:

a. Mr. Jerry Carrol
b. Mr. A. Kling

1.9 It was requested that the cost of a membership to the SPI be made known to the members of the Vinyl Chloride Safety Association. Mr. G. B. Speed of Escambia requested this information.

1.10 It was suggested that a check be made with the SPI to assure the Association that the SPI will accept our meetings with the minutes being closed to all but the members of the Vinyl Chloride Safety Association.

1.11a It was agreed that the newly appointed officers would look into this matter and advise the members (1) of the cost for use of SPI membership, (2) will the SPI accept membership from foreign countries, (3) what procedure will be required for divestiture from the SPI., or from the Vinyl Chloride Safety Association.

b The newly elected officers were requested to perform a survey of the members to determine and identify those who do not belong to the SPI.

2. Mr. D. L. Dowell, of B. F. Goodrich, indicated that the F.I.A. were planning a program to test the effect of a deluge water spray system on Vinyl Chloride and Ethylene Vapor Clouds.

At present, this program does not include the testing of water fog against the vapor clouds. If the latter is desired, it is requested that we make this known via letter to the F.I.A. It was recognized that all participants would be required to advance funds to finance these experiments. The F.I.A. have announced that they will contribute $5,000.00 to this cause.

3. Plant Safety Design:

Leader - J. T. Barr - Airco Chemicals

3.1a Use of a new fire proofing material which may be sprayed on to structural steel. It is called Thermastone and has a 2 hour fire rating with a pressure rating of 75 psf. Airco use this as a fire proof coating.

b Other members indicated the use of two to three inch thickness of foam glass held in place with stainless steel clamps. The foam glass was metal covered.

3.2a Use of Control Rooms:

	Yes	No	Std.Elec.Design	Exp.-Proof Design
No. of companies who use control rms.	16	11		
No. with control rms. on operating flr.	13	11		
*No. with control rms. away from bldg.	3			
No. with pressurized control rooms	15		16	
No. with separate crew in control rm.	1			
No. who use same men to police Kettles & operate the control room	16			
No. of blast-proof control rms.	2			

Note: "*" 1 control room 100 ft. away from Poly. Bldg. at ground level
1 at 60 feet
1 at 300 ft. (Conoco)
Those who have remote control rooms use radio to communicate with with the operators in the Poly. Bldg.

3.2b If control rooms are used on the operating floor of the Polymerization Building (2nd floor) care must be taken to assure a minimum of two exits from the room. At least, one of these exits must provide a direct protection path to the outside of the building. Diamond Alkali experie ced this problem. Their operators had difficulty in leaving the control room safely.

3.3 Difficulty has been experienced in pressurizing control rooms with air free of contamination from Vinyl Chloride Vapors. In one case, a duct 300 feet long was mentioned.

3.4 Pantasote uses a flapper type pressure switch on the exhaust vent from their pressurized control room (John Dyer pressure swithc). When the flap closes, it sounds an alarm and indicates that the control room is no longer under a positive pressure. This has helped to discourage operators from propping the doors in the open position.

3.5 Reinforced concrete blast wall:

Additional steel mesh is required near the surface of the concrete wall. In several cases, there is a hazardous condition created by surface particles spilling off the wall and shooting into space like shrapnel. The use of wire mesh screens about 1/2 inch below the surface will prevent this occurrence.

Most manufacturers indicate that their blast walls consisted of 8 to 10 inch thick reinforced concrete. This design is not normally accepted as a blast wall. It is normally considered a heavy fire wall.

3.6 Flexible Hoses:

A. All producers use stainless steel flexible hoses at the unloading stations. The majority employ a fusible link connected to a spring loaded or pneumatic shut-off valves upstream of the flexible hose. This provides protection against a fire.

B. Several companies, Monsanto and Goodrich, Firestone, do not permit the use of flexible hoses in any other area but at the unloading stations. Firestone do not use flexible hoses on their weigh tanks. They are piped up solid and employ several bends and welded ells to provide the flexibility deemed necessary for the weigh tanks. Goodrich, Firestone and Monsanto claim they inspect their flexible hoses once per month. All claim to test their hoses at least once per year to 1-1/2 times operating pressure. This is a good procedure. I recommend that we follow it.

3.7 Valves:

A. J. T. Barr expressed difficulty with the use of Durco teflon lined plug valves. They have experienced loose liners and have switched to Continental Tufline valves.

B. Several members indicated experiencing the presence of static electrical charges from teflon lined plug valves and teflon seated ball valves. Sparks were reported as existing around the valve.

Airco now check all valves for electrical continuity in the open and closed position. There exists a spring type device which is inserted in the valve bonnet to maintain electrical contact between the plug or ball and the valve bonnet. In Airco's case, the Maintenace shop had ejected the springs and assembled the valves without them.

3.8 Building Ventilation:

For closed buildings, most representatives use the design of 6 to 10 ACH for normal conditions, and 15 to 24 ACH for emergency conditions. We have the only plant with 30 ACH for normal summer conditions, 15 ACH for winter, and 60 ACH for emergency summer conditions and 45 ACH for emergency winter conditions.

4. Emergency Procedures:

4.1 Conoco use the rendezvous system and evacuate their plant within 2 minutes of a leak showing 25% L.E.L. Others allow the leak to go higher prior to evacuation.

4.2 With regard to the use of gas sensors, 5 manufacturers employ diffusion heads (2 are installed, 3 are awaiting installation), 2 manufacturers employ the MSA sequential systems, 7 will install diffusion heads with 2 years.

4.3 Deluge Systems:

A. Approximately 1/2 of the members employ deluge systems. The remainder use the wet type system. One open air structure does not employ any system.

B. Goodrich employ a closed head system and a separate fog spray system. They claim they can raise the relative humidity of the building to 90% RH within 1 minute, if the fog system is energized. It requires 0.10 gpm/sq.ft. of floor area to do this. This is 71.5% less than that required by a deluge system rated at 0.35 gpm/sq.ft. of floor area.

Firestone also do not employ deluge systems, and do not intend to install them. They are insured by the F.I.A.

American Chemicals Assoc., California, do not employ deluge systems. They are insured with the O.I.A.

C. There are films on automatic spray systems. These were recommended for training purposes.

4.4 Evacuating Buildings:

A. Hooker use hand ropes which are permanently mounted in the Polymer Building. In the event of a fire or vapor cloud and a blackout, due to loss of power, the operators are expected to find these hand lines and follow them out to the exits.

B. The remaining members rely on preplanning and practice in evacuating.

4.5 Hooker use pneumatic operated shut-off valves on all VCM lines to the polymerizers. These may be shut-off via manual push buttons. They did not indicate an automatic shut-off feature.

Others employ remote operated valves only for the storage tank areas.

4.6 Short-Stopping:

Agents used - Isoprene, Alpha methylstyrene, and styrene.

Firestone have a separate filled pot mounted on each reactor. They feed the liquid additive to the reactor via pressure equalization and gravity. Each pot is inspected on a weekly basis. The styrene is changed out based on a time cycle which was not greater than 3 months. In the event of power failure, most members advised the use of venting as a means of stirring-up and mixing the styrene into the batch.

At least, one member indicated the use of a dual system and distribution inside the plant. This provides a back-up to protect against a spent agent.

5. Fog Versus Deluge: (R. Schwaab of Allied Chemical & D. Dowell of B.F. Goodrich)

5.1 Allied Chemical employ a full scale deluge system designed for 0.35 gpm per sq.ft. of floor area. They are automatically tied into a diffusion head gas analyzer system (J&W). They use a 15 second delay on the gas sensor before setting of the sprinkler system at 50% L.E.L.

5.2 Allied's air ventilation pattern:

Air comes in at the roof top and goes out at the bottom of each floor.

5.3 Firewater Pumping Capacity:

Allied use: one electric pump at 2000 gpm
one diesel engine driven pump at 2000 gpm
one jockey pump at 30 gpm, with pressure set at 130 to 140 psig

5.4 Their deluge system will not start if the power is off. They do not have emergency power and are dependent on two separate feeds from the Public Utility.

5.5 Their deluge system is tripped by a point temperature sensing device rather than via a rate of heat rise (15°C) H.A.D. unit.

5.6 Goodrich employ a wet type closed head sprinkler system designed for 0.35 gpm/sq.ft. of floor area.

They have backed up this system with a fog spray system designed to deliver 1.13 gpm in a 10 ft. diameter circle. They employ a galvanized water header to these spray heads.

Per NFPA #113, they can obtain 90% R.H. within 1 minute of spraying fog. Nozzle employed - Spray Systems, Inc., 18G46W. Each spray nozzle branch header is equipped with a vokes filter with openings of 0.020 in. These filters may be cleaned in-place. Goodrich believes F.I.A. will accept the fog design.

5.7 Conoco can operate all three open head deluge systems at one time. The remaining members indicated that their design is restricted to handling one building at a time. Most do not have the pumping capacity to go beyond one building. Most members claimed to have spread out their plant sufficiently to provide for gas dissipation, should a vapor cloud occur. This was discussed in vague general terms.

One outfit tried to use plastic tubing for sprinkler headers. This proved to be a disasterous step. The pipe did not stand up under hot summer weather. It sagged between supports and eventually leaked.

6. High pressure water cleaning: (M.G. Glenn, General Tire)

6.1 Approximately 60% of those attending indicated that they used some form of high pressure water cleaning.

6.2 Allied Chemicals reported that initially they had employed demineralized water in their high pressure cleaning unit. This resulted in frequent generation of static electricity. This phenomenon ceased when they switched from Demineralized water to city water, common to their cooling water.

General Tire developed their own high pressure water system using boot-legged second-hand equipment from other plants. Their system is capable of 65 gpm at 5000 psig, but they normally run at 36 gpm at 3000 psig. They employ Orbit and Welco valves and use a model 1900 Hartex spray nozzle. A Micro switch is used to shut-off the high pressure valve in the event of an emergency; i.e., the man must hold this switch closed to keep the pump running. If he releases the switch, the pump shuts-off.

One of their high pressure water contract cleaners employs a foot operated switch. The operator must keep his foot on the pedal to maintain the switch in the energized position. As soon as he releases the pedal, the high pressure pump shuts-off.

D. Dowell at Goodrich recommended that we contact Job Master Industries, Houston, Texas, for novel ideas, procedures and equipment related to high pressure cleaning. This company is in the business of providing service and cleaning equipment and is used extensively by B. F. Goodrich. There was some discussion about the occurrence of static electricity in pipe and headers as the result of water moving through the system. All of the discussion was vague.

It was concluded that the presence of static electricity was possible regardless of pressure or flow. No one would accept the logic that a pressure of less than 3000 psig would create less static than one over 300 psig. The remedy against static was that of adequate grounding and bonding of the pipe.

All members use rubber covered, metal wrapped hoses for high pressure cleaning. All attempt to keep the hose as short as possible. It was recommended that hoses be subjected to full test pressure at least once every three months, and that a recorded visual inspection be accomplished at least once per week. Goodrich again offered its cleaning services via contract to anyone who was interested.

Note 1:

It was recognized that pressures higher than 3000 psig will clean faster and will achieve greater penetration of polymer build-up. Two companiea admitted to the use of 5000 psig.

Note 2:

One company suggested a short blast at the nozzle to generate a fog in the vessel prior to high pressure cleaning. This appeared to be an academic rather than a practical solution.

Note 3:

All members indicated that they do not permit the operation of high pressure water cleaning guns by men located inside vessels.

Note 4:

Goodrich and Firestone claim that they send their men into the vessel after each cleaning to inspect nozzles, rupture discs, relief valves, and thermowells.

Note 5:

Pantasote claim that they are now up to 20 reaction cycles between cleaning by hand or high pressure water. This has been accomplished by formulation and a close control of suspension agents or colloids. If the colloid content is allowed to become too high, they experience build-up.

7. Pressure Vessel & Inspection: (W. M. Iliff - Uniroyal)

All companies check for the presence of explosive gases and the presence of oxygen prior to allowing men to enter their vessels. 80%, maintain written records of these tests for a minimum of 3 months. Pantasote keeps their records for a period of one year.

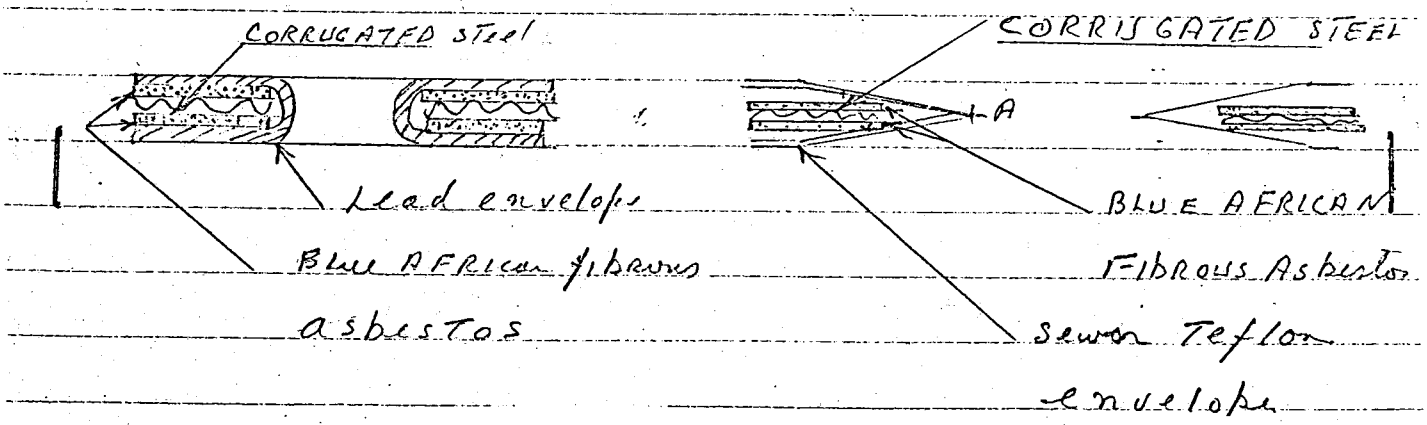
8. Gasketing: (E. A. Rose - Diamond)

8.1a Most companies employ lead enveloped, asbestos filled with a corrugated metal retainer, for gaskets mounted on glass lined kettles.

b Goodrich and Monsanto use Teflon enveloped asbestos filled with a corrugated metal retainer.

c All users of Teflon enveloped gaskets have experienced polymer build-up at the inside edge of the gaskets. Each man recognized that their gaskets were being damaged at this edge by operators attempting to remove the polymer build-up.

d It was noted by users of lead enveloped gaskets, that it is necessary to go back to a new joint and retighten the flange bolts after the joint has been subjected to pressure. Many leaks have occurred by ignoring this rule.



Note 1:

The lead or teflon envelope prevents VCM from entering the gasket and corroding the corrugated steel insert.

Note 2:

In the case of the Diamond Alkali plant, the teflon envelope had been damaged on the inside edge A by cleaners. The metal insert was found corroded.

Note 3:

Rubber plants claim 75% failure on teflon envelope gaskets.

8.2 Gaskets for Vinyl Chloride Pipe Lines:

The most common in use were:

1. Asbestos impregnated with teflon
2. Standard Garlock compressed asbestos.
3. Raybestos RM-700 an asbestos gasket with impregnated with latex.

8.3 O-Rings for Lenape quick opening flanges:

Pantasote and others use Buna-N-Rubber O-Rings. Pantasote now order their O-Rings via lot quantities. They require the supplier to submit typical samples from each lot. These samples are subjected to quality control tests.

1. Visual inspection.
2. Dimensional inspection prior to testing with Vinyl Chloride.
3. Subjected to soaking in VCM under pressure for 24 hours.
4. Dimensional check after soaking.
5. Dimensional check after being allowed to dry out.

Similar checks are made on their Raybestos RM-700 gaskets. Per Pantasote this has cut-down on the many small leaks they were experiencing.

8.4 Black filled polypropylene O-Rings:

Goodrich & Allied Chemicals claim excellent success with this type of ring; i.e., dimensional stability regardless of exposure to Vinyl Chloride.

8.5 Flange Surfaces:

There is a trend to machine the surfaces of glassed kettle flanges to achieve a smooth metal surface to receive the gasket. This is considered better than compromising with a chipped glass surface. No mention was made concerning the risk of corrosion to the flange or around the edge of the freshly cut glass at the join of the flange and the nozzle.

8.6 Checking gaskets:

Diamond Alkali were the only company who indicated that they were replacing all monomer exposed gaskets once per year. It was the consensus of opinion, that this policy would result in more leaks than if the gaskets are left alone. All other members claimed to rely on inspecting gaskets on vessels from the inside. Gaskets are replaced were damage or polymer build-up is encountered.

8.7 Sealing Compound in explosion-proof electrical fittings:

One member reported that they experienced a condition where Vinyl Chloride Monomer began to leak out of Class 1, Group D, Division 1, electrical fittings. He could not explain how the Vinyl Chloride got into the conduit and fittings. He did allude to condensation of Vinyl Chloride vapors. No other member indicated a similar experience.

Note: It was noted that the Vinyl Chloride liquid dissolved the sealing compound used in the explosion-proof fittings. It is requested that we arrange for an inspection of our fittings at both Flemington and Burlington.

9. Spark Sources - J. T. Barr, Allied Chemicals:

9.1 Laboratory Sample Bombs:

Numerous reports have been received concerning the generation of static electrical sparks by those who employ sample bombs without grounding them to the fitting or pipe line being sampled or by venting them to atmosphere without an electrical ground.

In almost all cases, the spark is followed by a fire at the nozzle of the sample bomb. There exists a need for a great deal of training in handling sample bombs and in bleeding samples from pipes and vessels.

9.2 Static Electrical Demonostration Kits are available from Carmody, Inc., and the Bureau of Mines or other such organization. One demonstration consists of a glass cylinder 12" long by 3 inch. in diameter. Into the bottom of this is injected two to three drops of kerosene onto some cotton, sufficient time is allowed to permit the kerosene to vaporize. A copper tube is affixed through the cylinder wall with one end terminating inside the cylinder close to the opposite wall. There is a metal insert in the cylinder near the end of the tube. Three to four drops of water are allowed to enter the tube from the outside and run into the cylinder. The movement of the water through the tube generates sufficient static to set the vapor mixture on fire. The demonstration serves to cause the observer to respect static electricity. There are no limitations to its occurrence. This dispels any theory which may be understood with regard to the use of lower pressure water as a safe cleaning

device against air-vapor mixes. Our best route to safety lies in removing the air-vapor mix prior to using water pressure to clean vessels, etc.

Ethyl Corporation have a trailor type demonstration which is available.

9.3 Clothing:

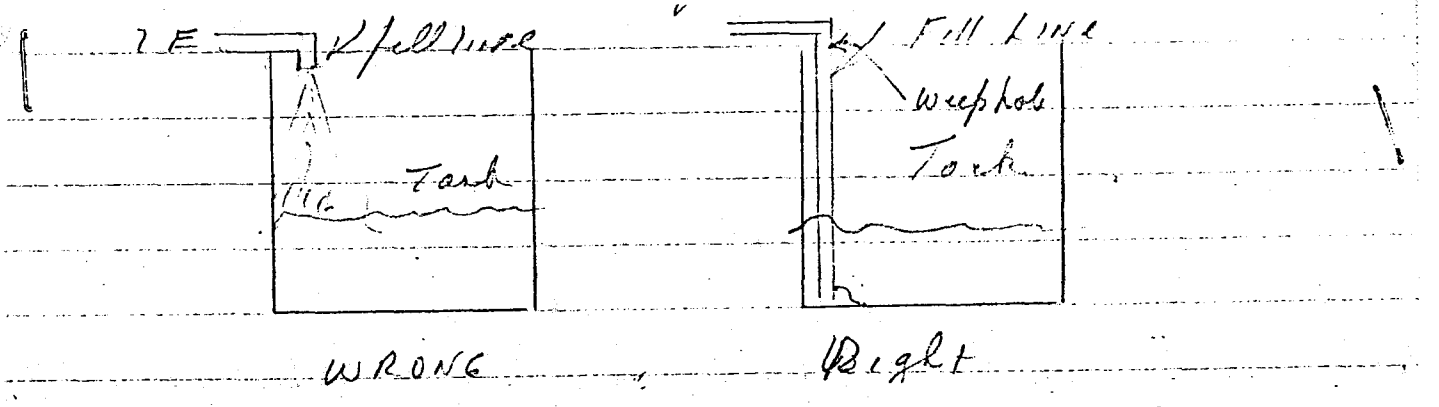
Diamond Alkali had one man severely burned due to his wearing a Ban-lon shirt (nylon wool) which caught fire and continued to burn despite repeated attempts to brush it out. This man was the second severe case as a result of the explosion and fire.

Pantasote supply all workers with cotton uniforms and require them to wear safety shoes, hats and glasses.

Others members are implementing rules against wearing 100% or 50% nylon or dacron clothing.

9.4 Dip Pipes:

The use of dip nozzles into tanks was recommended as a useful design tool for engineers who are attempting to eliminate static generation: i.e.,



9.5 Lightning Arrestors:

Airco use these extensively. One other member has some. The remainder have not employed Lightning Arrestors. No one could offer a good reason as to why not. Airco feel that these systems have saved their plant at Calvert City, Tennessee, on several occasions.

Vinyl Chloride Safety Meeting
Memphis, Tennessee, 2/10-11/71

February 19, 1971

10. Reports on Accidents:

10.1 Conoco - VCM Plant - Lake Charles, Louisiana:

A Continental Tufline plug valve was installed with an indicator that was 90° out of phase with the plug. They had a plugged Vinyl Chloride line. A check valve was removed from the line, leaving the plug under pressure from a Vinyl Chloride source and open to atmosphere through the open body bonnet of the check valve. The plugged line let go and Vinyl Chloride monomer poured out. The result was a large spill and the vapor cloud drifted toward a nearby cracking furnace and ignited.

A. This problem could have been avoided by applying good safety practices which would prevent opening lines prior to valving off, depressurizing and securing same.

B. It points out the need for a quality control inspection on all items received. A proper inspection of this valve would have discovered the fault.

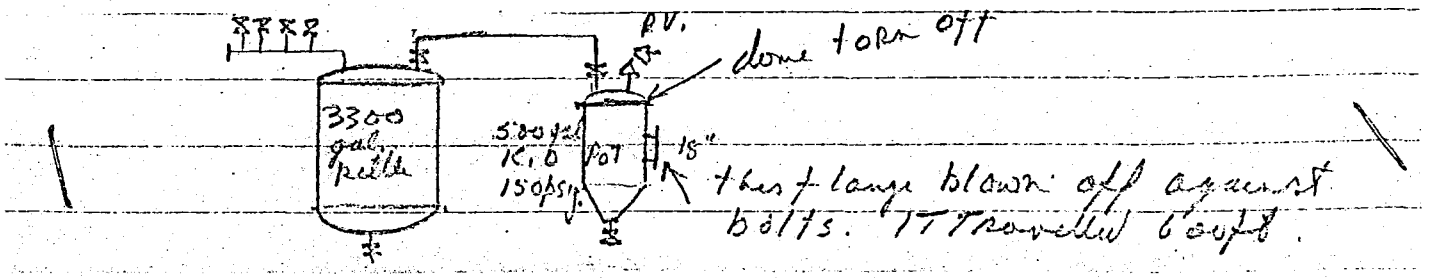
10.2 Another member reported that a spill occurred in a polymerization building. The building was evacuated. After a waiting period of 5 minutes, the men returned to the building. There were two driers in the building. These driers sucked in the air-vapor mix and static at the bag collectors ignited the mix. The ensuing explosion and fire killed 5 men. The sprinkler risers in the building were blown off at the ground by the force of the explosion. (This sounds similar to the Thomson fire in Massachusetts 1965),

10.3 Goodrich - Mexican Plant:

A 3,300 gallon polymerizer was over-charged with monomer. Catalyst had already been added to the charge. To correct the situation, the newly hired, uneducated operator, vented off a portion of the charge to a recovery knock-out pot, rated at 150 psig, 500 gallon capacity. When he had reduced the charge in the kettle to the proper level, he valved off the kettle and the recovery knock-out pot.

After a period of from 3 to 5 hours, the 18 inch manhole on the recovery knock-out tank blew off and travelled 600 feet. The top dome of the recovery pot was also blown off, literally forced off the vessel cylinder

All fire extinguishers and equipment were on the bottom floor, the building was not sprinklered; i.e.,



No one was killed, one kettle was damaged, the recovery knock-out pot was destroyed. Other items which occurred:

1. The operator ran to the roof and had to slide down to the ground via a vent pipe. There was only one exit ladder provided from the roof and operating floor. The fire was located such that he could not get to the exit.

2. The relief valve was not adequate to handle the run-away reaction which occurred within the knock-out pot.

3. The newly hired operator had not been trained sufficient to understand his work. He had also not been educated in his safety procedures and escape routes.

4. There was no water hose or fire extinguishers on the operator floor or roof.

Note: Per D. Dowell of Goodrich, Black and Sivall provide a manual which covers the design of rupture discs for explosions such that the final pressure in a vessel will not be greater than 7 times the working pressure. This may be used to prevent vessels from being destroyed completely via over-pressuring.

10.4 Diamond Accident - July, 1970:

Plant designed and built in 1952, operated in 1953. It was given a thorough safety check and was an open structure. The day of the fire, the weather was calm. A gasket on a 2,200 gallon polymerizer failed for an approximate length of 11 inches. The gasket was a sewed teflon envelope over two layers of fibrous asbestos filling with a corrugated steel insert in the center. One man with short sleeves was burnt on the arms.

One man, the bagger operator in the dryer building was killed via the fire which occurred in the building. This building, some 90 feet tall, is located next to the polymer building. It is under negative pressure due to the operation of a cyclone and bag collector located in the tower. There were louvered openings on the building wall facing the polymer building.

When the vapor cloud formed, it was sucked into the drier building were it exploded and burned. The flash caught the bagger who was working at his job.

10.5 The tower wall siding was of transite. The cause of ignition was attributed to static electricity as the gas escaped from the kettle. Reconstruction included sealing off this wall from the Polymer building and a more frequent replacement of gaskets. The maximum period for a gasket is now 12 months. Diamond have formed a Safety Investigation Committee to review all aspects of the plant.

Vinyl Chloride Safety Meeting
Memphis, Tennessee, 2/10-11/71

February 19, 1971

11. Evacuation of Plants:

11.1 10 Companies go through their emergency shutdown procedure once per year.
6 Companies use simulated tag out procedures or dummy-runs.
1 Company, Pantasote, checks out all its emergency procedures and trips prior to start-ups following holiday shutdowns or maintenance turn-arounds.

11.2 All Company representatives agreed that a head count, following a practice or real evacuation, is justified. Two representatives reported near fatalities which were prevented only as a result of head count at the rendezvous area.

11.3 Bomb Scares:

A. In general, most plants attempt to play-down a bomb scare. It is best not to put on a show of evacuating immediately since this provides satisfaction to the person who has generated the scare and will encourage him to do it again.

B. Most plants expect their supervision and volunteers to remain on the plant and search for bomb. If evacuation is decreed, they expect supervision to remain to effect an orderly shutdown.

C. Instructions may be obtained from:
1. The Army
2. Local police
3. State police

D. If the scare is by phone, hold the phone as long as the caller will remain connected. Go to another phone and attempt to have the call traced, if time permits. The receiver of the call is required to exercise some judgement as to the serious intention of the caller. The writer questioned this last statement. Who is capable of making an experienced judgement in this situation? Answer - I don't really know.

E. Again the use of short stop agents may be necessary if a full halt is decreed; i.e., styrene, hydro-quinone, full cooling, brine chilling, e tc.

C. G. Thompson

CGT:rmr

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO M.W. Williams AT Piscataway DATE March 10, 1971

FROM H.B. Carr AT Burlington COPY TO File

SUBJECT Shell VCM

Reference: Letter: D.E. Haupt (Shell) to M.W. Williams, 2/4/71

Shell's request to establish a nitrogen specification with a sliding scale to 10-15% in the event Shell has to nitrogen purge tank cars is not acceptable.

The problems that would be presented to us by high nitrogen levels were previously reviewed with G.I. Rozand, P.R. Scarito, H.H. Duhamel, C.G. Thompson and N.J. Quist when PPG specifications were being established. The consensus of opinion is:

1. Cars are unloaded such that vapors (including the nitrogen) would be blown through and into our storage tanks. The cars are then brought to a 6 psig "heel" with monomer for the return to the supplier. The build-up of nitrogen in our storage tanks from cars containing the exceptionally high 10-15% nitrogen that Shell mentions would eventually require venting if storage tank pressures build up beyond a safe operating level. The normal pressure level is 20-60 psig with a pressure release set at 150 psig. Since safety and operating considerations would be involved in venting storage tanks, a cost of ca. $10M+ would be required to install an appropriate refrigerated condensing column with valve and vent controls. Operating manpower costs would be required as well.

2. With nitrogen levels at the 10-15% level, the best bet would be to vent the tank cars prior to unloading. Once again, however, Tenneco would have equipment and handling costs.

3. In view of points 1. and 2., it is apparent that Shell should perform whatever steps are necessary to maintain nitrogen at 1000 ppm max in the tank car vapors including venting if required.

4. In discussion with P.M. Reed, Houston has not had problems with inadequate heels from the Plastics Division for the past two years. This may be attributable to our increasing heels from 6 psig to 8-10 psig. Plastics' gets an 1100 lb. VCM credit for heels. Again, according to P.M. Reed, THC shipments have contained normally less than 0.1% nitrogen over the years.

5. Notwithstanding point 3., our procedures for maintaining proper heels should be reviewed by Manufacturing and Engineering (in my opinion).

Based on the above considerations, our reply to Shell should be:

1. Tank cars containing 10-15% nitrogen in the vapor phase would cause severe handling and process problems in our plants and hence, would not be acceptable.

2. Tenneco will make every effort to maintain a 5 psig heel of VCM vapor. This has been done successfully for the Tenneco Hydrocarbon Chemicals Division for several years.

3. Should a 5 psig heel prove inadequate due to variable temperature between Texas and New Jersey, the heel will be increased to 10-12 psig with an appropriate increase in heel credit to Tenneco.

4. Based on these considerations, Tenneco must insist on a 1000 ppm (by volume) maximum specification for nitrogen in the vapor phase of the tank cars.

A letter has been prepared for your approval and signature.

H.B. Carr

HBC/jt

TENNECO Chemicals, Inc.
Plastics Division
P.O. Box 116
Burlington, N. J. 08016
609-386-9200

March 10, 1971

Mr. D.E. Haupt
Shell Chemical Company
One Shell Plaza
Houston, Texas 77002

Dear Mr. Haupt:

Thank you for your letter of February 4, 1971 concerning specifications for vinyl chloride monomer. We are pleased that you have accepted our specifications for oxygen and "heavy ends", both of which we consider important.

We consider the 1000 ppm (by volume) maximum nitrogen specification to be equally important for storage, handling and polymerization reasons. Tenneco appreciates your concern that tank cars with off-specification "heels" may require additional handling procedures. Over the years we have worked closely with our Tenneco Hydrocarbon Chemicals Division and have developed procedures that assure specification heels on returning tank cars. For this reason, our Tenneco Hydrocarbon Chemicals Division has shipped monomer consistently meeting the nitrogen specification.

In spite of this record, should Shell receive a tank car with an off-specification heel due to an ambient temperature difference between New Jersey and Texas, Tenneco requests that after nitrogen purging, the tank car is purged with vinyl chloride monomer to bring the nitrogen level within the 1000 ppm specification. Vinyl chloride monomer used for this purpose would be credited to Shell. At this time to preclude a reoccurrence, Tenneco would increase the heel to 10-12 psig with a companion increase in heel credit to Tenneco.

We trust that this recommendation will be acceptable and will enable Shell to meet the nitrogen specification. With our assurance of continued cooperation in this matter, we remain,

Very truly yours,

TENNECO PLASTICS DIVISION
Tenneco Chemicals, Inc.

M.W. Williams
Vice President
Research and Development

MWW/jt

INTER-OFFICE MEMO TENNECO CHEMICALS, INC.

TO Members - Divisional Safety Council AT DATE March 30, 1971

FROM P. L. Bogart AT Flemington COPY TO

SUBJECT Federal Occupation Safety and Health Act

1. This act will take effect nationwide on April 28, 1971. It will effect all commerce in the United States and contains no "grandfather clause" so that it applies to industrial properties without regard to their age or condition.

2. It is primarily a labor relations bill rather than a safety bill and its primary impact will be felt in the field of labor relations. Union representatives throughout the country are already attending seminars and work shops to alert them to the provisions of this bill.

3. There are two general employers provisions in this law. One "to furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing, or are likely to cause, death or serious physical harm to his employee." Two "comply with occupational safety and health standards promulgated under this act."

4. It is expected that the primary impact of this law for those companies such as Tenneco who are already sophisticated in safety and health management will be with regard to health matters, rather than specific safety; and to union-inspired complaints. The chief thing we must avoid doing is yielding to the temptation to lessen our present stringent voluntary efforts at real safety, (that is correcting items that we feel of primary importance) and concentrating at merely staying out of trouble within the law by taking care of those minor items most likely to be brought up by the employees.

5. On the other hand, we will not be able to set priorities which ignore items brought forward by the employees or which set forward correction of such items for an unreasonable length of time.

6. The law will work as follows: Federal Inspectors have the right to enter the plants at any time either on their own, or in response to a request by an employee, either to make a general inspection for compliance or to investigate a specific complaint or both. Any advance notice of such an inspection carries with it a $1,000.00 fine. The employee representatives have the right under the law to accompany the inspector on his rounds and the employer must permit the employee representative to discuss the inspectors findings with the inspector privately. During the inspection itself, the employer may (and obviously should) have a representative knowledgeable in the process accompany the inspector and the employee guide. Since we will receive no warning of such inspections before they occur, each plant manager should determine one person and at least one alternate who will automatically accompany the inspector upon his arrival.

If in responding to an employee complaint the inspector finds that the item complained of is indeed legitimate he will issue a citation to the employer requiring that certain corrective actions (to be spelled out at that time), be taken. This must be done within a time limit set by the inspector at the time the citation is issued. It is imcumbent upon all of us to be prepared to discuss such corrective action and time limits in a fashion calculated to inspire the inspector to allow us as much time as maybe considered reasonable for correction. If an item is found to be a imminent hazard, which could reasonably be expected to cause death or serious physical harm, either immediately or before the imminence such danger can be eliminated through enforcement procedures otherwise provided the inspector may obtain an injunction in local court requiring the shut-down of that particular operation. The bill as originally proposed contained a clause which would have permitted immediate on-the-spot shut-down by the inspector. This clause was modified to the present one through lobbying by Tenneco and virtually every other major industry in the country.

7. The standards referred to for compliance will at present include virtually every major standard now published. For instance, it will include all the National Fire Protection Association national fire codes a series of books which take up some 15 inches of shelf space by themselves. It will inculde all the American National Standard Institute Standards which apply to any of our operations and it will include virtually everything now under the Walsh-Healy Act. Additional standards will be coming forth from the Department of Labor on a regular basis since the Secretary of Labor has two years from April 28, 1971 to formulate a complete set of National Standards. At the moment the toughest standard in any case applies whether it be National or State.

8. The impact of this upon Tenneco operation in New Jersey is not that we may expect far tougher standards than those we now comply with, although this will be true in our operation in Massachusetts and Illinois. What we may expect is that the mass of data in the applicable standards is so vast that we cannot reasonably expect to comply with everything all of the time.

9. Citations. We may in light of the above, therefore, reasonably expect that we will receive citations from time to time since the law provides that the inspector, should he find us not following some particular standard, however obscure, has no recourse other than to write the citation. There is in short no verbal correction request, there is no temporary correction time, etc., as is currently the policy with insurance inspectors and the unofficial policy with state inspectors. The citation once issued must be posted as near as possible to the section of the work place where the violation occurred and must remain there for the employees to view until the citation is corrected. Fines for noncompliance do not take effect until after the end of the period the employer has been given to effect correction, thus again, the importance of working out this time with the inspector at the time of inspection. Additional more severe fines may, of course, be levied for "willful" violation of standards, rules, or orders under the act. There are also criminal penalities for a willful violation which subsequently

leads to the death of an employee. The penalty section is not gone into in detail in this report since with reasonable action on our part we should be able to stay clear of the penalties sections. It is interesting to note in this regard that where penalities are imposed, senior official of the plant involved is spelled out in the law as the person against whom the fine or jail sentence must be levied.

10. Industrial Hygiene. As stated previously, the new law will give particular impact to items that have formerly been covered only under the Walsh-Healy Act. Specifically in our case noise control and dust control. It is expected within the next year the permissible noise levels current under the Walsh-Healy Act will be reduced and these will, of course, become the Federal Standard. It should be noted that under Walsh-Healy personal protective equipment, such as ear muffs and ear plugs may be resorted to, to protect the worker from noise only after all reasonable attempts to ameliorate the noise through engineering methods have failed. Similiar considerations may be expected to apply to dusts. We have already been informed verbally by State Inspectors that it is expected that the State of New Jersey will soon change the permissible micron size involved in determining a respirable dust and that these changes will affect us by including some dusts produced in our plant which are now not considered as respirable dusts. These items are cited as examples at this point. Details of suggested preventive programs will, of course, be forthcoming from this department.

11. Record Keeping. The law will require certain specific records to be available to the inspector on his inspection trips. Generally, as far as can be determined at this time, the type of records currently being kept on reportable accidents will suffice for this purpose. There is, however, a special log sheet which will have to be kept and which will be distributed to the plants. This type of sheet is already being kept by this department but we will not, of course, have it available from here at each plant where the inspector arrives, so that each plant will have to keep this simple log themselves. Annual records and annual reports may be kept by the Divisional Safety Department as they are not required to be produced at each inspection. An entirely different method of recording accidents will be part of the new law, although it will not become effective immediately. Starting retroactive to January of this year this department will maintain records both under the old accident frequency -- accident severity system now in use by Tenneco and under the new system. The key feature of the new system is that there is no record of severity as such. An accident thus becomes an accident and if a medical reportable becomes a recordable accident. The concept of light-duty, the concept of days charged, for specific injuries, will both be eliminated under the new regulations. Also eliminated under the new regulations will be all the current dispensations and special circumstances under which certain accidents such as hernias, certain types of falls, etc. have to date not been chargable. An accident, if work-connected, will become a recordable accident.

12. Inspectors. States such as New Jersey which already meet Federal criteria for inspection standards have the option to request funding from the Federal government and then to make the inspections with present staff. New York has already made this request. As of this date New Jersey has not, so there is a question as to whether Federal employees or State Inspectors will be making the initial inspection. In Illinois and Massachusetts, which do not currently meet inspection standards, Federal employees will definitely be making the inspections. The employees to be trained for this work will obviously not have the technical background in the chemical and related fields we have become

used to from state inspectors. Several items are, therefore, of particular importance in dealing with this group. (A.) Housekeeping: The initial impression of the condition of the plant which the inspector receives as he walks through the gate can make or break the entire inspection. If the grounds, building areas, are a mess, if there are accumulations of resin, dust, scrap, etc visible, he will undoubtedly receive an unfavorable impression which will lead him to dig as deeply as possible for a specific violation. On the other hand, a clean well-ordered, obviously a well kept plant while not leading to over-looking to a specific violation can, however, set a favorable tone for the inspector at the outset. (B.) Employer - Inspector Relations: Providing a well-trained supervisory level person to accompany the inspector and the employee representative, one who is fully knowledgeable of the processes as well as the materials to be used in the plant, can be our most valuable asset. The worst thing we can do with an untrained or partly trained inspector is to be unable to give him direct specific answers to any specific question he may have regarding the process. It should be understood that he will be asking questions particularly in relation to the toxicity or other hazardous properties of material which we may be using. (C.) The Employee Representative: The employees will be aware that their representative (probably a shop steward) is to accompany the inspector and has the right to discuss the findings with him privately. The utmost cordiality toward this group, coupled with a good working cooperative understanding prior to the first inspection is essential to prevent excess "griping" and/or "nitpicking" by the employee representative.

13. Self Inspection: Self inspections by both employers and employees of the premises and pre-federal inspection correction of the deficiencies found is provided for in the law and although the specifics of this section are still unclear it is quite possible that at some time in the future this type of joint inspection will be a requirement rather than a suggestion. It is to our advantage, therefore, to continue the type of union-management joint inspection teams now in use at several of our plants, and we should consider extending these inspections to those plants that do not now hold them under contract. Obviously, it is better for the employee to bring items to our attention when they are correctable on our own schedule rather than waiting for him to bring them to the attention of the federal inspector. It is equally important that items raised on such inspections be given priority of repair. This last applies equally to the items brought forward by the employees in the Shift Safety Meetings. This is not to say that such items must receive priority in advance of essential items directly effecting an immediate hazard. It is to say that such items can not be tabled or given a low priority since the employee now has the right, under Federal Law, to request directly to the Department of Labor an inspection to bring citations for any item which he feels is detrimental to the health and safety of the workers in his department or plant.

14. Summary. Firms such as Tenneco which already have employee oriented effective safety programs have nothing to fear from the new law. There are, however, a number of points which management must keep in mind in considering the impact of this regulation. These include: (A.) An increased concentration on an interest in solving problems related to worker-health such as noise control, dust control, control of toxic substances, etc. (B.) Maintaining every plant in this division in such a condition of housekeeping that we would welcome a federal inspector at any hour of any day. (C.) Increased priorities toward correction of items brought forward, whether in shift meetings, during joint inspections, or individually by the employee. It must be realized that since the entire national program will begin on April 28, 1971 with only 173 inspectors initially, inspections may be excepted to take place on a basis entirely of employee request. That is to say, at the beginning of the program

the Department of Labor does not expect, accept in the worse cases, (such as the mining industry and portions of the construction industry,) the inspectors will be picking their "targets." They will almost exclusively be responding to request by employees. It is obvious that our best weapon against having such requests lodged with the Department of Labor is to correct the items the employee brings forward on our own before it becomes necessary for him to report them. (D.) Given the complexity of regulation to which we will be subject we must realize that it will not be possible to operate entirely without receiving any citations. It will, however, be possible given some of the ideas listed above to avoid penalities for such citations and to correct the items cited well within the time limit assigned. This department will, along with the Corporate Safety Department, make every effort to keep the plants informed of specific sections of the standard which may be expected to come under the inspectors scrunity. We will also have available as full a set as possible of each of the standards involved, so that should a question arise regarding an employee complaint, it can be determined immediately exactly what needs to be done to comply with the standard in question. (E.) It will become more than ever of vital importance that we maintain an excellent safety working relationship between plant management and the employee. Any feeling on the part of the employees that management is dragging its feet can only result in complaints to the Department of Labor which will involve unnecessary problems for both management and worker. The labor relations and personnel departments of the plants will, therefore, play an ever increasingly vital role in the direct safety program.

15. Supervisory Advisory. As soon as comments are received from the members of the Divisional Safety Council and such other persons in plant management as may wish to comment we will arrange meetings, seminars, etc. at the plant level with all members of direct line supervision to acquaint them with the primary facets of this law as outlined in this memorandum. The union will be prepared with full knowledge. It is essential that our line supervision be as knowledgable. This program will go forward as quickly as possible after your comments and suggestions are received.

P.L. Bogart
Safety Manager

PLB/sr

I-184 (SCM)

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO See List AT DATE November 18, 1971

FROM P. L. Bogart AT Flemington COPY TO B. Bonner, D. Rhoads, C. Thompson, G. Rozand, P. Scarito, A. Siegel, M. Wagshul, J. Zullo, A. Silverberg, W. Heal, R. Mathis, H. Snyder, N. Quist

SUBJECT Conference Notes - Vinyl Chloride Safety Association Safety Committee

The Vinyl Chloride Safety Association Safety Committee met in Rochester, New York on November 10, 11, and 12th. Items discussed included:

TOPIC SUMMARY

General

Mr. Thompson, as Chairman for 1971, opened the meeting noting our international flavor with members present from Norway, England and Mexico. The minutes of the last meeting were read and approved. It was noted that Air Products and Escambia had combined their representatives as one single membership. Twenty-seven members were listed on the official roster with two potential new members.

In the business it was decided that because of the fact that it would mean open meetings and open minutes we would not affiliate with either the SPE or the SPI. This decision was unanimous.

Catalyst Handling

This proved to be by far the most popular topic and almost the entire morning of the first day, as well as the entire afternoon, was devoted to methods of safely storing and handling catalysts, in particular fast catalysts. The speaker heading the group noted that the choice of a catalyst depended almost equally upon process economics and safety of handling. It appears that a number of firms have not gone to IPP even though it is an extremely fast catalyst because of the hazards and potential hazards in storing and handling this material. Goodrich reported that they have a comprehensive catalyst handling manual. This manual is based upon a grading system by hazard classification. The classification used is that used by Factory Mutual in their 1969 Bulletin Number 7-8. It was noted that there is also an AIA classification system and that there is an NFPA classification system for reactive chemicals although not specifically for organic peroxides. It was reported that the NFPA is currently working on a national standard classification system and it is expected that this is the classification that will be adopted under OSHA.

Goodrich in their manual, has noted the following headings for classifying catalysts for operator training. The manufacturer, the manufacturing name, the diluent if any, the concentration used, the physical form used, the melting point, the storage temperature and the hazard classification. (Note: It is felt that the fire characteristics, explosive characteristics, and fire fighting techniques should be included on this sheet at such time as we prepare such a sheet.) Goodrich uses the Factory Mutual distances to determine

distances from other buildings, roadways, etc. for storage. It should be noted as above that these are different from the NFPA distances which are currently in use by Tenneco. It was noted by the members that most feel that manual monitoring of the storage temperature at stated intervals is necessary. In short, it is not sufficient to depend upon alarms, lights, etc., to note low temperatures in that such alarms are generally set at a point where we have lost a good deal of time in taking preventive action after refrigeration has begun to drop. Logging of temperatures at regular intervals is recommended as well as spelling out specific steps to take should the temperature begin to go down.

Charging of Catalysts

Charging of catalysts was discussed at length. The primary conclusion was that whatever method is used to charge the catalyst, it is essential that the catalyst never be completely confined, as in a charge bomb, unless the vessel in which it is contained is equipped with a rupture disc or similar device. The second most important caution was to prevent monomer from returning to the catalyst at any point in the charge equipment. It was noted that it was extremely important that the operators be fully trained with regard to catalyst handling, particularly with regard to charging delays. There should be specific times beyond which catalyst once removed from refrigeration cannot be charged, but must be destroyed. There should also be specific lengths of time during which catalyst may be set aside after removal from refrigeration preparatory to the actual charging into the batch.

During this discussion Mr. Thompson raised the specific question of what experience others had had with operators in this regard and Mr. Hahn suggested that we might use a time clock showing each occasion on which catalyst was removed from the shack and the time which it was charged to determine whether or not we had a problem in this area. Others commented that they had had problems regarding operators removing materials from primary storage and putting more than one shift worth in secondary storage. All felt that rigorous training and supervision was the only answer to this problem particularly on the off shifts. With regard to intermediate storage it was emphasized that storage facilities such as explosion proof refrigerators must have only magnetic latches or some other type of explosion relief latch since we depend upon the door itself to provide explosion relief. In no case should such doors be secured with any kind of positive latch. This applies to freezer lockers whether vertical or horizontal as well as to refrigerators. It was agreed that secondary storage, that is temporary storage of one shifts' worth of catalyst, between the permanent storage and the reactors must be either in a separate explosion proof room within the building or preferably outside the building. It was recommended that refrigerators and freezers alone never be on the operating floor itself without the protection of a specially built and vented room. One member reported that they use a refrigerated charge bottle in charging the reactor. Two members recommended the use of a pump and a special container to insert the material into the reactor.

The question of container disposal was discussed at this session as well as in the later session with Lucidol. It was agreed by the manufacturer and by the group as a whole that it is not necessary to flush out the bottles with caustic solution. That in fact, the caustic solution use is in itself a hazard. The recommended practice is to thoroughly flush the bottle with water and then to slit or cut the bottle to prevent any possible reuse. It is felt that once the bottle has been slit or cut in this matter it may safely be disposed of in the ordinary trash. It was agreed that under no circumstances should catalyst bottles once removed from refrigeration be put back into refrigeration. Several members reported that this could create a particularly dangerous situation, since once the bottle reaches a certain temperature auto decomposition has already begun, and will not be completely arrested by re-refrigeration.

Lucidol Visit

The visit to the Lucidol plant conducted in the afternoon and evening of the first day is reported on here rather than in chronological order.

It should be noted by all concerned with the handling of catalyst that the entire manufacturing facility from which this material originates is designed and operated as a high explosives plant. The material itself is made within cells having 18" thick walls, observation ports, etc., with all controls remote from the actual operating area. All buildings are located at distances conforming to those for the manufacture of high explosives, systems are equipped with high pressure, high volume deluge systems, storage facilities all the features of the primary storage facilities at Burlington and Flemington and every precaution is taken during the manufacturers handling and transportation of the material to insure that high explosive standards are met throughout.

Lucidol recommends that goggles or face shields and gloves be used in the handling of catalyst. This includes the type of catalyst being used by Tenneco plants. Safety glasses alone are not considered sufficient protection as the material in use is a strong eye irritant.

The question was raised as to whether or not there was a hazard of accumulating flammable vapors from the hydrocarbons used as a diluent for the catalyst while the material is in primary storage. It was Lucidol's feeling that if the doors of the storage building are opened for normal entry and exit two to three times in a twenty-four hour day, this should be sufficient. It is intended by our Engineering Department to pursue this matter to the point where we are able to obtain some specific figures on vapor accumulation to insure that no hydrocarbon vapor hazard per se exists in primary storage.

Lucidol recounted the details of two incidents which had occurred at their plants. In one of them, some material became trapped in the process piping, auto ignited, and flashed back to the manufacturing reactor which they detonated, gutting the cell in which the process was being undergone. In the second incident fire destroyed a storage facility when several bottles of IPP were inadvertently placed in storage before the center of the material had completely cooled. Auto decomposition then took place. Lucidol explained at length the precautions they had taken to prevent reoccurrences of both accidents.

Films were shown including the training film which has already been shown to the employees of both resin plants. Additional films included 8 mil. films taken at Genneseo test grounds showing spontaneous auto ignition of IPP and 228 and auto decomposition without auto ignition of 225 and 223. It cannot be emphasized too strongly that the fumes given off in a visible white vapor cloud by decomposing 223, 225, and 228 are highly flammable in their vapor form should they strike any outside source of ignition, even though except for IPP and 228 auto ignition of the vapor phase does not normally occur.

Lucidol and a number of firms noted that they use liquid nitrogen piped directly into the storage facility as a backup method of maintaining temperatures in case of compressor failure. Most firms rely on the addition of dry ice to the facility as their method of backup.

A discussion was held of approved disposal methods of spilled or over-aged catalyst in view of the fact that the presently recommended method by burning is now forbidden in most states in the United States. The technical director of Lucidol advised that disposal could be affected by hydrolisis or by decomposition in an open area. Decomposition method while much slower than that of burning is considered satisfactory in that residues in quantities sufficient to cause ground or water table pollution are not expected to result.

Lucidol reported highly successful use of a Carmody simulator to train their operators in plant operations. The question of a proper sizing of rupture discs for containers of stored catalyst was again raised and Lucidol stated that they had to date found no specific satisfactory sizing. It was noted in examining one of their transportation containers that the rupture disc used is virtually the entire size of the top of the container. In response to a question upon classification of catalyst as to hazard, they stated that such classifications have been agreed upon by the manufacturers of catalyst and will eventually be published, probably next year. They are currently understudy by the Department of Transportation. This will afford the highly desirable single classification rather than the present varying classes from NFPA, DOT, the manufacturers, AIA, and others.

Welding

It was noted that most welding accidents happen as a result of attempts to take short cuts from hot work procedures, during shut downs or other periods when it is assumed that the plant, since it is not operating is "safe." One member reported such a case which resulted in a severe fire because of a hidden cross connection.

The members felt that the hot work permit in universal usage is considered as a preliminary step toward safe welding or other hot work procedures. It was emphasized that their must always be discussion between operating and maintenance personnel prior to doing any such work, so that there is full knowledge on both sides what is to be done, when, and how. It was also emphasized that maintenance must be given a thorough knowledge of the area in which they are to work and of adjacent hazards and not merely of what is going on in the equipment that they are specifically working on.

Further to hot work permits, it was noted that only production supervision should issue a hot work permit with the cooperation of maintenance supervision, but that in no case should such permits be issued only by Engineering. This was particularly emphasized in the case of contract work where staff engineers may be working with contractor personnel not directly under the supervision of plant engineering.

Most reported that they use only certified welders particularly in terms of pressure vessels or piping. This applies to groups using general classification of mechanic as well as those having a specific classification of welder. It also, of course, applied to the hiring of contract welders. Even among those who do not strictly adhere to this practice at this time, it was agreed that it is the only safe way to proceed whether state regulations require it or not.

One member reported and several others agreed on the use of work electrode over-voltage relays in plant arc welding equipment. The question was raised as to whether anyone present permitted hot tapping within their plants and none did.

Operator Training

This subject was discussed at considerable length with a great deal of comment and illustrative anecdotes from the various members. The member presenting the original paper discussed maintenance training. He stated that the training program in their facility went through four phases, a start, a deterioration, an evaluation, and a retraining. They started with a good program having hired 100 out of 1000 applicants for craft positions. They felt at that time that craft training was not needed since the mechanics were well trained in their individual crafts and concentrated on training on the processes. As production increased and manning decreased many new men entered the maintenance department largely by seniority. It was found that there was poor record keeping, the work order system had become extremely slack, there was a poor parts inventory, no preventive maintenance as such, many "temporary" lines had been strung for various purposes and then left intact, and they suffered from excessive overtime and an excessive number of grievances. In correcting this situation they felt that if they trained the mechanics they must change the operators policy to admit the new skills the mechanics had acquired. Particular emphasis was again given on full cooperation and coordination between the mechanical and operating departments. Some of the methods used in achieving their new system were a complete review of record keeping with regard to maintenance; a complete preventive maintenance program actually adhered to, and the use of contract language to insure skills; (These were set by developing standards on the skills of the existing men.) They also increased the number of men in the maintenance department. They undertook a 12-week training program initially. This consisted of three hours per week per man on overtime. They included in their training a critique of the actual costs of maintenance within the plant including the costs of excessive overtime and so forth. At the start of the program they outlined their goals to improve their labor material ratio and to improve their safety. By reviewing the basics of maintenance management operation with the mechanics themselves and by giving full attention to the program they were able to improve their

labor to material ratio from 69¢ material to $1.00 labor to $1.22 material to each dollar of labor. Their program includes a negotiated six, twelve, and eighteen month progression program. The mechanics are tested at these intervals and if they pass the test they then progress to the next grade of pay. If they do not pass the test they are retested in 30 days. If they do not pass in 30 days they are then dropped back to their former catagory. In this system they reach full rate in 42 months. They also encourage the mechanics to take high school and vocational education courses on their own time. A large number of their men have taken advantage of these courses to improve thier skills and thus to reach better paying positions within the mechanical force. They emphasized that a special training program was necessary since it is impossible to adequately train this type of personnel during the normal routine work day, since there are always projects which interfere by order of priority with the training.

This entire program and its success was very well received by the members with particular note that men trained this way feel that they are being advanced by knowledge rather than by favor. The program as undertaken has reduced unscheduled maintenance overtime to 2%, has reduced the number of major breakdowns and has virtually eliminated the maintenance department grievances. It goes without saying that it has also highly increased safety as well as decreasing the number of accidents suffered by not only the maintenance personnel but all personnel throughout the plant. In fact, the program has gone so well that they are now to do the exact same thing for the operators. Operator training and mechanical training will be covered further in another section outlining the paper presented by Mr. Thompson.

The general consensus of the entire group was that this type of attack on the maintenance problem was sorely needed. That in addition to the mechanical things such as keeping an adequate stock of parts, proper tools, preventive maintenance program and so forth it will be necessary for the entire industry to adapt some form of training and testing its mechanics for ability and advancement if the present high rate of maintenance problems is to be reduced. The members felt that there were unfortunate constrictions by Union contract on being able to undertake a full program of this nature without negotiating it in contract, however, it was agreed by all that portions at least of this type of program and the general approach could be undertaken by everyone and should be.

MAJOR ITEMS

Emergency Procedures

One member noted that the FIA has stated repeatedly that it is vital we have written EOP's regularly reviewed for each item which may occur to cause an emergency including loss of air, loss of process water, etc., as is the case with Tenneco. A number of the members have fire and accident procedures only. It appears that emergencies are covered, if at all, in the operating procedures.

There was no lengthy discussion with regard to emergency procedures inasmuch as most of the members seem to have them and except for the above noted they are approximately the same. It was noted that they should be direct and specify what each person does in each case and not simply a general discription of a potential emergency. It was also noted that more and more of the members are joining or forming mutual aid groups and that these groups should be drilled regularly as should the plant emergency brigade. Again it was noted that while we do drill on fire and other procedures on a regular basis, we are currently holding fewer air pak drills than almost anyone else. The industry standard

appears to be air pak training session for those in monomer areas on a monthly basis. Consideration will be given by this department to increasing the number of times annually that we actually drill with the units including the wearing of them while going through activities, other than simply putting them on and taking them off again.

It was also noted that those with emergency generators almost universally (except for Tenneco) when they are starting up after a scheduled shut down, start the entire plant, on the emergency generator, shut it down again and then start up in a regular manner. This takes only a few hours extra and is considered of vital importance by many members since it gives a chance to actually operate loaded units on the generator with everyone participating rather than merely starting the generator or load testing the generator at weekly intervals with supervisors.

Job Safety Analysis

Attached is the presentation by the Monsanto representative on Job Safety Analysis. It will be noted that a portion of this program was carried out in our plant particularly at Burlington some years ago and that the material gathered has been incorporated into our present operating procedures. It will also be noted that another portion of this program has been done under the safety audit program at Burlington and will be done under the safety audit to be conducted at Flemington. Mr. Bogart and Mr. Hahn explained that Mr. Hahn had conducted such an analysis in 1966 and that we had gone beyond this step: 1. By conducting an audit, 2. by taking the material developed during the job safety analysis and putting it step by step into the operating procedures, carefully avoiding excerpting safety specifically. The membership in general agreed that this was an excellent suggestion and a number noted the intention of reviewing their AOP's with the aim of intergrating the safety procedures into their regular procedures as well.

Vapor Cloud Test Program

It was reported that the FIA has selected Southwest Research Institute to conduct the tests of the effect of water vapor and deluge systems on monomer and other flammable gas vapors. The contract has been let on the basis of $35,000.00 pledged, with the FIA putting up $5,000.00, and the goal being $38,000.00 for the complete contract. Further details will be furnished by the subcommittee in charge.

Bulk Handling

It was noted that considerations in bulk handling of MVC are first- personnel protection, second - quality protection and third - fire and explosion protection. A number of items were discussed, none of them at great length. One was the system if diking versus ditching. The question raised was whether or not given the rapid vaporization of spilled monomer diking to NFPA Flammable Liquids and Gasses Specifications, is more of a hazard that it is a safety item. It was considered that containing monomer within a dike system particularly where they are more than one tank in the dike might present a severe exposure hazard. It was noted that in France in particular, the larger spherical

storage tanks now in vogue are protected by a ditching system where a partial dike encloses the area and an open ditch runs to a pond in a remote area. A number of the members expressed the feeling that with the possible exception of splitting a sphere by overpressure it would be unlikely that the spillage of monomer into an enclosed area would be so great as to have any appreciable amount of liquid for any length of time given the evaporation rate. Those who have had experience with major spillages have reported that in every case the material evaporated into gas almost immediately. While no one plans any changes in their present diking system consideration should be given in the construction of new above ground storage facilities to the provision of run off systems rather than diking systems where spacing and property size permits. It was, of course, agreed that above ground covered storage or underground storage presented far less of a hazard than storage in spheres or tanks supported above ground.

Hooker reported that they are using Nitrogen seals on their unloading compressors.

A number of companies noted that in addition to checking the oxygen content of the railcars coming in they also check regularly for oxygen buildup in the bulk tankage itself.

It was agreed by everyone that teflon valves are not for use in bulk lines. A number of members in the past have reported difficulties with teflon valves.

Minimum standards for tanks and piping for storage were expressed as being 100 PSIG for tanks and 150 PSIG for piping.

Aluminum was discussed briefly and it was agreed that recovered monomer in particular will corrode aluminum and that the use of aluminum should be avoided in monomer service.

The question of railcars, particularly leaking railcars was touched upon briefly, but time for this particular discussion did not permit expanding this subject. It has been the suggestion that this be discussed at some length at the next meeting.

It was pointed out with regard to diking that since OSHA is adapting NFPA consensus standards as regulations, if this group had any specific objections to the diking regulations as they currently applied, it would be well to express those reservations at this time, before the OSHA regulations are solidified.

Industry-wide Safety Standards

After a considerable discussion it was voted to have the executive committee appoint an add hoc committee to set up a method of creating certain industry-wide safety standards. Among those mentioned as typical were tag out and lock out standards, eye and head protection programs, etc. During the discussion one member noted that they have overall programs for eye wear, safety shoes, hard hats, long sleeves and long trousers (cotton, no nylon) and that the operators have authority to ask anyone not properly garbed to leave the area.

It was agreed that the basic goal for safety on an industry-wide specific basis would be the complete elimination of monomer vapors. A number of items were covered during this discussion, one of them being the use of air wrenches on reactors. One firm reports success in using air wrenches for opening tops and closing openings on bottoms, another reports using an air tool to tighten "C" clamps on the tops of reactors, specifically. Another expressed the problem regarding over-torqueing, another the problem regarding stripping threads on bolts. It appeared that the item of air tools for buttoning up is still one involving considerable controversy.

Those members currently using vapor detection systems emphasized the importance of not routinely turning off detectors during certain operations such as dumping k-o tanks or operating draw offs on tanks. Even with tight supervision this was considered an extremely bad practice and it was advised that methods of performing all routine operations without activating the detection system must be engineered or else the overall value of the detection system is lost. One member noted that under OSHA and its emphasis on health, it is more essential than ever that we stop industry-wide any inhalation of VCM. One member noted that in this same vein, in order to eliminate pollution, they have a practice of bagging out bad batches, of bagging out cleanings from reactors, and of sewering absolutely no solids. Everything is bagged in linen bags which permit the passage of liquid and retain cleanings, scrapings, et cetera. It was agreed that this type of goal is one which we will all have to meet in the near future.

Pre-employment physicals were touched upon briefly with one member reporting that in the doctor's examination and medical history they do not permit the employment of anyone with kidney, liver or alcohol history.

In voting to begin a survey of industry-wide standards, it was the feeling of most of the members that if we do not, the government or the insurance companies will, and that if someone is going to do it this is the group who should be doing it.

Pressure Vessel Inspection and Record Keeping

It was agreed that there should be one man responsible for overall pressure vessel inspection in the plant. This does not mean that one man should do it, but that one man should be responsible for maintaining the proper records and for liasion with the boiler insurance carriers and any other carrier having jurisdiction over pressure vessels in that state. One of the group reported that they include in their pressure vessel inspection all pressure vessels over fifteen pounds and they have an annual internal as well as an external inspection. This statement led to some discussion in which it turned out that a considerable number of the members also internally inspect vessels annually. This would include storage tanks, blend tanks, etc and it was felt that this was a very good idea by which they test vessels in case the visual inspection shows some suspect condition. They use electronic thickness measurement equipment, but do not x-ray. Most who hydrostatic test, hydrostatic to one and one-half times working pressure. One member reported that they use the "Accuray" sonic method of accurately testing the exact thicknesses of various vessels including glass-lined reactors during an inspection was highly desirable. This led into the next subject which was pressure test procedures. Almost all members test relief valves annually. They also test vacuum vessels as well as pressure vessels if they have any vacuum vessels.

With regard to testing reactors after they are buttoned up it appears that we are one of the very small group that does not either hydrostatically test or nitrogen test each reactor after it has been opened for cleaning before it is charged. Two members reported hydrostatic testing and the vast majority do a full nitrogen pressure test. They do not rely upon checking for leaks once the charge has been begun.

Diamond reported that they have just completed a program of grinding down all nozzles and manways on their vessels. (Some of these vessels are over 20 years old.)

In pipe lines, it was agreed that the relief valve should be placed in every section that is blocked in, that is every section between valves. There is no specific footage requirement for relief valves in plant pipe lines exposed to sun, except this one. A number of members reported using three-way valves under pipe line and other relief valves, but not on reactor relief valves in any case.

One member reported that they have used color coating on their relief valves by marking the valve with an aerosol paint when it is annually tested and using a different color for each year so that the inspecting personnel or operating personnel can tell at a glance whether that valve has been tested in the current year or not.

The best suggestion appeared to be that of a member who has completely computerized his vessel valve test program. The input is fed to the computer by the engineering department and every six months a print-out is sent to the safety, engineering, and operating departments at each of four plants indicating which, if any, valves or vessels are overdue for test within that particular month.

PLANT SUPERVISION

Mr. Thompson's paper on this subject is attached. Considerable interest was raised by his basic concept that within the next ten years it will not only be advisable but necessary to operate largely automated plants. This conclusion, based upon figures shown on his paper, derives from not only economic and operating considerations but safety considerations. All present agreed that in almost every case of serious accident within the last year, there has been an operator error or a short cut or oversight. This seems to occur even with the tightest of supervisory programs, and it was the conclusion of Mr. Thompson's paper that this can be prevented and serious accidents thus prevented only by removing the operator from responsibility where ever possible to computerized control systems which do the same thing every time the same way. In describing the supervisors program currently in use for getting safety to the operators, Mr. Thompson noted the safety "jogger" program at Burlington. While it was agreed by the membership that the basic idea was sound, considerable question was raised as to whether or not turning in cards on each specific contact would tend to involve the program and the supervisor in so much additional paper work that it would lose its effect. One general conclusion was that programs designed to keep the operating personnel aware of safety must be changed and revised and the approaches switched about every so often, lest disinterest result from excessive repetition. Mr. Thompson also mentioned the anticipated use of the audiovisual strips to be developed through our vidiotape system. This concept evinced considerable interest and we were requested to furnish cost figures particularly, in the use of an explosion proof TV camera.

OSHA

The luncheon speaker, Mr. Cortney B. Justice of the Department of Health, Education and Welfare gave an overall view of the Federal Worker, Safety and Health Act, the details of which are already familiar to Tenneco personnel. In his talk, Mr. Justice made two salient points of general interest. One was that the government's basic feeling is that the price of a good produced should accurately reflect the cost of producing that good. He cited as an example the practice of plants removing water from rivers free, returning it to the river in some way (either by contamination or thermal action) polluted, and thus requiring plants and municipalities down stream to purify the water before they in turn could use it. This purification then becomes a form of subsidy to the industry or city upstream. The same philosophy applies to air and ocean pollution. It is this type of inequity which it is the government's intention to correct. The second item was the reiterated warning already issued by this department that within the next two years there will be strictures upon environmental conditions as stringent as those being spelled out by OSHA for internal health conditions. The lesson here is that you may not correct the condition within the plant by blowing the dust outdoors or putting the effluent in the water table. The entire package of health, both for ones own workers and the general public must be considered as an intergral whole.

In conducting the workshop session on OSHA, Mr. Bogart attempted to stay with those specific items directly related to our industry. He pointed out that the primary change in thinking will be that in addition to the traditional problems of fire and explosion protection and monomer exposure, we will now be required to do two additional things: one is to consider all aspects of the health of the worker and the second is to pay more attention to the small standard safety items that we have been so used to working with we tend to ignore their importance on occasion. He cited a number of examples of the type of citations which have been handed out during OSHA inspections and distributed a list of such items. In the ensuing discussion one member noted that he had had an OSHA inspection, that citable items had been exactly the type discussed and that, in addtion the inspector had had considerable interest in the plants' operating and emergency procedures as well as in details of their safety programing. He noted that the inspector had been of a higher caliber of professional than he had been led to expect and he exphasized to the group that procedures in writing with records showing that they are being regularly followed will be of particular importance.

VCM Sniffing

The gentleman from Dow who led this discussion stated that he had obtained most of his information on the subject from the Dow medical department. The question was one of the occurrence of intentional sniffing or inhalation of VCM vapors similar to the intentional sniffing of model air craft glue vapors and similar materials. He stated that there have been over 110 SSD's in the United States identifying these as sudden sniffing deaths. These are cases in which fatalities have occurred (largely among teenagers), as a result of sniffing materials which are not in themselves toxic and in quantities which do not by themselves exclude oxygen. He stated that the apparent cause here is the low oxygen blood content plus the suddenly accelerated Adrenalin flow which in turn causes articular fibrillation with subsequent death in 2 1/2 to 3 minutes.

He stated that his medical department feels that occasional sniffing as opposed to massive ingestion of monomer vapor is not permanently harmful. He went on to describe a number of the methods used in inhaling various intoxicant vapors. In the discussion which followed, one member reported a case in which a man was found intentionally breathing the vapors. Dow reported on two such cases and another reported on three such cases. The member with the three cases stated that in each of the three there had been an alcohol problem involving the individual prior to his being deliberately ingesting monomer vapor. The general consensus was that while this is not necessarily an industry-wide problem nor is it a problem of any great magnitude at this time, it should be viewed as part of the overall drug abuse problem in the United States and watched for in the same manner that industry watches for signs of alcoholism in its workers. It was noted that any case of inhalation or apparent inhalation should not be dismissed off-hand by supervision, but should be checked on until it is proven to be accidental and that any cases of suspicious orgin should be referred immediately to the medical and/or health departments for further investigation.

Noise

Noise had been raised as a subject during the OSHA session and the discussion of it was now resumed. One member noted that they have plotted their plant in noise areas rather than simply according to specific noise producing equipment. They have placed their ear protection signs in the entire noise area, rather than following the general practice of the members of placing signs only in the area of specifically noisy material.

It was noted that Dupont has produced in their instrument division, a pocket size recording noise measurer which gives a continuous additive recording of the decibels which the worker is exposed to in a given period of time. It was also noted by the members, that Mr. Justice in his talk had specifically discussed the noise critera and all agreed that 84 decibels rather than 90 is the goal to be striven for as it will undoubtedly be the regulatory level in a relatively short time.

Virtually all members are now requiring in their specifications for new equipment that it must meet an 84 decibel standard.

One member noted that they had had success on installing mutes on motors which they had bought from Pulsco in St. Paula, California. Another member reported success in certain areas with a lead and vinyl coating material trade named "Coustifab." Another reported that they had tried a trowel-on type material on blowers and found it of little use. Another member reported that they had used Urthane foam type coatings and sound drapes with considerable success. The general consensus was that all members are actively pursuing a noise control program as rapidly as possible and that while there are no overall specific engineering solutions, particular solutions to particular problems can be found. While such solutions may prove expensive it was agreed that they are absolutely necessary to meet OSHA standards which will undoubtedly get stiffer as they are further developed. Regrettably the noise control program in our resin plants appears to be somewhat lagging in comparision to what the other members are doing and the speed in which they are doing it.

Accidents

The members recounted various accidents which had occurred in their plants over the past year. Mr. Bogart gave a critique on the accident at Flemington involving Mr. Pierson, pointing out the lessons we felt we had learned from this particular incident.

One member recounted the difficulties involved in the sinking and subsequent salvage of an MVC carrier off the coast of Holland.

Continental Oil reported on a plant fire. They stated they had blocked in a pump which had an inline 8" plug valve gear operated. They opened the check valve below this valve for cleaning, depressured the pump, and drained it. They were using the standard permit system. They had not blanked this 8" line because it was a vertical line and had certain technical problems which prohibited using a blank successfully. The mechanics opened the bonnet of the 8" valve and went to get a gasket and returned in fifteen minutes during which time the bonnet had been opened. At this point a plug in the line released and they had a full release of 150° mixture of vinyl and HCL. Ignition occurred almost immediately from nearby cracking furnaces and there was a severe result at fire. The cause was attributed to the fact that the plug valve was full open even though the indicator showed it to be closed. The vertical leg above the valve had plugged and allowed them to depressure the pump with the valve open. It was found that when the valve was rebuilt at some point in the past the gear operator was turned 90° away from the plug direction and this also reversed the direction of the open and closed. This line was not double valved - that is valved at both the tank and pump. The lesson here is that it is entirely possible to put this type of valve together backwards and extremely difficult to detect this error during assembly since there are portions of the valve which have to be assembled from a position which does not permit seeing the plug section itself. Particular caution must therefore, be taken at any time when this type of valve is disassembled and then reassembled.

Diamond reported on an incident involving polyperioxides in recovered monomer at their Delaware City plant in June of 1970. The operators reported crackling sounds from the graveled area in the recovered monomer area. They also reported snapping and cracking sounds from the recovered monomer pump. Dilute caustic was soaked into the ground on several repeat occasions and caustic was injected into the tank feeding this pump. When samples were taken it was found that there were from 1,000 to 2,000 parts per million of oxygen in the compressor. They took the course of controlling the PH of the recovered monomer by anomonia injection and ruled that the residence time of monomer in the tank could not be over one shift. It was agreed by the members that the only real answer to this problem is the course taken by Tenneco and that is the exclusion of oxygen from the recovery system, almost entirely.

The representative from Norway reported on five accidents, none of which had involved any injuries. Two were fires. In the first fire a valve had been taken out of a line while the line was under pressure, frozen MVC in the line prevented the material from escaping, after a half hour this material melted, the MVC was released, ignited from a cracker and the plant was down for three weeks. In the second fire a gasket blew off a quencher, static was the apparent ignition cause. In the third accident MVC was noted bubbling up through the ground from the underground storage area. Since they had no place to put the material in the tank they had to continue to use the MVC up for 5 days while

the leakage continued. Investigation showed that the tank had been installed in a layer of concrete in a rock concavity. During construction, apparently one of the steel bottom plates had folded and eventually had failed at the fold allowing the monomer to bubble up through the ground. This tank was located in the middle of the plant which continued to operate reaction but closed down all nonessential operations such as drying, bagging out, etc., during the five day period. No ignition occurred during this period and there was no personnel exposure. The gentleman described this as having been "a very exciting time."

The most serious accident occurred in their polymerization plant. This accident bears an uncanny resemblance to the one which occurred at Flemington, even to the same reactor numbers. In this case a reactor operator who was about to charge number 10, noted that there were some lumps still remaining in the dump valve at the bottom the reactor, this valve was the same type of quick opening handle valve as on our Flemington reactors. He went down to open this valve to remove the lumps and in error opened number 11, which had just been charged and was filled with monomer. He then attempted to close the valve assisted by two operators, but the three of them together were unable to move it. The explanation given here was that it was felt that the monomer had partially frozen the valve in the open position. The entire contents of the reactor went on the floor, the three operators after trying to close the valve ran from the building. The entire 5,000 gallons went out onto the floor, but dispersed in a matter of minutes and was not ignited. There was a discussion of the various methods used to prevent this type of accident with Mr. Hahn describing his two light system of the double valve and air valve in use at Tenneco and a description by one member of a double key interlock system which prevents the wrong reactor from being opened.

Also in the Norway Polymerization plant in January of 1971 a suspension polymerizer was under high pressure and when the operator saw the pressure going up he went out to see if the agitator was running and it was. He checked the temperature, reported to the foreman, he was told to manually vent the reactor. As he went out of the control room he heard the safety valve blowing, he opened the manual vent, which leads from a separate nozzle to a common header above the safety valve, and as he did so he heard the gaskets on the manway blow. He ran back to the control room and threw the reactor on full cooling. With the monomer going out the vent, the safety valve, and the gasket, the charge dissipated in a few minutes. This building is a former aluminum factory and is not designed specifically as a polymerization building. The reactors are located along both sides of the operating floor. This floor was equipped with large windows which have been removed. Heavy rolls of plastic material unrolled from the bottom are used to close these window openings in the winter time. They are hoisted and lowered by means of a rope. Emergency procedures call for cutting this rope with an ax and allowing the plastic to drop to the floor giving ventilation through the building. In this particular case the foreman did not take the ax to the rope but instead lowered one of the window covers by means of the regular rope provided, a process which naturally takes somewhat longer. He was, therefore, able to open only one of these windows prior to being required to flee the building. When they opened the reactor they found the glass had come off the inside. They tested the safety and found it to operate correctly. They found the bourdon tube of the pressure gauge flattened. When tested they found it took 700 pounds of pressure to achieve this. They could not find out how the agigation stopped at some point, but feel that it did stop and during that period bulk polymerization occurred on the top of the charge. Their charge operator starts the agigator, and the fact that it is operated is checked and signed off by two men. Neither man could account for a period for which the agigator had not been running. Thier catalyst is a mixture of

lauryl peroxide and tertiarybutylcyclohexylpercarbonate. Their safety valve is sized four inches inside, six inches outside, but only a two inch orifice. Obviously, the safety valve was inadequate to vent the pressure of the entire charge even with the four inch hand manual valve open. They felt that the opening of the safety valve had been restricted by the lumps of polymerized material forced up into it. They also reported that upon examination they had found the steel of the reactor jacket to have been stretched by the over pressure.

Ethyl reported a minor blowout which had occurred due to the wrong gasket having been used and a sponteneous ignition of inorganic persulfate caused by the inadvertent addition of flake caustic.

Great American reported on a fatality which occurred to a cleaner. The man and the buddy opened the reactor and put the blower in it, then the senior man went for a smoke break by himself, and in seven minutes he came back. When he checked the reactor he found the other man draped on the agigator and smiling. He went immediately for help and when he returned he found that the ladder had been moved away from the hatch so it was necessary to obtain another ladder. He put on the rescue mask and went in with the rescue line and found that the man in the reactor was not wearing wristlets. He tried to hook onto his belt and his belt broke. Another man then entered with a mask and placed wristlets on the first man. After he was removed from the reactor and taken to the hospital he was listed ad dead on arrival at the hospital. It was estimated that he had been unconscious for three to five minutes in the reactor and that he could have been in the reactor for five minutes before that. They have a full reactor entry procedure, very much similar to that at Tenneco, none of this procedure had been followed, nothing was listed as done on the two-man initialing entry list, no explanation was found as to why this man had entered the reactor in the manner in which he did. They have taken among other precautions to locking the manways, only the lead operator has the key and he personnally opens the manway when it is necessary to do so. They have a Johnson and Williams Detection System and they have a single portable head attached to this system which is left in the reactor during the entire time the man is cleaning. This is equipped with a panic button which the man can press to sound the alarm and will of course, sound the alarm at 20% of LEL at any time. They are planning to eliminate the buddy after a certain additional test period. It was agreed by those present that regardless of the efficiency of any automatic alarm system from a safety standpoint, it might well be unwise to eliminate the buddy, even in states where this is permitted. The overall objective is to achieve complete reactor cleaning without the necessity for any manual entry at any time.

In another incident a mechanic working on top of the reactor dropped his wrench in, the operator who was an old hand and knew better, went down to get it, bent over to pick up the wrench and became unconscious. The mechanic got assistance the other operator put the blower hose (which blows in their case in rather than sucking out) into the reactor directly over the man's face and he has recovered after a period in the hospital. This firm has run an entire safety program on this incident with the man who was overcome relating his sensations and feelings at the time, and his own feelings toward his action.

Another firm reported a similar incident involving tank car entry. This tank car entry which involved a fatality was reported on last year.

Dow reported on a high pressure water cleaning accident where they clean the inside of the reactors which are equipped with cooling coils. They use a cleaning platform and a 20-inch lance to get behind the coils. In stepping back onto the platform the man lowered the gun without releasing the trigger and cut a small laceration in his toe. They have gone back to a 36-inch lance and feel that there is little else they can do since present considerations require that this reactor be cleaned from the inside.

The last item considered was the incidents of Acroosteolysis better known as AOL. One firm reported that they had had a $9,000.00 award and a $4,000.00 award as results of claims for this disease. It was noted that if x-ray examination is to be undertaken it must be done by specially trained technologists as a standard x-ray technician cannot properly read the x-rays for this particular disease. Several firms mentioned medical programs in which they have gone or are going to special examination for signs of AOL. The entire subject was of much interest but few had any concrete recommendations to be made at this time. Dow is to furnish such information as they have through their medical department to the members at large and the subject will be reopened in detail at a subsequent meeting. This concluded the formal discussion program of this meeting.

NOTE: In addition to the previously mentioned visit to Lucidol with a subsequent seminar on catalyst handling and the luncheon speaker, the dinner speaker was a representative of Backrack Instruments, Manager of the J & W Detector System. He discussed and demonstrated the type of equipment which Tenneco has already installed in both of its resin plants.

P. L. Bogart

PLB/sr

I-184 (50M)

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO G. Rozand AT Piscataway DATE November 23, 1971

FROM A. Siegel AT Burlington COPY TO J. Kilcullen
J. Fath
P. Scarito

SUBJECT Report on the meeting with the Occupational Health Committee of MCA, Washington D.C. on November 16, 1971.

On November 16, 1971 a meeting was held in Washington, D.C. between company representatives of the Vinyl Industry and the MCA Occupational Health Committee to discuss a proposed research program to study the possible carcinagenic effects of Vinyl Chloride Monomer.

The meeting opened with a brief announcement that the University of Michigan had almost exhausted the funds allotted for the Acroosteolysis (AOL) Study. The MCA has additional monies available but requires authorization for commitment of these funds from the participating companies. This will be done shortly through a letter ballot. In answer to questions from the floor Dr. W.E. McCormick (B.F. Goodrich) indicated that there were approximately 50 active cases of AOL still followed. The value of continuing the study would be to determine whether any measures taken by the companies are having any effect of the incidences of AOL.

Dr. McCormick then gave the background leading to the current meeting.

In May of 1970 Dr. P.L. Viola, Regina Elena Institute for cancer research, Rome, Italy, presented a paper to the 10th International Cancer Congress alleging for the formation of cancer in rats as a result of very high and prolonged exposure to Vinyl Chloride Monomer vapors. This work grew out of the original study of the investigation of AOL. In his program Dr. Viola exposed rats to 30,000 parts per million of VCM vapors for 4 hours per day, 5 days per week, and for a total of 12 months. Almost all the animals developed tumors of the skin and lungs. At the lower level of exposure for example, 10,000 parts per million, 5,000 parts per million and below 5,000, the tumor rates were reduced to 25%, 15% and some indication, respectively.

In May of 1971 after meeting with Dr. Viola, the MCA's Occupational Health Committee recommended that this matter be brought to the attention of those companies in the Vinyl Industry to determine whether they would support further research in this area. Dr. McCormick indicated that although Dr. Viola's findings have been challenged by a number of Vinyl Industry doctors, his findings are now public record and present the Vinyl Industry with some very serious problems. Over reaction by the Federal Government, State Agencies and by the public could;

1. Force companies to cease operations.
2. Require companies to redesign their plants to prohibit exposure to VCM vapor.
3. Pay for every case of cancer reported regardless of how remotely connected with VCM exposure.

In view of the extremely serious nature of this problem the MCA proposed that a study be undertaken immediately to either refute Dr. Viola's conclusions or better to define the cancer causing agent.

Dr. Torkelson (Dow) then outlined the proposed research study:

1. There are two manufacturing processes used in the United States for the production of VC monomer. The ethylene monomer derived 90% of the productive capacity with the acetylene accounting for the remainding 10%. (Dr. Viola used acetylene derived monomer.) Both monomers will undergo study.

2. Both rats and mice will be used in this study as opposed to only one animal used in Dr. Viola's experiments.

3. The VCM concentrations will be at a lower level starting with the highest concentration at 5,000 parts per million, and reducing to 500 parts per million. The inclusion of the higher level was to provide for an overlap with the original study.

4. Exposures would be from 18 months to 24 months, 5 hours per day and 5 days per week.

Prior to the meeting, an inquiry was made to research on what independent laboratories would be interested in conducting the tumor inducing properties of VCM and to determine the estimated cost of such studies. The lowest acceptable bid was $183,000.

Dr. M.J. LeFevre, Solvay et Cie - was asked to address the group and explain what European companies had found during research studies. Dr. LeFevre launched into a lengthy discourse on the AOL studies, laboratory findings and plant investigations.

With regard to the carcinogenic effects of VCM:

a. Dr. LeFevre expressed doubts that Dr. Viola was correct when he stated that one could assume that the VCM he used had insignificant amounts of non-carcinogenic contaminates to be concerned about and would not influence the outcome.

b. No cases of tumors have been detected in any of the Solvay workers in any of their plants throughout Europe.

c. European companies have been unable to determine what specific agent causes AOL or the possibility of cancer.

d. Since their Solvay findings showed only AOL was apparent in workers cleaning reactors. Solvay sampled the gases found in the reactors after the reactions and just prior to reactor cleaning. They found a very high level of impurities and susupect that these impurities may have been generated during the reaction cycle. If the possible causal agents are in these impurities then it would be necessary to concentrate on these areas for prevention of exposure.

Considerable discussion followed the two presentations. Some of the typical questions raised were as follows:

1. Is any governmental agency taking an active interest in Dr. Violas's report?
   Answer: Dr. Torkelson though there was, but could not recall which one. He did however, know it was on the agenda for discussion by the American Conference of Industrial Hygienics.

2. What do we hope to gain if we confirm Dr. Viola's results in rats or mice?
   Answer: The industry can gain approximately two to three years of time to determine what course of action is required to prevent exposure to VCM. In addition we have a moral obligation to our workers and the public to determine if the hazard really exists.

3. Shouldn't the congenital effects (embryo) and the genetic effects be included in the study?
   Answer: This would be a good idea, however, it will cost considerably more than the original proposal.

4. Should acetylene derived VCM be left out of the study in order to reduce costs since it only represents 10% of U.S. production?
   Answer: No, since the vinyl industry should know which one if any monomer causes cancer.

5. Since there have been no reports of cancer in human beings that had been attributed to vinyl chloride, what would be the difference if the studies do confirm Dr. Viola's results?
   Answer: I believe (Dr. McCormick) that,"The Vinyl Industry would be in a very bad time."

6. What other industry should have cause for concern besides the vinyl industry?
   Answer: It would appear that all ethylene based deriviates, styrene and butadiene just for starters.

7. Should we start with the detailed lab analysis of VCM or at least have this analysis in conjunction with the animal studies?
   Answer: Possibly, it does however, add to the cost of the original research proposal.

It was the unanimous opinion of all of those at the meeting that a research program should be under taken. However, a lengthy discussion followed as to what items should be included or deleted from the studies and the method of funding. (Example: Pro Rata on published capacity data or equal cost.)

Since no definite program or funding arrangements could be agreed to, an Ad Hoc committee was selected to determine what course of action to take. The MCA will then send out along with the recommendations, a letter ballot requesting that companies indicate their choice of program and funding. This should be completed within a month from the date of the meeting.

The MCA meeting notes should be sent to you within the next few weeks. Attached is a report of Dr. Viola's presentation, a copy of an article in the Chemical Marketing Newspaper, the original MCA request for bids on the research program and a list of participants at the meeting.

Should you require any additional information please let me know.

A. C. Siegel

SECTION VII

RECOMMENDATIONS

1. The association between reactor cleaning and the occurrence of AOL is sufficiently clear-cut that steps should be taken to minimize the exposure of workers responsible for this operation. These steps may take the form of substituting water-jet or solvent cleaning ~~for~~ to eliminate the present hand scraping operations. Where it is necessary for workers to enter the reactor tanks, ~~sufficient~~ adequate ventilation should be provided ~~to reduce the~~ vinyl chloride concentration below 50 ppm.

2. Because of evidence that the disease AOL affects bony structures other than the phalanges, and because of information made available by other investigators that there may be other connective tissue involvement, recognized cases should be removed from further exposure and should be examined at intervals to determine whether there is any progression of the disease.

3. Attempts to produce the disease in experimental animals should be ~~continued~~ supported to isolate the agents responsible for the disease.

4. Plants that had no cases of the disease in the present survey should not assume that they are immune. In many instances failure to demonstrate cases may have been the result of the small number of employees exposed or limited experience rather than due to a difference in practices. Because of these factors, plants that do not now appear to have cases of AOL should perform regular periodic medical surveillances since this study cannot predict unequivocally that cases of AOL will not occur in the future. For the same reasons, it is recommended that all plants, whether or not they have had cases, adopt the practices outlined in item 1 above.

A.

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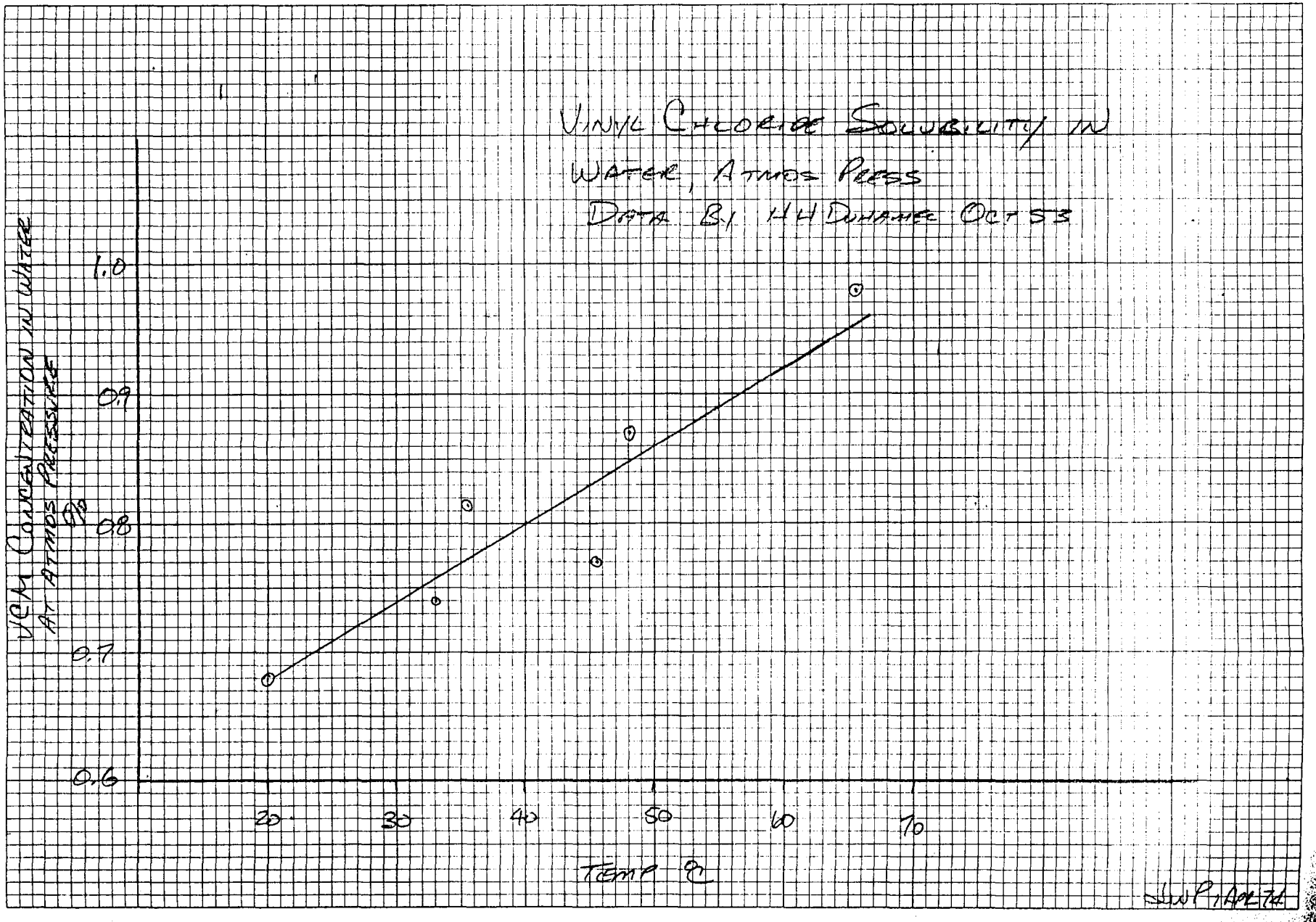

I-184 (50M)

Filed - Occupational Safety & Health Act

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

DEC 17 1971

TO Route List AT DATE December 14, 1971

FROM P. L. Bogart AT Flemington COPY TO

SUBJECT American Institute of Plant Engineers Conference

The writer attended the above conference at the Newark College of Engineering on November 23, 1971.

Speakers included: Ralph Nader, Alfred Barden, the regional director of OSHA Region 2, Senator Harrison A. Williams, coauthor of the OSHA act, and Mr. James Conlon of the State of New Jersey.

A number of salient points of interest were made during the sessions. Some of these are:

1. In response to the question "What determines an "adequate" safety training program under OSHA?" Mr. Barden stated that when a penalty is to be assessed for a cited violation the evaluation of the employer is made on a merit system basis. He stated further that the criteria for this system largely depended on how much time the employer has taken to make the employees aware of the law and their right to these under the law. He stated that it was expected that this would be done by Foremen's meetings formerly referred to as "tailgate" meetings and not formal classroom training. One of the points to be covered was how much the employer has told the employees about the conditions to which they are exposed. This would include dust conditions, noise conditions, and so forth. In short, the OSHA inspector is evaluating the plants good faith on the basis of written proof that safety training is being held and that there is a good feedback in communication between supervisor and employee. Once again we have an example of the absolute importance of holding our regular safety meetings and of reporting on them in depth.

2. There were a number of questions directed at Senator Williams and others as to why the bill does not provide for penalties to the employee. The Senator, Mr. Conlon, and Mr. Barden all replied with some asperity that the employer representatives on the committee which drew up OSHA made a very particular point of the fact that they did not want any specific strictures against the employees since they felt that this would result in government stepping between employer and employee. This was reemphasized several times and the people and organizations including the New Jersey Chamber of Commerce that insisted on this point were listed. Now the entire responsibility for seeing that the employee obeys the OSHA regulations is upon the employer, and the employer is fully expected under the law to see to it that his employees do follow the regulations and do obey the law. Mr. Barden, in particular, emphasized that if an employee does not follow the regulation they fully expect that the employer will discipline him in whatever manner contractual obligations call for.

3. A number of questions, particularly to the Senator, regarding the prospect of compliance with OSHA running up the cost of goods produced in the United States to the point where they were no longer economical in terms of goods being imported from countries which do not have such stringent regulations. There were

a number of answers to this, one of them being that in many instances the countries that are supplying goods to us have more stringent regulations than we do. Two examples were given: The fire laws in Great Britian for manufacturing establishments which are supervised by government inspection and the safety and working conditions in mines in other countries which Senator Williams stated he had personally found to be far better than those in the United States at the time he was drawing up Mine Safety Legislation. A second answer was that the present cost of compensation in the United States runs some 4 billion dollars per year and that compliance with OSHA must inevitably sharply decrease this cost. This alone should offset a large portion of the funds that will be necessary to comply with OSHA. The moral obligation to provide a safe work place was, of course, sharply stressed, with the general comment being "what price can you put on a life or a limb?"

The Senator also felt that while there would be short term increased costs in meeting OSHA in addition to the above, cost would be returned as investment because having a safer work place would make it more effective and thus would increase productivity. This has long been a standing rule of the safety profession.

The Senator also stated that he and other Senators are exploring international safety standards which would bring the standards in foreign producing areas up to those of OSHA. He is actively working, at the moment, on protection against disadvantages to the United States manufacturers in meeting environmental standards, by requiring environmental standards of equal stature world-wide and by asking some form of tax break for U. S. manufacturers forced by the government to meet environmental standards.

4. Mr. Barden stated the opinion that it is the plant engineering staffs with their responsibility for designing and maintaining the work place who can "make or break" the effectiveness of OSHA. We have already seen within Tenneco that upon the plant engineer evolves a great deal of the responsibility for bringing his particular plant up to Tenneco and OSHA safety standards.

5. It was noted that the largest single cause of industrial fatalities in Region 2 has been electrical, specifically poor grounding, faulty wiring, and faulty portable electrical tools. The emphasis by OSHA inspectors on meeting items such as these is to some degree prompted by this number of fatalities.

6. Virtually every speaker including Mr. Nader, again tied together the environmental situation and plant health and safety. This cross-connection has been emphasized by this department in every report we have made to date on conferences, seminars, speeches, etc., on OSHA. It is obvious that additional governmental control of environmental conditions is both a necessity and to be expected in the imminent future. Should we fail to recognize our obligation, not only to remove the hazard from the work place, but not to pipe or pump it into the environment, we will have only ourselves to blame, as we have been warned again and again by government and private speakers that the entire package is going to be treated as a package and we must as industry regard the problem as an overall single world-wide problem.

7. Some specifics of enforcement of the law were discussed. Mr. Conlon stated that the Federal and New Jersey reporting requirements will be virtually identical within a year to a year and one-half. It has not as yet been decided whether there will be major changes in the procedures now called for for filing the L & I one form, but it is expected that federal and state records will be identical and much of the present duplication will be eliminated. It was noted that the employer bears responsibility for the equipment used by the employee, even if that equipment is furnished by the employee. Although Tenneco does not follow the practice of some companies of requiring the employee to provide, for example: his own respirator, we do allow the employee to purchase safety shoes and then require that he wear them. This is an example of an area in which if the employee is not wearing his shoes, or if he is wearing defective shoes, even though he owns them we will receive a citation as the employer for defective personal equipment. As has been stated by this department before, it is not sufficient to provide a respirator or a set of ear muffs, we must see to it that they are clean, in good condition, and properly used.

8. It was noted that the present regulations are considered a strictly temporary expedient until such time as permanent regulations can be formulated. A particular point was made of the fact that it was industry, acting on NFPA committees, ANSI committees, etc., that drew up the consensus standards by which we must now live. A warning was given to those persons serving on such committees that they may find that the regulations they put in standards on the theory that they are maximum goals have a habit of turning around and becoming laws with which we must now live. The government's attitude and the state's is that we wrote them, we said that we could live by them, and now don't object to them being laws. On the other hand, there are numerous opportunities for those affected to have their say as to what goes into these standards. Mr. Conlon in particular discussed at some length the function of the governor's State Industrial Safety Committee as being the place where changes, corrections, additions, subtractions, to new regulations are thoroughly hashed out for 90 days prior to going to public hearing. This is one of the most extensive plans in the state regulations, but regulations such as those drawn up by the NFPA for example, are entirely written by committees representing the industries involved. Mr. Murphy of the NFPA, Chairman of the Industrial Section, made a particular plea for persons with expertise in industrial fire protection items to join the committees of the NFPA, drawing up this type of standard. All emphasized that it is far easier to get what you want put in the standard in the first place than it is to get something in the standard changed after it has been adopted and you find that you can't live with it.

9. Of approximately 200 persons present four stated that they have had OSHA inspections. There are presently 400 OSHA inspectors in the country with 60 of them in Region 2. There are also 80 State Inspectors in New Jersey who are making parallel inspections. Several instances were cited of cases where the New Jersey inspectors have turned over information on specific violations to the OSHA inspector. This is a fact that had not been officially confirmed prior to this meeting. One instance involved a case where a manufacturer was found to have an extremely noisy machine and this machine is installed in each of this manufacturers plants throughout the country. OSHA was given this information

since they have national jurisdiction. In another case OSHA was informed of failure by the company to post the required OSHA poster. They were also advised that certain records were not being kept, which the state, as well as the federal government require.

10. It was noted that where a firm has obtained a variance from a state regulation this variance is not binding on OSHA, only OSHA can issue variances for OSHA regulations. Their variances are not being issued except in the most exceptional circumstances, since the issuance of a variance actually is in effect a change in the regulation. In at least one case where there has been considerable complaint of a certain aspect of the reporting system, the Secretary of Labor has actually changed the regulation rather than granting any variances. This involves two points: one is the former statement that two visits to the doctor constituted a medical reportable, which was changed to say that regardless of the number of visits a medical reportable is anything that is not a first aid case. The second one is that the citation now be posted for a maximum of three days or until the violation is abated rather than the former fifteen days regardless of when the violation is abated.

11. It was noted that the penalty which accompanies a citation can not be avoided by simply abating the violation. It was explained that the system in use is the same as that for the issuance of a traffic summons. The citation states that they are in violation of a certain section of the code and they are being fined for that violation. They are expected to correct it. The fine is not being imposed <u>until</u> they correct, the fine is imposed because the violation existed in the first place. This is analogous to receiving a summons saying you have been speeding and you will be fined for having been speeding. The fact that you saw the trooper and slowed down does not mean that because you are now proceeding at the legal limit you are not guilty and, therefore, finable for having been exceeding it. The analogy is carried further by the fact that the traffic summons simply calls you to court to explain why you should not be fined. It does not, of itself, constitute proof but is an allegation. Similarly the federal citation is an allegation that you have been doing something wrong and you have the opportunity to appeal on three grounds: (a) That you were not in fact in violation, (b) that the penalty imposed is to great for the violation and (c) that the conditions given for amending it, the time allowed, or whatever are impractical or impossible of completion. In an unconscious irony, Mr. Conlon in explaining this, stated that, therefore, your chances of winning in court are approximately the same as they are in beating the traffic summons. This comparision was not lost upon the audience.

12. In answering two private questions Mr. Barden noted that with regard to the potential corruptability of his inspectors: one, they are being paid an average of $6,000.00 a year more than a state inspector; two, that any evidence whatever of corruption results in immediate dismissal and; three, that there is in effect a check system, that is to say that at present, every inspector who makes a major inspection and issues citations has a check inspection made on the same facility within the next few days by another inspector who is normally a supervisory inspector. If obvious violations are noted by this second inspector that did not show up on the first inspection some sharp questions are going to be asked. It is felt that this type of checkup, plus others, that Mr. Barden did not care to detail would prevent the development of the type of bribery and corruption that seems to be so wide-spread in so many other official organizations.

With regard to the effectiveness of the inspector as reflected in the extremely minor nature of the violations being cited at the moment, Mr. Barden cheerfully admitted that his people were new to this type of inspection, that while many of them had expertise in some particular field of safety, virtually none of them, even the most experienced, had complete knowledge of all aspects of the various types of industries that they were covering, and that, therefore, they are deliberately citing the most obvious and most standard violations, rather than attempting at this time to dig into process hazards et cetera. He noted that this will surely come and it should begin fairly shortly, so that industry should not adopt the attitude if they clean the place up and get all the lights working on the exit signs this is all they will be concerned with. Ventilation, noise hazards, dust hazards, process hazards in themselves will fairly shortly become as important as they properly should be in federal inspections.

13. Mr. Barden noted that there have been approximately 200 complaints in Region 2 by the employees. Out of these two hundred only one was found to actually involve a serious violation. The others were actual conditions which did exist and in most cases for which citations were issued, but they were not considered nearly as serious under the act, as the employee complaint had considered them. There have been virtually no complaints of any kind that could be attributed to simple harrassment. Mr. Barden feels that the employers' fears in this regard are entirely unfounded. Mr. Barden also noted one case in which a Union had complained of a violation and investigation showed that the union did not represent the plant, but was indeed attempting to organize the plant. Mr. Barden's group refused to investigate this particular allegation. The law is quite specific in stating that only an employee affected or an employee representative (that is a union) representing the employees in that particular plant who are effected may make a complaint. The Union cannot complain if it does not represent that particular worker and no one outside that particular group of employees can complain about, for example, conditions in somebody else's plant.

14. With regard to responsibility under the law within divisional classifications it was again emphasized that the person in charge of a specific plant has responsibility for conditions in that plant. Should serious violations be found it is possible that divisional and/or corporate management could be held jointly responsible, but in all cases, the manager, supervisor, works manager, (or whatever his title) of <u>that</u> particular place of employment bears the complete responsibility under the law and may not delegate his responsibility under the law to a safety man or other staff official. Citations are issued to the plant manager and penalties in the case of civil penalties would be leveled against the plant manager.

15. With regard to New Jersey's option to maintain a class 18B plan handling OSHA inspections themselves, Mr. Conlon noted that the Unions' are strongly against having the state continue to do it and that most of the employees appear to be in favor of having the state continue to do it. He urged that individually as employers and as groups if it is felt that the state of New Jersey has been doing by and large a good job and could be the most effective

method of continuing OSHA inspections their feelings be made known to the governor who will make the final determination. It was pointed out that the federal government will fund 1/2 of the cost of such inspections, but that if the states decide not to do it at all the federal government will do it themselves. On the surface, of course, this will result in a reduction of operating costs to the state. In fact, it will require more federal taxes from the same sources, individuals, and corporations, for the federal government to do it. As Mr. Conlon pointed out the primary advantage to having the state do it is that one is dealing with Trenton and not with Washington.

16. Mr. Nader expressed the viewpoint that consumer protection was not to be construed as concerning only the user of a product as in preventing unsafe automobiles, or defective toasters, or whatever, but that it affects everyone equally in that we all consume certain commodities, the air we breath, the water we drink, the land we occupy, etc., and that this large overview is the one which we must take both as individuals and as industries. He noted his difficulties in obtaining professional witnesses when he first began his investigations of safety in the automobile industry and stated that only when he was finally able to obtain an engineer or two who is willing to sacrifice his job by testifying was he able to convince Congress of the necessity for safety legislation. He stated that it was the engineers who were able to provide precise, exact examples of the type of defects and safety lacks that he was talking about. He urged that as good citizens, engineers such as those at the meeting make themselves available as witnesses or as experts on committees and to do so through their professional society, this being the manner in which they could do it without risking their individual employment.

Mr. Nader noted that a field of interest to him and to others in the environmental field is that of the mental health and well being of the american workers, to wit, the physiological effect of putting the bolt on the same nut for 40 years at the same point in the assembly line, or the effects of going into a known dangerous atmosphere such as a mine day after day. He also noted that international interest in environmental protection is rapidly breeding international interest and action in worker health and safety protection.

P. L. Bogart

PLB/sr

Route List

C. DePaola
G. I. Rozand
C. G. Thompson
P. R. Scarito
J. Vercauteren
J. Geris
J. J. Zullo
M. Berger
E. Smith
B. Britton
W. W. Heal
B. G. Bonner
D. Rhoads
H. G. Snyder
J. R. Clawson
N. Quist
J. Schmitz
P. Mitten
A. Holmes
J. Kintzel
E. Kanyok
C. Brown
J. Doyle
A. C. Siegel
M. Wagshul
T. Comparato

I-184 (50M)

CONFIDENTIAL

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

A. C. Siegel

TO	G. I. Rozand	AT		DATE	May 2, 1972
FROM	A. C. Siegel	AT		COPY TO	P. R. Scarito

SUBJECT

MEETING REPORT - CARCINOGENIC POTENTIAL OF VINYL CHLORIDE MONOMER

On April 20, 1972, a meeting was held in the Washington, D.C., offices of the Manufacturers Chemists Association (MCA) to discuss a revised research program into the carcinogenic potential of vinyl chloride and the method of funding this program.

Prior to the meeting, I met with Dr. W. J. Boyne and H. L. Schmidt of Borden Chemical and Dr. W. D. Harris of Uniroyal to discuss their concern for the elimination, in the revised research program, of two levels of exposure with acetylene derived vinyl chloride monomer. The Borden representatives, in particular, took a strong position that the acetylene derived vinyl chloride monomer group would be in an untenable situation with regard to the Federal authorities or the public should the highest proposed level (10,000 parts per million) of exposure indicate positive results. They suggested that Borden, Uniroyal and Tenneco assume whatever additional testing costs are required if the remaining members of the vinyl industry could not be persuaded to share these additional expenditures. We agreed to suggest to the group a compromise in the program that would permit the additional levels of testing desired without increasing the overall cost. Then, if that approach proved to be unsuccessful, we would request an official quotation on the cost of testing one or two additional levels that were eliminated from the original program. It would be up to corporation management to decide if they wished to assume the additional burden.

K. D. Johnson (MCA staff) called the meeting to order at 10:00 A.M. on April 20, 1972, and opened with the previously stated purpose of the meeting.

Dr. Torkelson (Dow) reported that Industrial Biotest increased the original cost by $3,000 to $153,000. Additionally, he recommended that funds in the amount of $2,500 be appropriated as part of this program to permit Dr. Dinman of the University of Michigan (A.O.L. Studies) to visit the European Labs currently doing research on the carcinogenic problem. He went on to explain that the European companies have been very reluctant to release any information to the MCA or the American vinyl industry companies on their findings to date. He speculated that this reluctance may be in their desire

to complete their studies before releasing any information. The only possible way there is to obtain this current information in order to guide the American vinyl investigation appears to be through the academic route using the offices of Dr. Dinman. After some speculation on what is thought to be the European program, Dr. Harris, Uniroyal, proposed that our research program be revised to include the original three exposure levels of acetylene derived monomer and maintain essentially the same program cost by using the identical total number of animals, but breaking them into smaller groupings. This proposal was not accepted.

When questioned as to whether any Governmental body has taken an active interest in the possible carcinogenic affect of vinyl chloride monomer, Dr. Torkelson stated that NIOSHA, the basic research arm of OSHA, was aware of the vinyl industry efforts to establish an investigative program. To date, they have not listed vinyl chloride as a carcinogenic agent and appear to be taking the position that the 30,000 parts per million exposure used in Dr. Viola's original experiments were unrealistically high. The Goodrich representative, however, indicated that they may, as a precautionary measure, eliminate use of vinyl chloride monomer where it might lead to public exposure, such as, in aerosol sprays.

The B. F. Goodrich representative questioned Mr. George Best (MCA) on the reasons for the Shell Company's withdrawing its support for the research program. Mr. Best was unable to give an absolute reason, but did speculate on his conversations with them in which they expressed their dissatisfaction with the insufficient attention given to this meeting by the upper management levels of the participating companies. Shell, however, is now the only monomer producing company that is not participating in the program. The Goodrich representative indicated that in view of Shell's withdrawal his top management may now wish to modify their financial commitment to the program. He did not anticipate any drastic change. Mr. Best was directed to contact Shell to see if it was possible to get them back in the group or at least determine their reasons for withdrawing. He was also asked to contact CONOCO in view of Shell's withdrawal since they did not have a representative at this meeting and might not be aware of the situation.

PPG indicated that they would send a letter confirming their willingness to increase their funding commitment by $4,000. Goodrich, Dow, and Ethel all indicated they would advise Mr. Best in writing of their position now that Shell had withdrawn. None expressed concern that the commitment would be any lower than originally stated.

It was recommended that Mr. Best recalculate the necessary commitments with Shell and Standard Oil of New Jersey out of consideration and then resubmit the new assessments to the remaining participating companies. In the event the recalculated commitment does not exceed the originally stated funding limitations, it would be expected that these companies would continue to support the program.

A tentative company payment schedule was then proposed as follows:

*Payment Due	&	Percent of Assessment
1. Upon approval of the MCA Board (not later than July 1, 1972)		40%
2. April 1, 1973		40%
3. April 1, 1974		20%

* It was agreed that any company wishing to pay in advance of this schedule would be permitted to do so.

It was agreed that Borden, Uniroyal, and Tenneco will receive an official quotation on the additional cost that would be required to include one or two additional levels of acetylene derived monomer in the current program.

A motion was made, amended and passed to accept set "A" as the level of exposure but giving the authority to the AD-HOC committee to adjust these levels in accordance with any developing information that may come out of the European studies or our own research program.

Mr. Best indicated that the plant managers of the various monomer producing facilities had been contacted to determine if they could fill cylinders on a continuing basis for the entire length of the program. The MCA was to purchase and supply new cylinders in order to prevent any possibility of contamination, and then supply these cylinders to the producing plants. No one at the meeting seemed to have a good understanding of the current status of this phase of the program.

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I would recommend that Dr. Rosen, as our official representative check to determine if we wish to supply monomer for the program and whether or not our Houston Plant would be in a position to fill cylinders on a continuing basis. If we do not decide to support the two additional levels of acetylene derived monomer exposure, then the quantity of monomer required would only be that necessary for 10,000 parts per million of level of exposure since all the rest of the experimentation would require the ethylene derived material. Dr. Boyne indicated that Borden may be in a position to fill cylinders with both acetylene and ethylene derived monomer from their Illinois plant. Should Dr. Rosen wish to pursue the ramifications of the research program, I would recommend that he contact Dr. Harris, the Industrial Toxicologist for Uniroyal, who is by far the most knowledgeable with regard to this area of research.

Dr. William J. Boyne
Engineering Manager
Borden, Inc.
50 West Broad Street
Columbus, Ohio 43215
614-461-8585

Dr. Walter D. Harris
Industrial Toxicologist
Uniroyal, Inc.
Oxford Management & Research Center
Middlebury, Conn. 06749
203-573-2139

The MCA meeting notes should be sent out within the next few weeks. Attached is a list of those who attended the meeting, a list of official company representatives to future meetings, and information on the proportionate share of funding prior to Shell's withdrawal.

Should you require any additional information, please let me know.

ACSiegel

A. C. Siegel

ACS:pjd
5/1/72
Attchs.

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CARCINOGENIC POTENTIAL OF VINYL CHLORIDE

Research Proposal-Review Meeting

MCA Conference Room-April 20, 1972-10 A.M.

ATTENDANCE

Air Products & Chemicals	W. Mayo Smith
Allied Chemical Corporation	William A. Knapp
Borden Chemical	William Boyne Henry L. Schmidt, Jr.
Dow	T. R. Torkelson
Ethyl Corporation	W. E. Rinehart
Firestone	W. W. Madden
Goodrich	W. E. McCormick B. M. G. Zwicker
Monsanto	E. P. Wheeler
PPG	Zeb G. Bell, Jr.
Stauffer	R. Asti (For M. V. Anthony)
Tenneco	A. C. Siegel (For M. Rosen)
Union Carbide	R. N. Wheeler, Jr.
Uniroyal	W. D. Harris
Goodyear	C. A. Johnson
MCA Staff	G. E. Best K. D. Johnson

5/3/72

pjd

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TECHNICAL TASK GROUP ON TOXICOLOGY
OF VINYL CHLORIDE MONOMER
(Carcinogenicity)

Designations by companies:

Air Products & Chemicals	W. Mayo Smith
Allied Chemical	W. A. Knapp
Borden Chemical	Henry L. Schmidt, Jr.
Conoco	Flynt Kennedy
Dow	T. R. Torkelson
Ethyl	W. E. Rinehart
Firestone	W. W. Madden
Goodrich	W. E. McCormick E. P. Wheeler
Monsanto	-
Olin	Mac Roy Gasque, M. D.
PPG	Zeb G. Bell, Jr.
Shell	-
Standard Oil of N. J.	N. V. Hendricks
Stauffer	A. B. Lindquist
Tenneco	Marvin Rosen
Union Carbide	R. N. Wheeler, Jr.
Uniroyal	Walter D. Harris

5/3/72
pjd

VINYL CHLORIDE MONOMER - CARCINOGENCITY PROJECT

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Contributors	Proudction Capacity VCM & PVC Million lb/yr	Appx. %	Proportionate Share of $165,000
Air Products & Chemicals	160	2.0	$ 3,300
Allied Chemical	440	5.3	8,745
Borden Chemical	390*	4.7	7,755
Conoco	830	10.1	16,665
Dow	1,200	14.6	24,090 (1)
Ethyl	450	5.5	9,075 (1)
Firestone	240	2.9	4,785
Goodrich	1,600	19.4	32,010 (2)
Monsanto	150	1.8	2,970
Olin	150	1.8	2,970
PPG	900	9.7	20,000 (Max)
Shell **	600	7.3	12,045 (3)
Standard Oil of N. J.	-0- (150)	1.8	2,970 (1)
Stauffer	150	1.8	2,970
Tenneco	300	3.6	5,940
Union Carbide	350	4.2	6,930
Uniroyal	285 *	3.5	5,775
	8,345	100.0	$168,995

* Includes Monochem capacity

**Shell withdrew from participation as of 4/20/72

(1) Exceeds stipulated limit

(2) No limit stipulated

(3) Commitment still pending

5/3/72

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TELEX 9-9349

May 31, 1972

TO ALL CONTRIBUTORS OF WATER SPRAY-VAPOR CLOUD TEST PROGRAM:

You all received notice that a series of tests were to be run on May 11 in San Antonio. The following were present:

D. W. Buffy	Olin Corporation
Cantrell, J.	Celanese Corporation
*Doyle, W. H.	FIA
Eggleston, L. A.	SwRI
Gillan, J. E.	ICI America
Grubb, R. C.	duPont
Hallburg, J. O.	duPont
*Mehall, J. R.	Hooker
*Metzger, G. H.	B. F. Goodrich
Pish, M.	SwRI

*Member of Project Steering Committee

Jim Gillan prepared a summary for transmittal to his principals in London. As a result he was nominated, ex post facto, as ad hoc secretary and has accepted the assignment. I enclose a very slightly edited copy of his report.

I also enclose a copy of a report on the same meeting prepared by SwRI.

I have just heard from SwRI that an additional 72 air movement tests have been made but that the results need analysis and that some need repeating because of anomalies.

Sincerely,

W. H. Doyle, Chairman
Steering Committee

WHD:ld
Enclosures

ICI America Inc.

Wilmington, Delaware 19899
(302) 656-9311

INDUSTRIAL RELATIONS DEPARTMENT

May 17, 1972

PROGRESS REPORT
WATER SPRAY - VAPOR CLOUD TEST PROGRAM

Introduction

The Southwest Research Institute, San Antonio, Texas, was visited on May 11 to witness demonstrations planned for representatives of contributing companies.

The tests, originally planned for May 3, were postponed when the test structure was virtually destroyed by tornadic winds. Foul weather again forced cancellation of the tests. Monsoon-like rains the preceding day or two had made it difficult to even drive to the test site, which is remotely located on a cattle ranch a mile off a paved highway.

These difficulties proved to be advantageous. When the test structure was rebuilt, it was redesigned to allow more meaningful testing. Extensive discussion of the program was substituted for the cancelled demonstrations. This discussion, plus a brief inspection of the test site, was at least as informative as witnessing demonstrations.

Summary

SwRI is managing the program efficiently and imaginatively. The past months were mainly devoted to devising a suitable test structure and refining procedural details. Testing should now proceed rapidly.

Completed tests have verified that ab/adsorption effects are minimal. Further tests have proven that water spray does cause air pumping, and presumably vapor dilution. However, amount of pumping is clearly dependent on nozzle design and water pressure. Nozzle height and vent area are suspected variables and shall be investigated.

Tests and data collection procedures have been refined for testing the effect of water spray on the velocity of flame propagation during deflagration.

Preliminary decisions have been made concerning the arrangement of water curtain efficiency tests.

It is unlikely the program can follow a closely prescribed test schedule. Each test series may alter preconceived opinions, pose new questions, and suggest changes in procedures. Some tests may become unnecessary. Additional tests may become advisable. SwRI and the steering committee have developed a flexible management arrangement that should yield maximum results in this situation. [The last sentence also represents the probably biased opinion of the steering committee chairman.]

Loss Control Mechanisms

Water spray systems have been advocated for the suppression and control of flammable vapor clouds based on four probable loss control mechanisms, namely:

- Ab/adsorption causing vapor removal
- Air pumping causing vapor dilution
- Reduction of flame propagation velocity causing reduced overpressure and damage to facilities
- Curtain effect causing limited cloud travel

Ab/adsorption Mechanism

Preliminary tests, not subject to detailed discussion at this meeting, showed that water spray caused no appreciable removal of vinyl chloride monomer vapor from a vapor-air atmosphere. This reportedly confirmed the unpublished results of tests recently conducted on ethylene-air atmospheres by Factory Mutual and Texas Eastman Company.

It was concluded this mechanism is not practical for the removal of relatively insoluble vapors. No further testing is planned.

Air Pumping/Dilution Mechanism

Initial Test Series

The data, previously distributed, from an initial series of 15 tests involving five nozzle designs and three test pressures showed this mechanism can be of value for reducing vapor concentrations.

The pumping efficiency of the nozzles tested varied widely and showed little correlation with droplet size or initial discharge velocity. The Rockwood T4-39 nozzle was the most efficient under the chosen test conditions.

The standard sprinkler caused no measurable air pumping. While this may appear surprising, it is consistent with the design basis of the head. Modern sprinklers are intended to cause no disruption of the thermal updrafts rising from a fire. Their success is partially based on these updrafts carrying small droplets upward to cool structural members above the head.

Additional Test Variables

Two potential variables require investigation to achieve a more complete understanding of the air pumping/dilution mechanism. They are:

- Elevation of nozzle abovegrade.
  Increasing the elevation should lessen and possibly clarify the effect of differences in initial discharge velocities.
- Area of return duct [venting].
  Increasing duct area will demonstrate whether or not the air pumping data in the initial test series was reduced by the relatively limited duct area provided.

Alteration of Test Structure

The initial test series was conducted with a 3 ft. by 3 ft. cross section, return duct framed adjacent a side wall with openings at grade and roof levels. Two additional return ducts have been provided at other walls. Their cross sections are 3 ft. by 4 ft. and 4 ft. by 4 ft. This will permit tests with total duct areas of 9, 21 and 37 sq. feet by using one, two or three ducts in parallel.

During previous tests the structure had a flat roof at an elevation of 15 feet above grade. The test nozzle was centered horizontally at 14'-6" abovegrade.

A new pyramidal style roof has been built above the vertical, 15 ft. high sidewalls. The peak is 20 ft. abovegrade with the four roof panels set at 45° slopes. The tops of the three return ducts are framed into the sloping roof panels. The test nozzle can now be installed at 19'-6" or at any lower elevation by using a vertical drop pipe.

Proposed Future Tests

The initial tests will be repeated using both two and three ducts with four nozzles [omit Sprayco "Special"] at three test pressures. This will mean a total of 24 tests if the series is completed. However, the series may be discontinued if the data agrees closely with the data of the initial test series thereby indicating the air pumping rate is not a variable function of duct area within the range of test conditions.

The initial tests will be similarly repeated with the four test nozzles mounted at 19'-6" abovegrade. These tests may also be discontinued if the increase in nozzle elevation does not cause a significant variation of data.

Reduction of Flame Propagation Velocity

Initial Test Series

Initial tests have verified the feasibility of the currently proposed test procedures. A live test involving the explosion of a VCM-air atmosphere under water spray was recorded on video tape and photographed with a high speed camera. During the meeting, we viewed the high speed film and prints from the tape.

Eye witnesses to the test reported that all they observed was a fireball, a whoosh, and the rupture of the plastic film sheathing on the test structure. However, the visual aids clearly showed the advancing flame front. It is expected this will permit relatively accurate calculation of flame propagation velocities during future tests.

Proposed Future Tests

A test series will be conducted following completion of the air pumping tests. The return ducts will be sealed or removed.

The test series is currently planned to involve use of Reliable, Sprayco 3/4, and Rockwood T4-39 nozzles at 40 psig for VCM-air and ethylene-air atmospheres. This will provide six live tests in addition to a couple of blank [no spray] reference tests.

At this point it is difficult to conjecture on results. There appears to be agreement on the concept that the flame propagation rate increases as turbulence [air pumping] increases. The possibility of producing a quenching effect, possibly as a function of droplet size, will be studied by this test series.

Water Curtain Effect

Test arrangements are relatively vague at this time. The current concept is to arrange a modular, lateral segment of a full scale curtain.

Initial thinking is to remove the existing plastic film walls from the test structure and to erect two, parallel, vertical plastic film walls at a 3 ft. separation. Wall height and length have not been decided, but a dimension of 10 ft. was mentioned in each case. This will form a 3 ft. wide corridor open at the top and at both ends. A nozzle or nozzles will be mounted along the center line of the corridor and well above the top of walls.

A variable speed blower at one end will simulate a wind velocity of between 3 to 18 mph. Vapor will be metered into the wind upstream of the corridor, and vapor concentrations will be measured at the downstream end of the corridor. An ignition source at the downstream end can be used to test the ability of the spray curtain to prevent flashback.

It is likely that some of the upcoming tests will yield data which can be used to improve and further define the test arrangement and procedures for the water curtain tests.

Observations and Comments

There is unquestionably a serious need for the fundamental data that can be expected from these tests. It is difficult to speculate as to the ultimate effect these tests may have on spray system design. It is not impossible that many existing spray systems may be proved to have limited value for control of vapor cloud exposures. Certainly the ab/adsorption conclusion may be surprising to many.

SwRI expects to complete the air pumping tests by the end of May, granting some cooperation from local weather. They have promised to release the raw data promptly to all contributors. It appears likely the flame propagation tests will be completed during June. The vagueness surrounding the water curtain tests discourages any predictions on scheduling.

[signed] J. E. GILLAN

here was the equipment being used for air movement tests and determination of gas concentrations in the test structure. Because of weather conditions, which interfered with work at the test site, a detailed discussion wal held on all test work that had been completed. The development of the procedures for measuring air movement of the various strays was detailed by Eggleston. At this time, copies of the letter of April 26, 1972 from SwRI to F.I.A. was distributed. This letter contained the results of all air movement tests outlined by the Steering Committee as Phase I Air Movement. The ad/absorption tests were discussed next. These tests had been run with both ethylene and vinyl chloride using two different spray nozzles and two different delivery pressures designated by the Steering Committee. These tests and a blank test, with each gas using no water spray, constituted the conclusion of Phase I work.

Phase II, ignition/quench, was discussed next. The main parameter to be measured was the speed of the flame front with and without water sprays. A preliminary test was made using ten percent vinyl chloride and water spray utilizing a "special" spray nozzle. This nozzle delivered a high volume and coarse droplet size. Test records were shown taken from video tape and a high speed film of this test was discussed. At this time the group decided to change the Phase II tests as outlined in the meeting of March 20, 1972 and specify the number and type of tests to be run. It was decided to run all ignition/quench tests with <u>two</u> high speed cameras at 90°. The tests outlined are as follows:

1 - Preliminary (high volume, large droplet)
1 - Blank (no water spray, ethylene)
1 - Blank (no water spray, vinyl chloride)
1 - 1/2" Reliable Nozzle @ 40 psi (ethylene)
1 - 1/2" Reliable Nozzle @ 40 psi (vinyl chloride)
1 - Rockwood T439 @ 40 psi (ethylene)
1 - Rockwood T439 @ 40 psi (vinyl chloride)
1 - 3/4 HH71WSQ @ 40 psi (ethylene)
1 - 3/4 HH71WSQ @ 40 psi (vinyl chloride)

9 tests (1 already run)

At this time, there was a break in the weather so the group was taken to the site for an inspection. The group was shown the test facility, instrument house, power supply, water supply and the fan and engine to be used in Phase III, the air curtain tests.

After returning to SwRI and lunch, the group continued discussion of the ignition/quench tests. It was decided by the group to leave the plenums off

the test facility during Phase II tests to facilitate ease of reconstruction. The position of the ignition source and the use of mixing fans was then considered. This concluded the discussion of Phase II.

Since it was too early in the program to outline tests for Phase III, discussion then centered around the different parameters effecting this work. Of primary interest was additional air movement tests with various plenum sizes which would supplement Phase I work. It was decided by the group to rerun the 1/2" Reliable, Rockwood T439, 3/4 HH71WSQ and 1-1/2 H190WSQ at the original height and five feet higher to evaluate the effect of the greater dropping distance of the water spray on air movement. This work was scheduled for the week of May 15-19. It was also decided to run these tests before continuing with Phase II tests. After the results of these tests were analyzed, a decision would be made on the restart of Phase II tests. Discussed next was the source of vinyl chloride and handling procedures to be used. Metzger agreed to furnish all data to SwRI on this matter. The group decided to run all air curtain tests with a rich concentration of flammable gas.

Discussion ended with W. H. Doyle asking Eggleston to supply him with a rough schedule of tests so contributing firms could send representatives at a later date.

cc W. H. Doyle

VINYL CHLORIDE SAFETY ASSOCIATION
Minutes of May 26, 27, 1970 Meeting
Point Pleasant, W. Va.

1. The dangers of peroxide formations were discussed by Mr. J. T. Barr, Airco Co. It was agreed although this phenomena is more evident in purfied monomer, these will form in almost any monomer. Case histories indicate more prevalent formation in recovery areas. Lower temperatures will slow down the rate of the reaction. The formation of peroxide appears to be more prevalent with positive displacement type compressors; a nitrogen purge on packing glands on a reciprocating type compressor proved to be an answer to this type of problem. No one in attendence could report on peroxide build-up when using a Nash Compressor.

   The use of oxygen monitoring equipment on recovery vent gas was reported and these oxygen readings were reported at 2 to 3%.

   The blockage of recovery systems was indicated by several members and the effective use of Bisphenol in minimizing polymerization problems.

2. The question of providing emergency power for emergency agitation and/or alternates such as manifolded vent system to a flare or the use of a terminator such as iso-prene or styrene was thoroughly discussed with Mr. S. Schreiber, discussion leader. The pros and cons of each system were thoroughly explored and the consensus of opinion was that the most dependable means was to provide emergency power, since terminators only provide for delay reactions.

3. Mr. M. Smith of Conoco Plastics discussed a 10-point model "H" MSA detection system which apparently increases ventilation in a polymer building at 25% of the L.E.L. and automatically tripped the deluge systems at 50% of the L.E.L. The shortcomings of this system were discussed in that the pickup points are on a program basis and could conceivably take 4-5 minutes to complete the program. Allied Chemical and others reported the use of individual diffusion head pickups which trigger ventilation and deluge systems in a matter of seconds. Allied reported satisfaction with Johnson-Williams detectors that have resulted in picking up upset conditions several times.

4. Mr. Clay Thompson substituted for our ailing founder, Mr. G. Rozand, Tenneco Plastics. It was unfortunate that Mr. Rozand was too ill to attend since he was directly responsible for the formulation of this association and for a good portion of our work preceeding the last meeting.

   Mr. Thompson outlined Tenneco's procedure for preventing

valves being opened inadvertently and covered the check list used by Tenneco..

Use of Lenape manheads which prohibits the opening of a reactor when pressurized, was discussed and indicator lights to indicate a kettle was still pressurized, is being used by many members.

Problems and plugging of valves were thoroughly discussed, and a vote of confidence was given to the Yarway valve.

5. The problems associated with reactor cleaning were discussed by Mr. G. Schaaf and reference was made to bone problems and the necessity of pre-employment physicals as well as an X-ray program. More information may be available from Dr. Wilson of B. F. Goodrich Medical Division, 500 S. Main St., Cleveland, Ohio. A film was shown by Mr. Schaaf on Goodrich's patented-automatic cleaning arrangement. (20 Minutes to Clean a Reactor.) Further information concerning this procedure can be obtained from Mr. A. L. Hastings, B. F. Goodrich, 3135 Euclid Avenue, Cleveland, Ohio.

6. Mr. Ray Asti of Stauffer Chemicals discussed the safety advantages of excess flow valves and remote cut-offs and generally outlined their procedures in secondary valves with fusible links at the weigh tanks and on the suction side of pumps. The excess flow valves are designed at two times pumping capacity and can be shut remotely from the control room. The one danger in this system is that small leaks of up to 200 gpm will not trip the valve. Motor operated valves can easily be checked and others can be visually checked for proper seating. The emergency procedure for Escambia was thoroughly explained by Mr. G. Speed, covering their venting procedures, deluge trips, dry runs for emergency procedure for the total plant including escape routes and most importantly, allowing any operator to trip the alarm for the emergency plan. One button in the control room to isolate all feeds into the monomer plant is provided.

7. Mr. Bill Boyle of Monsanto discussed the design of rupture discs and relief valves and some of the pitfalls. Some members indicated their practice of removing all relief valves and using only rupture discs. Mr. Boyle further stated without changing nozzle size on the reactors, it was possible to increase venting capacity by simply flaring a larger sized vent line on to the existing vent line. The practice of using plastic bags over vent stacks causing static charges was reported.

8. Mr. J. T. Barr, Airco Co. reported on potential fires in dryers and reported on a couple of actual case histories. Conoco reported glowing material in the stationary section of the dryer.

9. Mr. Pete Bogart, Tenneco Plastics outlined their procedures for vessel entry and distributed a copy of this check list and procedures. Assuming you all have copies of this procedure, I will not repeat the entire check list. If you want another copy of this check list, I suggest you write directly to Mr. Bogart.

10. The advantages of hydralically designed deluge systems, were discussed by Mr. S. Schreiber, Allied Chemical indicating that their plant has a system designed .35 gpm per sq. ft. of floor area and their actual case history demonstrates the ability of knocking vapor clouds down, and below, the explosive range. There is no qualitative evidence available to prove this theory, but a recent committee has been formulated to actually conduct tests to prove or disprove this theory, sponsored by voluntary contributions from the industry and the FIA, with work being done by Arthur B. Little Co.

11. Although, not part of the planned agenda, Mr. Dowell of Goodrich reported on an accident involving a charge bomb intended to charge IPP into a reactor. An explosion occurred, resulting in a fatality and several injuries. A polymerization took place in the bomb due to a deficient nitrogen pressure, and the fact that their bomb did not have a relief valve nor a rupture disc, and although there were check valves between the reactor and the bomb, it was of no help. This presentation led into a free discussion of the hazards of storing and handling IPP.

S. Schreiber

SS:ls

Shin-Etsu Chemical Industry Co., Ltd.

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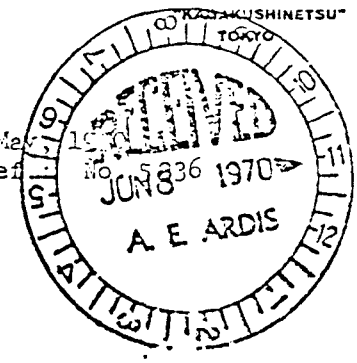


25th Ma 19
Our Ref No. 5836

Olin Reserch Center
275 Winchester Avenue
New Haven 4, Connecticut 06504
U.S.A.

Dear Sir;

We are taking the liberty of writing to you to introduce the newest development in the large-scale manufacture of PVC.

This new technology concerns the introduction of very large polymerizers, 130 cubic meters (34,000 gallons), to the PVC manufacturing process; this process we have developed in our Naoetsu Plant complex, and it will be the basis for our new PVC capacity at Kashima which is scheduled to go on stream about August-September of this year with an ultimate capacity of 300,000 MTPA.

Please note a number of significant advantages which are to be obtained at the time of full-scale operation.

1. The very large polymerizers with our new process will greatly reduce and save on fixed investment.

2. The production of improved, high-quality PVC resins which small-size reactors have not previously been able to achieve.

3. A production capacity of 200,000 - 300,000 MTPA using 5 or 6 workers per shift including the full cycle from raw material charging to resin storage.

4. A maintaining on the internal surface of the polymerizer a mirror-like state offering a virtually self-cleaning technique.

5. The development of the software and process computers for the complete computer control and on-line analysis of a large-sized PVC plant.

Our new technology may be applied to 130 - 150 m^3 polymerizers with a production capacity for each reaching 25,000 - 35,000 MTPA.

We are enclosing published information concerning our newly developed technology, and if your company wishes to have additional information, we would like to indicate, that Mr. C. Kanagawa, General Manager of Shin-Etsu Chemical International Division, expect to be visiting the United States during July or August and would be available to call on your company for discussions.

We would be pleased to hear from you concerning our proposal on the new technical development or the prospect of Mr. Kanagawa's visit at your convenience and assure you of our every cooperation concerning this matter. In your reply please specify to what individual in your organization we should further communicate on this matter.

Yours very truly,

SHIN-ETSU CHEMICAL INDUSTRY CO., LTD.

M. NAKAGAWA
MANAGING DIRECTOR

INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO	Mr. J. Fath	AT	Piscataway	DATE	July 13, 1972
FROM	Dr. P. A. Lobo	AT	Piscataway	COPY TO	
SUBJECT	JAPANESE TRIP - June 24 - July 8, 1972				

The following summarizes the major results of my recent trip to Japan:

PVC Reactor Technology

In meetings with seven Japanese PVC producers, Sumitomo, Kanegafuchi, Denka, Mitsui Toatsu, Sekisui, Nippon Zeon, and Shin-Etsu it was determined that only the latter company is operating suspension reactors above 13,000 gallons in size. Shin-Etsu's plant, comprising seven 34,000 gallon stainless steel reactors, has a capacity of 175,000 tons per annum and has been operating for over a year.

The Shin-Etsu technology also includes a special technique which eliminates manual reactor cleaning as well as radical new developments in dryer design. Preliminary evaluation of their resins has shown them generally comparable to our polymers. As a result of a visit to their plant, I feel their plant construction and computerized control system are highly sophisticated and that we must seriously consider their technology for our proposed PVC plant.

The PVC industry in Japan has an average reactor size above that of the U.S. and may be ahead in the application of computer control to PVC plants. Essentially, all the firms I met with either already had complete plants under on-line control, or were testing the concept in their plants. Techniques in reactor cleanings seemed at a par with those in the U.S. with high pressure water generally utilized.

PVC Paste Resins

Four companies expressed a keen interest in licensing us their know-how for the production of paste resins, Sumitomo, Shin-Etsu, Mitsui and Kanegafuchi. Sumitomo has already licensed Allied and Stauffer in this country and Firestone produces dispersion resins under license from Kanegafuchi.

It appears that anyone of these processes might readily be adapted to our existing 3700 gallon glass-lined reactors at Burlington. I have requested samples of these resins be air-mailed to us and will send additional details to the Japanese companies on our reactor design so that we can determine if a viable project can be developed at an early date.

Polyvinyl Butyral

At a meeting with Sekisui, the sole manufacturer and fabricator of polyvinyl butyral in Japan, the Sekisui people informed me that as yet they had not made a decision on licensing their technology in the States. They suggested we continue to work with

their New Jersey representative as it may be six to twelve months before a policy is formulated. Sekisui is currently building a plant in Mexico in association with a Japanese partner.

PVC Purchase

During meetings with PVC producers and the major Japanese trading companies, our 1973 requirement for 10,000-15,000 tons of general purpose homopolymer was reviewed. At the present time PVC production is curtailed at 75% of capacity by the PVC cartel in an effort to raise domestic prices. Exports are controlled by an export cartel which sets export quantities for individual companies. Compounding these difficulties are the future uncertainty of the value of the Yen in relation to the Dollar.

Several companies felt they might be able to export to us outside the control of the cartel since we are a producer and would use the material internally. This circumstance would minimize, if not eliminate, any danger of dumping charges. Samples of PVC homopolymer will be mailed to us for our evaluation by potential suppliers and several companies agreed to determine immediately from the cartel if direct export was possible.

Impact Modifiers

Kureha and Kanegafuchi were not interested in a meeting to discuss possible licensing of their impact modifier know-how at this time. Consequently, a meeting was arranged with Japan Synthetic Rubber who produces products reported to be competitive to those of Kureha and Kanegafuchi. Samples will be air-mailed to us for our evaluation. Additionally, it was determined from the Nissho-Iwai people that they are in the early stages of marketing Mitsubishi Rayon's impact modifier in the States. Samples will be requested from Nissho's New York office.

Dye Technology

Meetings were held with Mitsui Toatsu to obtain additional information on the structure, manufacturing process and cost of the three Mitsui disperse dyes which we are interested in producing in the States. The Mitsui people are willing to work with us on an exclusive basis in the disperse dye field, and as an indication of this interest will send us five of their dyes just developed for our evaluation. I am highly optimistic that this association will be of great value to us in the long-term.

I also met with Daito, Nippon Kayaku, and Sumitomo, three other leading producers of disperse dyes, however, as developed earlier - their technology is not available to us, or uncompetitive in the U.S. market.

A meeting was held with Hodogaya, the acknowledged leader in the cationic dye field in Japan. We have been marketing limited quantities of Hodogaya's dyes for five years, however, recent revaluation of the Yen has made this virtually impossible. Hodogaya has excess intermediates capacity and is anxious to export intermediates to a U.S. firm for conversion to the finished dyes. This opportunity is open to us if we so desire. As forecasts for cationics are bullish, I feel we should consider their offer seriously.

Dye Intermediates

Contacts were made with the major trading companies, Mitsui and Sumitomo Shoji as well as Sakai and the dye firms mentioned above, to determine the availability of intermediates of interest to us. In general, disperse dye and acid dye intermediates will be critically short in 1973 because of poor forecasting. Consequently, it may be difficult to obtain even the small amounts currently purchased. I believe that the personal contact in Japan will be of benefit in giving us some preference on future purchases. Efforts to obtain H-Acid and Isatin for immediate shipment were unsuccessful.

Para-Hydroxybenzoic Acid

Discussions were held with Mitsui Toatsu and Uneo's sales representatives, Kanematsu-Gosho, as to the status of para-hydroxybenzoic acid in Japan in view of our current requirements. Uneo's has 5000 tons per year of capacity via their continuous process with Mitsui's capacity of 180 tons/year with export capability of 100 tons per year. Evaluation of samples of both products by manufacturing is either underway or scheduled.

Stabilization of Formaldehyde

Mitsui Toatsu has received a U.S. patent covering a novel stabilizer for formaldehyde which is reportedly better than currently used by most formaldehyde producers in the States. They will send us a sample for our evaluation and have indicated an interest in licensing this technology, if we should so desire.

Heat Stable PVC

In a meeting with Nippon Zeon, samples of their thermally stable PVC were requested and will be sent us. This is a new product which supposedly requires less stabilizer, so that the more expensive non-toxic stabilizers can be used at little or no increase in cost. Nippon Zeon is still evaluating their product's market prospects in Japan and hence, has not decided on a licensing policy.

Newport Division

At the request of the Newport Division, inquiries were made to determine the availability of technology for the manufacture of l-menthol. Although it was not possible to definitely confirm Glidden's acquisition of Takasago's know-how in this area, there may be a possibility of obtaining similar technology from Nippon Terpene.

Sanyo Chemical produces a line of resins based on dimer acids which are similar to General Mills' products. Newport's interest in following up in these two areas will be determined.

Licensees

Visits were made to the offices of Harima-Kasai and Kikuchi Pigment as well as Harima's plant near Osaka. Although the latter facility is relatively small, I was impressed by the enthusiasm and interest of Harima's operating and technical staff. They are currently evaluating synthetic acids for dryer manufacture and are making efforts to produce zirconium-base driers. Unfortunately, the main producer of zirconium carbonate in Japan is a major competitor in the drier field.

Kikuchi Pigment is still having difficulty penetrating the liquid stabilizer market as a newcomer against numerous firms that have been in the business for years. They are just about to start sampling Supercryl 100 to local PVC pipe producers. As Kikuchi has substantial stabilizer business with these people, they are optimistic about selling our product which is reportedly better than Japanese flow modifiers.

Polyols

Meetings were held with four of the major polyol manufacturers in Japan - Sanyo, Mitsui Toatsu, Nippon Soda and Asahi Denka, to obtain additional information on their technology for the manufacture of polyols and to evaluate the extent of their involvment in new product development. Sanyo's personal, product mix and research and application capability are impressive. They recently have licensed their know-how through Scientific Design on a non-exclusive basis to a U.S. firm who reportedly is building a plant. Nippon Soda and Mitsui also have broad product lines and can be considered potential licensors.

Polyol plants of all companies visited are small and considerable scale-up will be necessary to obtain a viable U.S. plant. Scientific Design has apparently done this with Sanyo's process and is willing to guarantee performance in larger reactors than is Sanyo. Immediate steps are to evaluate additional samples of polyols from Sanyo, Mitsui and Nippon Soda, including polyols imparting flame retardancy to the polyurethane, and to further define project economics.

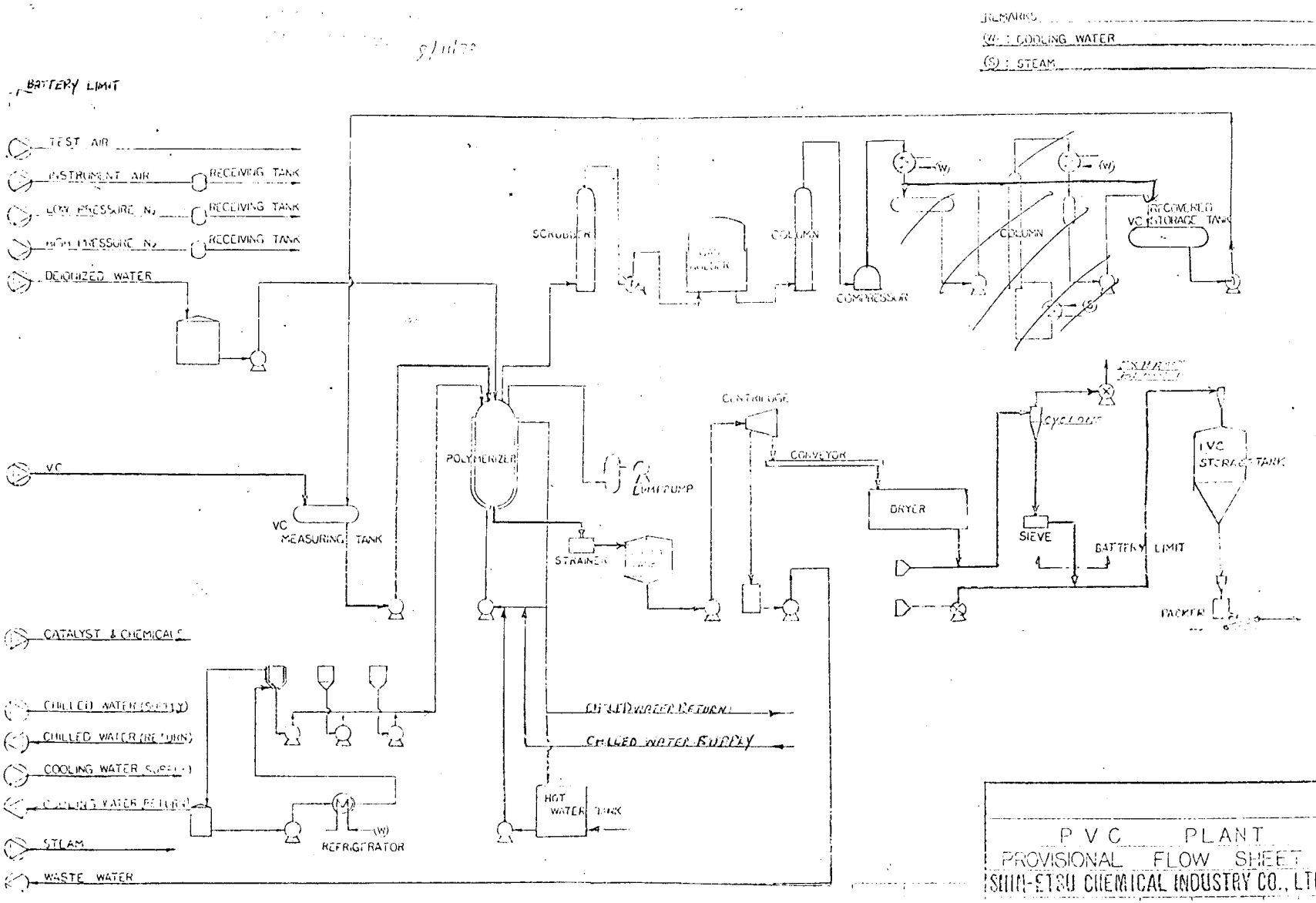
Kanematsu Gosho

A meeting was held with our agent for specialty chemicals, colors and lubricants in Japan, Kanematsu-Gosho. They are making good progress with the Anderols having sold as much in the first six months of 1972 as in all of 1971. This firm also handles drier sales for Harima.

I believe the trip was highly successful in moving our licensing of disperse dyes ahead and in determining the present status of PVC technology in Japan. Also, the contacts made with PVC producers and intermediate manufacturers should assist us in our purchases of these materials during next year. Detailed reports of my meeting with the various companies in Japan are available should you desire additional information.

P. A. Lobo

/jg



CAPITAL COST ESTIMATE - 330MM LBS PVC PLANT

BURLINGTON, NEW JERSEY

				Installed Cost, $
I.	1.	Major Machinery & Equipment	5,836,000	
		Tank Farm	393,800	
		Utilities	1,564,500	
		Not Installed	7,794,300	
		Installation Cost: 25% of M&E 1 x .25 = .25		
		Installed Cost: 1.25 x 7,794,300 =		9,740,000
	2.	Piping		4,180,000
	3.	Electricals		2,045,000
	4.	Instrumentation		1,750,000
	5.	Paint & Insulation		389,000
	6.	Structural (yard, bldg, steel, concrete)		6,710,000
				24,814,000
I.	1.	Indirect Costs (function of direct labor costs)		
		Direct Labor Cost		
		Item I.,1. not installed	7,794,300	
		Add 10% for Material	779,000	
			8,573,300	
		Direct Labor Manhours = 700,000		
		Burlington: $8.53 x 700,000 = 5,971,000		
		Indirect (Field) Costs: 40% x 5,971,000 =		2,388,000
III.	1.	General Contractor's Costs (Home Office)		
		7,794,300 x 1.25 = 9,740,000		
		9,740,000 x .32 =		3,117,000
IV.	1.	Contractor's Fee		
		9,740,000 x .16 =		1,558,000
				31,877,000
Plus additional offsite facilities for Burlington				1,997,000
				33,874,000
Plus 5% Contingency				1,694,000
				35,568,000

Revision 1

H.H. Duhamel

330MM LB PVC PLANT

BURLINGTON, NEW JERSEY

		Purchase Price, $
A.	**Tank Farm**	
1.	MVC Storage Tanks 64' D x 64' H, 2.5MM gals. ea. insulated	321,800
2.	Evaporative Refrigeration, 200 tons	72,000
3.	TCE Storage Tank	Existing
4.	VCM Unloading Station	"
5.	VCM Vaporizer	"
6.	VCM Unloading Compressor	"
7.	TCE Charge Pump	"
8.	VCM Filter	"
9.	TCE Filter	"
10.	TCE Unloading Station	"
		393,800
B.	**Utilities**	
1.	Steam Generator, 200,000 lbs/hr	306,000
2.	Electrical Substation, 9,000 KVA	117,000
3.	Instrument Air, 3 - 2,500 cfm cent. comps (incl dryers)	219,000
4.	Nitrogen Generator, 200 cfm cap	10,000
5.	Well Water, 1,200 gpm	30,000
6.	City Water	Not Required
7.	Water Softeners (& brine tank) 7,500 gal cap	32,800
8.	DM Water Units, Mixed Beds, 6 x 80 gpm	226,000
9.	Caustic Bulk Tank, 35,000 gal (20%)	13,400
10.	Sulfuric Acid Bulk Tank, 5,000 gal (66°)	5,500
11.	Effluent Plant, incl. pit pumps	250,000
12.	Fire Protection	354,000
		1,564,500
C.	**Offsite Facilities (additional)**	
1.	Site Preparation	50,000
2.	Railroad Siding	20,000
3.	Dock for Sea-going Vessels	1,633,000
4.	Area Drainage	50,000
5.	Access Roads	24,000
6.	Yard Lighting	20,000
7.	Communications Equipment	20,000
		1,817,000
8.	Concrete chilled water sump, 500,000 gal.	180,000
		$1,997,000

CAPITAL COST ESTIMATE - 330MM LB PVC PLANT

BATTERY LIMITS EQUIPMENT COMMON TO ALL SITES

		Purchase Price, $
1.	Six (6) 34,000-gal. SS reactors - 6 x 230M	1,380,000
2.	Twelve (12) jacket water pumps - 2,000 gpm	32,400
3.	Six (6) steam-water mixers	6,000
4.	Six (6) hot water hold tanks - 6,000-gal.	9,900
5.	One (1) solution MU tank - 4,000-gal. & 10 HP agit.	19,000
6.	One (1) solution hold tank - 4,000-gal. & 7 HP agit.	8,600
7.	Two (2) solution transfer pumps gear, 200 gpm, 50 HP, 304 SS	~~6,000~~ 3,000
8.	One (1) monomer charge pump, 2,000 gpm, 150 psi	13,900
9.	One (1) DM water charge pump, 2,000 gpm, 150 psi check meter	13,900
10.	One (1) catalyst bldg, 14,000 ft^3, refrigerated -20°F	67,000 with
11.	Two (2) DM water storage tanks, 60,000-gals. ea.	80,000 with
2.	One (1) DM water heater	8,000 with
13.	Three (3) 1,100-ton refrigeration units	200,000
14.	One (1) cooling tower - 10,000 gpm incl. 2 H&CW pumps	108,000
15.	Four (4) recovery compressors, 600 cfm ea.	229,500
16.	Four (4) intercoolers - 91 ft^2 ea.	13,900
17.	Four (4) recovered monomer condensers, 910 ft^2 ea.	40,500
18.	One (1) defoamer tank & agit., SS 304	6,100
19.	One (1) defoamer pump	1,000
20.	Three (3) 10,000 gallon recovered monomer tanks	27,600
21.	One (1) distillation column and reboiler, 5' dia.	75,000
22.	One (1) reflux condenser, 1380 ft.^{2}	25,000
23.	One (1) monomer cooler, 165 ft.^{2}	7,300
~~24.~~	~~One (1) 50-ton refrigeration unit, -20°~~ with vent condenser	~~25,000~~
25.	One (1) gas holder, 60,000 ft.^{3}	82,000
26.	One (1) recov. mon. column feed pump, 50 gpm	1,600
27.	Two (2) caustic circulation feed pumps, 25 gpm	2,000

		Purchase Price, $
28.	Two (2) purified monomer charge pumps, 500 gpm	~~14,400~~
29.	Two (2) rec. mon. filters, 500 gpm	4,400
30.	One (1) 10,000 gal. caustic storage tank	5,000
31.	One (1) heavy ends incinerator	250,000
32.	Four (4) 60,000 gal. slurry tanks SS304 & agitator	184,000
33.	~~Three (3)~~ 4 centrifuge feed pumps, 200 gpm	~~6,900~~
34.	Three (3) 40x60 centrifuges, SS304 & motors	216,200
35.	Three (3) Flash & fluid bed drying systems	1,125,000
36.	Three (3) product sifters w. motor	33,000
37.	One (1) solvent evaporator system, 225 ft^2 heating surface	~~125,500~~
38.	Two (2) residue receivers 1,000 gal. each	~~10,600~~
39.	One (1) feed preheater to evap.	~~1,500~~
40.	One (1) recov. solvent storage tank, 15,000 gal.	~~16,000~~
41.	One (1) used solvent hold tank, 15,000 gal.	~~16,000~~
42.	One (1) solvent heater	~~1,500~~
43.	One (1) solvent circulation pump, 200 gpm	~~4,600~~
44.	One (1) solvent filter, 200 gpm	~~3,000~~
45.	Three (3) pressure tanks & blowers 30,000 lbs/hr. each	~~181,200~~
46.	Thirty ~~(30)~~ 15 10,000 $ft.^3$, overhead alum. storage bins	~~645,000~~
47.	Twelve (12) 5,000 $ft.^3$, inside holding bins, alum.	~~168,000~~
48.	~~Two (2)~~ 1 25,000 lbs/hr. bagging units	~~30~~,000
49.	Two (2) fork trucks	18,000
50.	Computer control	267,000
		$ 5,836,000

AUXILIARIES AND OFFSITE FACILITIES

DESIGN CALCULATIONS

330MM LB PVC PLANT

BURLINGTON, NEW JERSEY

Purchase Price, $

A. Tank Farm

1. MVC Storage Tanks:
Daily usage: $\frac{330 \times 10^6}{350 \times .98}$ = 962,000 lbs MVC/day

= 128,000 gals/day

One month's inv. = 128,000 x 31 = 4,000,000 gals
Tanks, at 85% capacity:

$\frac{(4 \times 10^6)}{.85}$ = 4.7 million, say 5 million gals.

2 - 2.5 million gal. tanks

Cost: Vert. Cyl. $\frac{\pi x^3}{4}$ = $(2.5 \times 10^6)/7.5$ = 333,000 ft^3

x^3 = 262,000 ft^3 x = 64 ft = D' & H'
120,000 x 1.2 index = $144,000 each
Insulation: Area: $\pi R^2 + 2 \pi RH$
= $\pi 32^2 + 2 \pi 32 \times 64$ = 16,100 ft^2
2" polystyrene foam: .69$/$ft^2$ x 1.33 (index) = .92$/$ft^2$
16,100 x .92 = $14,800 each
Total: 160,900 x 2 = 321,800

2. Evap. Refrigeration
Mantua: 250 tons for 2 x 3.36MM
for 2 x 2.5MM, 200 tons - 60000
60,000 x 1.2 = 72,000

B. Utilities

2. Electrical Substation
$\frac{.15 \text{ KW/lb.} \ (330 \times 10^6 \text{ lb./yr})}{8400 \text{ hrs/yr.}}$ = 5900 KWH
Allowing 50% more for peak load, 9000 KVA.
Cost: 7500 KVA: 105,000
for 330: 105,000 $(\frac{9000}{7500})^{.6}$ = 117,000.

4. Nitrogen Generator
Concrete pad 10,000.

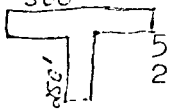
5. Well Water
D.M. water, & Make-up only
Steam: Condensate return

D.M. water:	320 gpm
C.T. 10% of 10,000 =	1000 gpm
Steam 10% of 400 =	40 gpm
	1360 gpm
	$30,000

	Total Price, $
C. Offsite Facilities	
1. Site Preparation (same as Pasadena)	$50,000
2. Railroad siding (same as Pasadena)	20,000
3. Dock for sea-going vessels	

Dredging, 1.15 million yd^3 x 1.20 = $1,380,000

Wharf, T shaped



500' x 50' = 25,000
250' x 50' = 12,500
37,500 ft^2 x 50 .$/$ft^2$ = 1,125,000

2 mooring dolphins, 16' diam.
(75' total height) 20' below river bottom & 15' above L.W.L.

	50,000
Pile driver set-up	15,000
	$2,570,000

4. Wharf for sea going vessels - Revised Estimate for lighter construction.

(Poppet 102)

Wharf: 3 in. deck, light construction
max. 7.5 $/$ft^2$ x 1.2 (index) = 9 $/$ft^2$
T shape Quote from Mr. Earle: $10/$ft^2$
500' x 25' paralled to channel = 12,500 ft^2
250' x 25' shoreward = 6,250 ft^2
18,750 ft^2

18,750 x 10 =		$ 187,500
	say	188,000
2 mooring dolphins, 16' diam.		50,000
Pile driver set-up		15,000
		253,000
Dredging: 1.15 million yd^3 x 1.20 =		1,380,000
	Total	$1,633,000

CAPITAL COST ESTIMATE - 330MM LBS PVC PLANT

PASADENA, TEXAS

				Installed Cost, $
I.	1.	Major Machinery & Equipment	5,836,000	
		Tank Farm	468,300	
		Utilities	1,581,700	
		Not Installed	7,886,000	
		Installation Cost: 25% of M&E x 0.75 of Burlington labor cost: .25 x .75 = 0.188		
		Installed Cost: 1.188 x 7,886,000		9,360,000
	2.	Piping		4,030,000
	3.	Electricals		1,968,000
	4.	Instrumentation		1,686,000
	5.	Paint & Insulation		375,000
	6.	Structural (yard, bldg, steel, concrete)		6,460,000
				23,879,000
II.	1.	Indirect Costs (function of direct labor cost)		
		Direct Labor Cost		
		Item I.,1. not installed	7,886,000	
		Add 10% for Material	789,000	
			8,675,000	
		Direct Labor Manhours	710,000	
		Pasadena: $6.42 x 710,000 = $4,560,000		
		Indirect (Field) Costs: 40% x 4,560,000 =		1,824,000
III.	1.	General Contractor's Costs (Home Office)		
		Same as if plant was built in Burlington, i.e. 9,360,000 x .32		3,000,000
IV.	1.	Contractor's Fee		
		Same as above		
		9,360,000 x .16 =		1,500,000
				30,203,000
Plus additional offsite facilities for Pasadena				364,000
Plus 5% contingency				1,530,000
				32,097,000

Revision 1

H.H. Duhamel

AUXILIARIES AND OFFSITE FACILITIES

330MM PVC PLANT

PASADENA, TEXAS

		Purchase Price, $
A.	**Tank Farm**	
1.	MVC Storage Tanks	(pipeline delivery)
2.	Evaporative Refrigeration	(pipeline delivery)
3.	TCE Storage Tank, 5,000 gal.	3,000
4.	VCM Unloading Station	(pipeline delivery)
5.	VCM Vaporizer	(pipeline delivery)
6.	VCM Unloading Compressor	(pipeline delivery)
7.	TCE Charge Pump, 304 SS 100 gpm	5,000
8.	VCM Filter SS 304	(pipeline delivery)
9.	TCE Filter SS 304 100 gpm	1,800
10.	TCE Unloading Station	2,500
11.	Resin conveying system 12 units (2500 ft.)	456,000
	Total	$ 468,300
B.	**Utilities**	
1.	Steam Generator 200,000 lbs/hr (6,000 H.R.)	306,000
2.	Electrical Substation switchgear, bldg. MCC's	150,000
3.	Instrument air 3 - 2,500 cfm cent. comps. incl. dryers	219,000
4.	Nitrogen Generator 200 cfm cap	(existing)
5.	Well Water, make-up only, 500 gpm	25,000
6.	City Water 9,000 gpm (60°)	(not required)
7.	Water Softeners (& Brine Tank) 7,500 gal. each	32,800
8.	D.M. Water Units, Mixed Beds 6x80 gpm.	226,000
9.	Caustic Bulk Tank 35,000 gal. (20%)	13,400
10.	Sulfiric Acid Bulk Tank 5,000 gal. (66°)	5,500
11.	Effluent Plant incl. pit pumps	250,000
12.	Fire Protection	354,000
	Total	$ 1,581,700
C.	**Offsite Facilities** (additional)	
1.	Site preparation	50,000
2.	Railroad siding	20,000
3.	Dock for sea going vessels (existing)	-
4.	Area drainage (little)	50,000
5.	Access roads	24,000
6.	Yard lighting	20,000
7.	Communications equipment	20,000
	Total	$ 184,000
8.	Concrete chilled water sump, 500,000 gal.	180,000
		$ 364,000

CAPITAL COST ESTIMATE - 220MM LB PVC PLANT

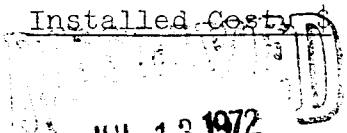
BATTERY LIMITS EQUIPMENT COMMON TO ALL SITES

		Purchase Price, $
1.	Six (6) 34,000-gal. SS reactors - 6 x 230M	1,380,000
2.	Twelve (12) jacket water pumps - 2,000 gpm	32,400
3.	Six (6) steam-water mixers	6,000
4.	Six (6) hot water hold tanks - 6,000-gal.	9,900
5.	One (1) solution MU tank - 4,000-gal. & 10 HP agit.	19,000
6.	One (1) solution hold tank - 4,000-gal. & 7 HP agit.	8,600
7.	Two (2) solution transfer pumps gear, 200 gpm, 50 HP, 304 SS	6,000
8.	One (1) monomer charge pump, 2,000 gpm, 150 psi	13,900
9.	One (1) DM water charge pump, 2,000 gpm, 150 psi	13,900
10.	One (1) catalyst bldg, 14,000 ft^3, refrigerated -20°F	67,000
11.	Two (2) DM water storage tanks, 60,000-gals. ea.	80,000
12.	One (1) DM water heater	8,000
13.	Three (3) 1,100-ton refrigeration units	200,000
14.	One (1) cooling tower - 10,000 gpm incl. 2 H&CW pumps	108,000
15.	Four (4) recovery compressors, 600 cfm ea.	229,500
16.	Four (4) intercoolers - 91 ft^2 ea.	13,900
17.	Four (4) recovered monomer condensers, 910 ft^2 ea.	40,500
18.	One (1) defoamer tank & agit., SS 304	6,100
19.	One (1) defoamer pump	1,000
20.	Three (3) 10,000 gallon recovered monomer tanks	27,600
21.	One (1) distillation column and reboiler, 5' dia.	75,000
22.	One (1) reflux condenser, 1380 $ft.^2$	25,000
23.	One (1) monomer cooler, 165 $ft.^2$	7,300
24.	One (1) 50-ton refrigeration unit, -20°	25,000
25.	One (1) gas holder, 60,000 $ft.^3$	82,000
26.	One (1) recov. mon. column feed pump, 50 gpm	1,600
27.	Two (2) caustic circulation feed pumps, 25 gpm	2,000

		Purchase Price, $
28.	Two (2) purified monomer charge pumps, 500 gpm	14,400
29.	Two (2) rec. mon. filters, 500 gpm	4,400
30.	One (1) 10,000 gal. caustic storage tank	5,000
31.	One (1) heavy ends incinerator	250,000
32.	Four (4) 60,000 gal. slurry tanks SS304 & agitator	184,000
33.	Three (3) centrifuge feed pumps, 200 gpm	6,900
34.	Three (3) 40x60 centrifuges, SS304 & motors	216,200
35.	Three (3) Flash & fluid bed drying systems	1,125,000
36.	Three (3) product sifters w. motor	33,000
37.	One (1) solvent evaporator system, 225 ft^2 heating surface	125,500
38.	Two (2) residue receivers 1,000 gal. each	10,600
39.	One (1) feed preheater to evap.	1,500
40.	One (1) recov. solvent storage tank, 15,000 gal.	16,000
41.	One (1) used solvent hold tank, 15,000 gal.	16,000
42.	One (1) solvent heater	1,500
43.	One (1) solvent circulation pump, 200 gpm	4,600
44.	One (1) solvent filter, 200 gpm	3,000
45.	Three (3) pressure tanks & blowers 30,000 lbs/hr. each	181,200
46.	Thirty (30) 10,000 $ft.^3$, overhead alum. storage bins	645,000
47.	Twelve (12) 5,000 $ft.^3$, inside holding bins, alum.	168,000
48.	Two (2) 25,000 lbs/hr. bagging units	50,000
49.	Two (2) fork trucks	18,000
50.	Computer control	267,000
		$ 5,836,000

CAPITAL COST ESTIMATE - 330MM LBS PVC PLANT

FORDS, NEW JERSEY



I.	1.	Major Machinery & Equipment	5,836,000	
		Tank Farm	444,200	
		Utilities	1,564,500	
		Not Installed	7,844,700	
		Installation Cost: 25% of M&E x 1.05 of Burlington labor cost: .25 x 1.05 = .263		
		Installed Cost: 1.263 x 7,844,700		9,900,000
	2.	Piping		4,260,000
	3.	Electricals		2,080,000
	4.	Instrumentation		1,782,000
	5.	Paint & Insulation		397,000
	6.	Structural (yard, bldg, steel, concrete)		6,830,000
				25,249,000
II.	1.	Indirect Costs (function of direct labor cost)		
		Direct Labor Cost		
		Item I.,1. not installed	7,844,700	
		Add 10% for Material	784,000	
			8,628,700	
		Direct Labor Manhours = 705,000		
		Fords: $8.93 x 705,000 = $6,300,000		
		Indirect (Field) Costs: 40% x 6,300,000 =		2,520,000
III.	1.	General Contractor's Costs (Home Office)		
		Same as if plant was built in Burlington, i.e.		
		7,844,700 x 1.25 = 9,800,000		
		9,800,000 x .32 =		3,136,000
IV.	1.	Contractor's Fee		
		Same reasoning as above		
		9,800,000 x .16 =		1,568,000
				32,473,000
		Plus additional offsite facilities for Fords		2,947,000
				35,420,000
		Plus 5% Contingency		1,771,000
				37,191,000

Revision 1

H.H. Duhamel

AUXILIARIES AND OFFSITE FACILITIES

MILLION POUND PVC PLANT

FORDS, N. J.

		Purchase Price, $
A.	**Tank Farm**	
1.	MVC Storage Tanks, 64' H x 64' D insul. 2.5MM gals ea.	321,800
2.	Evaporative Refrigeration 200 tons	72,000
3.	TCE Storage Tank 5,000 gals	3,000
4.	VCM Unloading Stations, 4	24,000
5.	VCM Vaporizers, 2	4,000
6.	VCM Unloading Compressors, 2	5,000
7.	TCE Charge Pump, 304 SS, 100 gpm	5,000
8.	VCM Filter SS 304, 2,000 gpm	6,000
9.	TCE Filter, SS 304, 100 gpm	900
10.	TCE Unloading Station	2,500
		$ 444,200
B.	**Utilities**	
1.	Steam Ge erator, 200,000 lbs/hr.	306,000
2.	Electrical Substation, 9,000 KVA	117,000
3.	Instrument air 3 - 2500 cfm cent. comp. incl. dryers	219,000
4.	Nitrogen Generator, 200 cfm	10,000
5.	Well Water, make-up, steam, DM, 500 gpm	25,000
6.	City Water	-
7.	Water Softeners & Brine Tank	32,800
8.	D.M. Water Units, Mixed Beds 6 - 80 gpm	226,000
9.	Caustic Bulk Tank 35,000 gal. (22%)	13,400
10.	Sulfuric Acid Bulk Tank 5,000 gal. (66%)	4,500
11.	Effluent Plant incl. pit pumps	250,000
12.	Fire Protection	354,000
		$ 1,564,500
C.	**Offsite Facilities (additional)**	
1.	Site preparation	1,000,000
2.	Railroad siding	20,000
3.	Dock for sea going vessels	1,633,000
4.	Area drainage	50,000
5.	Access roads	24,000
6.	Yard lighting	20,000
7.	Communications equipment	20,000
		$ 2,767,000
8.	Concrete chilled water sump, 500,000 gal.	180,000
		$ 2,947,000

CAPITAL COST ESTIMATE - 330MM LB PVC PLANT

BATTERY LIMITS EQUIPMENT COMMON TO ALL SITES

		Purchase Price, $
1.	Six (6) 34,000-gal. SS reactors - 6 x 230M	1,380,000
2.	Twelve (12) jacket water pumps - 2,000 gpm	32,400
3.	Six (6) steam-water mixers	6,000
4.	Six (6) hot water hold tanks - 6,000-gal.	9,900
5.	One (1) solution MU tank - 4,000-gal. & 10 HP agit.	19,000
6.	One (1) solution hold tank - 4,000-gal. & 7 HP agit.	8,600
7.	Two (2) solution transfer pumps gear, 200 gpm, 50 HP, 304 SS	6,000
8.	One (1) monomer charge pump, 2,000 gpm, 150 psi	13,900
9.	One (1) DM water charge pump, 2,000 gpm, 150 psi	13,900
10.	One (1) catalyst bldg, 14,000 ft^3, refrigerated -20°F	67,000
11.	Two (2) DM water storage tanks, 60,000-gals. ea.	80,000
12.	One (1) DM water heater	8,000
13.	Three (3) 1,100-ton refrigeration units	200,000
14.	One (1) cooling tower - 10,000 gpm incl. 2 H&CW pumps	108,000
15.	Four (4) recovery compressors, 600 cfm ea.	229,500
16.	Four (4) intercoolers - 91 ft^2 ea.	13,900
17.	Four (4) recovered monomer condensers, 910 ft^2 ea.	40,500
18.	One (1) defoamer tank & agit., SS 304	6,100
19.	One (1) defoamer pump	1,000
20.	Three (3) 10,000 gallon recovered monomer tanks	27,600
21.	One (1) distillation column and reboiler, 5' dia.	75,000
22.	One (1) reflux condenser, 1380 $ft.^2$	25,000
23.	One (1) monomer cooler, 165 $ft.^2$	7,300
24.	One (1) 50-ton refrigeration unit, -20°	25,000
25.	One (1) gas holder, 60,000 $ft.^3$	82,000
26.	One (1) recov. mon. column feed pump, 50 gpm	1,600
27.	Two (2) caustic circulation feed pumps, 25 gpm	2,000

		Purchase Price, $
28.	Two (2) purified monomer charge pumps, 500 gpm	14,400
29.	Two (2) rec. mon. filters, 500 gpm	4,400
30.	One (1) 10,000 gal. caustic storage tank	5,000
31.	One (1) heavy ends incinerator	250,000
32.	Four (4) 60,000 gal. slurry tanks SS304 & agitator	184,000
33.	Three (3) centrifuge feed pumps, 200 gpm	6,900
34.	Three (3) 40x60 centrifuges, SS304 & motors	216,200
35.	Three (3) Flash & fluid bed drying systems	1,125,000
36.	Three (3) product sifters w. motor	33,000
37.	One (1) solvent evaporator system, 225 ft^2 heating surface	125,500
38.	Two (2) residue receivers 1,000 gal. each	10,600
39.	One (1) feed preheater to evap.	1,500
40.	One (1) recov. solvent storage tank, 15,000 gal.	16,000
41.	One (1) used solvent hold tank, 15,000 gal.	16,000
42.	One (1) solvent heater	1,500
43.	One (1) solvent circulation pump, 200 gpm	4,600
44.	One (1) solvent filter, 200 gpm	3,000
45.	Three (3) pressure tanks & blowers 30,000 lbs/hr. each	181,200
46.	Thirty (30) 10,000 $ft.^3$, overhead alum. storage bins	645,000
47.	Twelve (12) 5,000 $ft.^3$, inside holding bins, alum.	168,000
48.	Two (2) 25,000 lbs/hr. bagging units	50,000
49.	Two (2) fork trucks	18,000
50.	Computer control	267,000
		$ 5,836,000

AUXILIARIES AND OFFSITE FACILITIES

DESIGN CALCULATIONS

330MM LB PLANT

FORDS, NEW JERSEY

A. Tank Farm

4. VCM Unloading Stations

VCM Vaporizer 2 x 2000 = 4,000
Unloading comp. 2 x 2500 = 5,000
Unloading platform 4 x 6000 = 24,000
$33,000

9. TCE filter, 304 SS 100 gpm 200 psi
25 microns, quote: $891. (18 cartridges)

8. VCM filter, 2000 gpm, 304-SS 200 psi
25 microns, quote $6,000. (330 cartridges)

C. Offsite Facilities

1. Fords: South of existing plant - Raritan river frontage
Site preparation (C.G.T. to H.H.D. 5/18/72)

Soil stabilization:
20 Acres: Muckout 4 to 10', replace with fill.
50,000 $/acre x 20 = $1,000,000.

2. Fords: North of existing plant (C.G.T. to H.H.D. 5/18/72)
Soil stabilization: $25,000/acre x 20 = $500,000.

3. Normal Site Preparation
(P & T 113) 1% of fixed capital investment
1% x 37,000,000 = $370,000.

SHIN-ETSU CHEMICAL INDUSTRY CO., LTD. July 1, 1972

ESTIMATED CONSTRUCTION COST

1. Assumption

   1) Basis of cost estimate

      All cost estimate are based on the cost in Japan as of June, 1972.

   2) Plant capacity (6 REACTORS) (3-DRYERS)

      150,000 MTPA in terms of Shin-Etsu's grade TK1000

   3) Working hour

      350 days per year, 8,400 hours per year

   4) The battery limit covers processes starting from the pure VC measuring tank up to the ~~sieves~~ SCREENS for dried PVC product. All the utilities including deionized water are ~~boundaries~~ OUTSIDE of the battery limit.

2. Construction cost (Japanese Yen)

Process equipment	844,200,000
Foundation	67,400,000
Installation (ERECTION)	42,600,000
Building & structure - PER KASHIMA DESIGN	149,700,000
Piping	
Pipes	27,000,000
Fittings	33,500,000
Valves	57,400,000
~~Works~~ LABOR	77,300,000
Sub total	195,200,000
Insulation & painting	34,500,000

COLORITE 007239

Wiring	
Electrical equipment	59,400,000
Cable & wire	27,100,000
Miscellaneous	33,000,000
Works LABOR	34,000,000
Sub total	153,500,000
Instrumentation	
Analog instrument & control valves	250,700,000
Panel & sequence devices	191,200,000
Computer & power source	(120,000,000)
Miscellaneous	95,500,000
Works LABOR	33,000,000
Sub total	690,400,000
Temporary ~~Construction~~ Cost (STORAGE, TEMP ELECTRICAL, ETC	18,000,000
Grand total	2,195,500,000

3. Cost of main equipment (FOB, Japanese main port) *

Polymerizer (130m^3) with auxiliary equipment	63,000,000 | 6 - 378,000
Dryer (7MT/H) with auxiliary equipment (CYCLONES + HEATER - SYSTEM)	55,000,000 x 3 = 165,000
AGITATOR + MOTOR	5 x 3,000
	844
	301

* INCLUDES EXPORT PACKING @ 10% (SHIPPING CONTAINER)

300 MM # PVC Plant

7/13/72

Firm Confirmation of exact mix dest eq't.
Why do we need column?
bag vs bulk %

$$\begin{aligned} &40,000 \text{ gal} \\ &= 5000\ ft^3 \\ &\times 5 \\ &\overline{25,000\ ft^3} \\ &\times 10 \\ &\overline{250,000\ ft^3} \\ &\approx 270/ton \end{aligned}$$

28,000 lb/day

4 ladder day

COLORITE 007241

PVC reactors provide precise temp control, automated cleaning

Top view of one of the 20,000-gal, conventionally jacketed reactors for the Deer Park plant on flat car prior to installation. Note jacketing on top head

Six large, jacketed reactors for the production of polyvinyl chloride at Diamond Shamrock's PVC plant in Deer Park, Texas meet specific requirements for precise temperature control and automated cleaning capability.

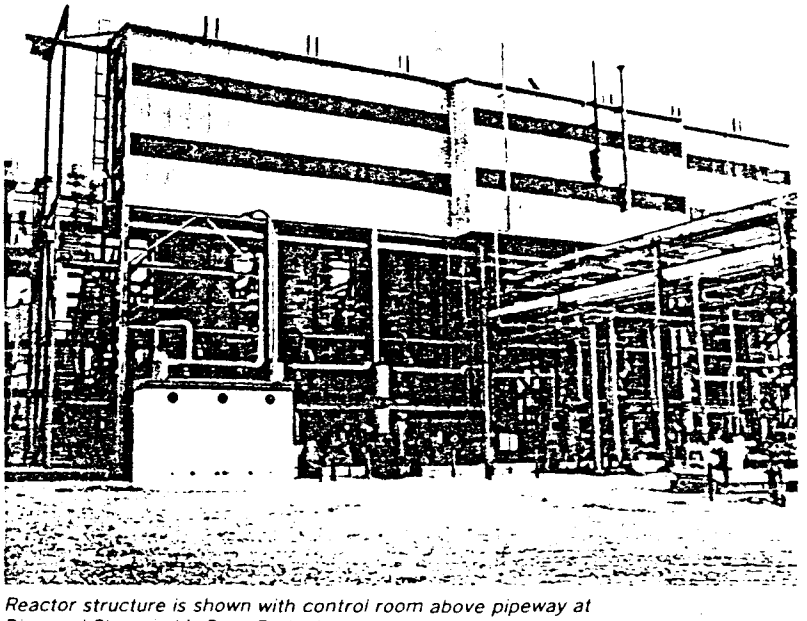
In the production of polyvinyl chloride, Diamond Shamrock uses a proprietary suspension technique to polymerize vinyl chloride monomer under agitation in the presence of an initiator that is soluble in the monomer. Precise temperature control, water and a suspension agent are absolutely essential to the reaction.

Reactors were provided with conventional jackets completely surrounding the shells. Chilled water is circulated through the jackets to dissipate the heat generated by the reaction. To provide added cooling capacity, the top heads of the reactors are also jacketed. All of these efficient heat-transfer methods contribute to extremely accurate regulation of reaction temperature which is critical to the process.

Health and safety considerations demanded remote control hydraulic cleaning. A special cleaning system, specifically developed for this plant, does not require maintenance personnel to enter the reactors for manual cleaning. Nozzles on the hydraulic units direct jets of extremely high pressure water against the interior surfaces of the reactor to clean and remove residual polymer from throughout the inside of the vessels.

The six reactors each have a capacity of 20,000 gal. They are fabricated from Type 304 ELC clad stainless steel and built with a special "mini-skirt" design with legs. Super-finished interior surfaces, which include both an 180-grit mechanical finish and an electropolish finish, make the use of these computerized cleaning units practical. The high-release electropolish finish is applied to the mechanical finish in the reactor's interior to prevent product adhesion. This process, which is guaranteed not to fracture, chip, crack, flake or peel, is particularly valuable where frequent between-batch cleaning is required.

With the use of jacketed reactors, accurate temperature regulation of PVC production is achieved. Health and safety of plant operators is provided through the use of remote control hydraulic cleaning. Both factors contribute in making this 200 million lb/yr PVC plant safe and efficient. ■



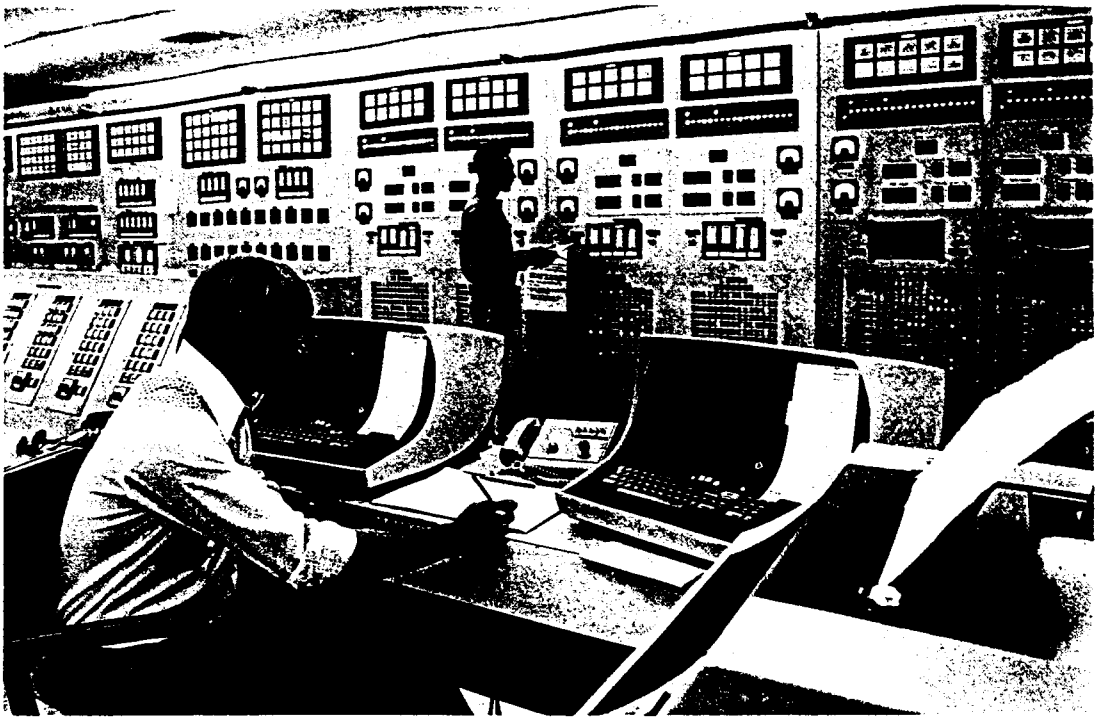
Reactor structure is shown with control room above pipeway at Diamond Shamrock's Deer Park plant

Additional information on the reactors is available from Brighton Corp., 11861 Mosteller Rd., Cincinnati, OH 45241.

Circle 352 opposite last page

Engineering, design, procurement and construction services at Diamond Shamrock PVC plant were provided by C.F. Braun & Co., 1000 S. Fremont Ave., Alhambra, CA 91802.

Circle 353 opposite last page



Shintech's master control room keeps continuous track of all operating units, while CRT screens display operating conditions and product status upon call

Computer control raises throughput 40% on basis of capital cost

CHARLES HARRINGTON, Technical Manager
Shintech Inc.
Houston, Texas
JOSEPH POWERS, Associate Editor

Precise computer control, augmented by proven large-reactor technology and advanced engineering, is helping the recently expanded 320-million-lb/yr plant of Shintech Inc. to produce uniform, high-quality poly (vinyl chloride) resin. Shintech's 35,000-gal reactors, designed to operate at the industry's highest efficiency ratios, provide economies of scale and also ultra-uniform resin for critical rigid and plasticized PVC products.

This plant, located in Freeport, Texas, has the largest PVC suspension-polymerization reactors on-stream in the country. Shintech employs sophisticated computer control to specify the grade and quantity of resin to be made for any specific run, then directs the entire processing operation — sequencing and actuating the equipment to assure quality consistency of the finished resin. Continuous exact reactor control provides a product with excellent uniformity and consistency.

The PVC process, developed by Shin-Etsu Chemical Industries Ltd., of Tokyo, Japan, became a commercial reality with the 1970 completion of a plant for the mass production of PVC in Kashima, Japan. The process provided the resolution to numerous longstanding barriers to scale-up of batch polymerized suspension PVC manufacture. In particular, the precise control of large-volume polymerization vessels became feasible.

Shin-Etsu then provided the engineering design for a new U.S. plant utilizing the new process. It was constructed in 1974 by Shintech Inc., Shin-Etsu's subsidiary, in Freeport. The Freeport plant integrates all the mass-production design features of the Kashima plant with direct digital computer control.

Shin-Etsu has numerous international licensees for the new process, including Shintech, Tenneco Chemical, and Firestone Plastics in the U.S.

Important to large-scale production of PVC are the demands of process safety and product consistency. Both require absolute reproducibility of what goes into the process and of what is allowed to happen within the process. This can be achieved only by computer control. At the Shintech plant, twin direct-digital computers are major components of the overall control scheme.

Valves, fittings and tubing are made from Teflon PFA for corrosive applications over a temperature range from cryogenic to 500°F. Technical data and detailed specifications for individual items are covered in Fluid Handling Products Catalog. Fluid handling cat. Fluoroware Inc.

Circle 796 opposite last page.

In-place pipeline coating based on a corrosion- and solvent-resistant polyamide epoxy formulation is highlighted in 8-pg brochure. Time-saving features of the process are described and measurable economic advantages of internal pipeline coating are shown by graphs which compare bare pipe and coated pipe for pressure drop in a 30″ gas pipeline, and loss of head in a 6″ water pipeline. Bro F-4128 — Industrial Services Subsidiary, Union Carbide Corp.

Circle 797 opposite last page.

Stainless steel connectors for corrosive fluid services are featured in catalog that contains detailed specifications on hose fittings, quick-disconnect couplings and adapters. Bul 5506. Aeroquip Corp., a subsidiary of Libbey-Owens-Ford Co.

Circle 798 opposite last page.

Cold galvanizing compound can be applied by brush, roller or spray on ferrous and non-ferrous surfaces to prevent rust and rust creepage. Surface preparation, federal/industrial test conformance data, and information on re-galvanizing damaged and worn hot-dipped galvanized surfaces is included in 4-pg Bul 104. ZRC Chemical Products Co.

Circle 799 opposite last page.

Tubes, pipes and plates for critical applications are available in commercially pure nickel, titanium and copper and their alloys, in addition to a full range of stainless steels. Chemical composition, physical and mechanical properties, and typical applications are detailed in 60-pg "Vital Dimensions in Metals" booklet. V.D.M. Div., Ore & Chemical Corp.

Circle 800 opposite last page.

Copper-based alloys are highlighted in 86-pg capabilities brochure that includes sections on the cast, wrought and fabricated forms in which aluminum bronzes and other alloys can be specified. Detailed charts cover the composition, properties and specifications for more than 75 alloys with nominal chemical composition, mechanical properties, specifications and forms available. Copper Alloys Capabilities/application Bro. Ampco Metal Div., Ampco-Pittsburgh Corp.

Circle 801 opposite last page.

Circle 802 opposite last page.

The computers perform a number of functions such as sequencing, additions, DDC (direct-digital control), monitoring and emergency contingencies.

In the sequencing function, the batch polymerization process is divided into sub-processes and further subdivided into discrete operating steps. Computer control ensures that all prerequisites for each operating step are met. For example, before starting a pump, tank levels and valve positions must be confirmed. Each operating step takes place in the correct order.

Furthermore, each of the raw materials for the suspension-polymerization of PVC must be added in precisely the correct amount at exactly the proper time in the process sequence. The computer monitors and verifies all materials changes. Everything that goes into the process is controlled.

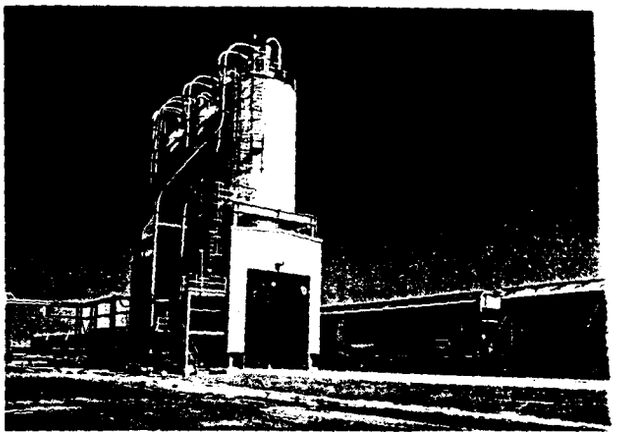
Major process variables, such as polymerization temperature, are under DDC. As part of a carefully conceived process engineering scheme, the computer provides a degree of precise process control — hence batch-to-batch reproducibility — previously unattainable in PVC manufacture.

Dependent process variables and important equipment parameters are monitored on-line against preset standards. Conditions such as pump-discharge pressures, rotating equipment speeds, valve positions, and tank levels are followed continuously. This provides the operating technician with immediate fingertip access to all important process conditions.

As the scale of any manufacturing process increases, so does the scale of potential emergency situations. Integral to the new PVC process are contingencies for safely terminating the polymerization reaction at any point should an emergency condition occur. The computer plays a role in initiating emergency-control procedures, including computer malfunction sequences.

The safe design of the process includes both passive and active safeguards — passive safeguards, such as detailed process monitoring and double-checking to prevent the occurrence of emergency conditions, and active safeguards to provide contingency sequences in case an emergency does occur.

Computer control can give increases of 30 to 40% in throughput per unit of capital cost, when compared with manual control. Under the latter, a polymerization cycle may take about 14 hours. Computer control can cut this time significantly, depending upon grade.



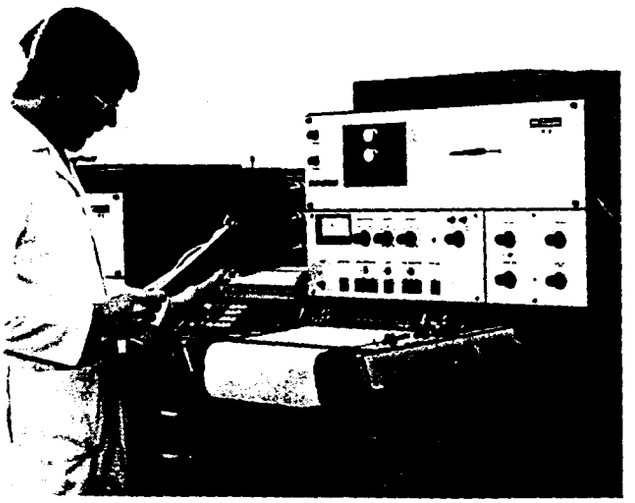
Half of the loading silos, containing specific grades of Shintech ultrapure powdered PVC resins, can load more than 300 tons/day into rail cars by pneumatic transfer

It accomplishes this by several means. First, it takes dead time out of the process by making certain that the reactor and its associated equipment are never standing idle waiting for an operator to do something. Second, it optimizes and hastens the heat-up and cool-down phases of the process. And third, it allows simultaneous performance of steps that must be done serially in a manually controlled plant.

Charging a PVC reactor involves a large number of steps and the operation of as many as 50 valves and other devices. Opening and closing that many valves can be time-consuming. When a few seconds are trimmed from the operation of each such device, and when sequential make-ready steps that take an hour are replaced by a computer-controlled operation that takes a few minutes, the saving of time can be substantial. ■

Further information about the direct-digital computers employed at this installation can be obtained by circling reader service number below.

Circle 803 opposite last page.



Automated gas chromatographs are used for consistently accurate analyses

Line printers produce hard-copy continuous diagnosis of operating processes throughout every run, controlling process variables when operating parameters or product quality exceed preset limits

Operators can reprogram flow of streams through pipelines with microcomputer-based system

New Solutions to Plant Problems

From the control panel of a microcomputer-based system, operators at Phillips Philrock Station in Borger, Texas, can reprogram the flow calculator and monitor the flow of ethane-propane streams through pipelines in widespread locations.

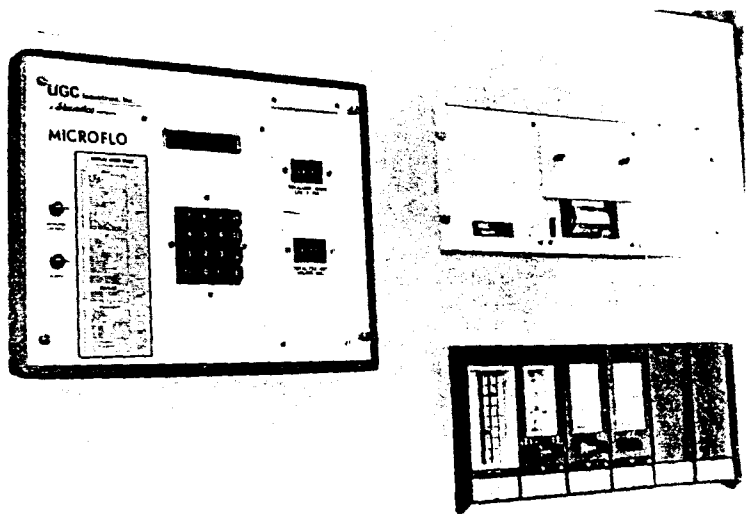
Phillips Petroleum is one of several petroleum processors who are using the microcomputer-based flow calculator to provide an economical, yet accurate means of measuring their products in widespread areas. The system can calculate the flow of liquids, gases or steam in volume, mass, standard 60°F barrels or other units of measure.

A microcomputer automates the complex process of measuring the different products. It works in conjunction with turbine meters which measure the gross volume and calculates the number of pounds. The microcomputer is especially instrumental in its conversion capacity as the material being piped must be measured at 60°F and equilibrium pressure, impossible constants to maintain while it is actually being pumped. The microcomputer is capable of correcting it back to these standards.

Measuring the flow of gas and petroleum products involves a series of complex calculations. Factors such as temperature, pressure, compressibility, and gravity of the material to be measured must be entered into a complex equation in order to accurately calculate flow.

The microcomputer automates a process which formerly involved recording the flow factors, manually interpreting this data, and subsequent computer processing to determine a totalized flow.

A field-replaceable PROM in the instrument eliminates the need for the user to send hard-wired memory back to the manufacturer for reprogramming. Since the system easily adapts to major basic changes in operating parameters, users no longer need to scrap and then replace expensive, hard-wired, electronic measurement devices.



From this control panel, operators at Phillips Petroleum can monitor flow of ethane-propane streams through pipelines in widespread locations

The microcomputer is custom-programmed for each user's specific flow measurement requirements. When preselected parameters such as pipeline diameter or place orifice size are later changed, the microcomputer can be reprogrammed on site with the keyboard console.

This built-in keyboard and digital display allows operators to enter data, monitor overall system operation, and recall data from the microcomputer memory for verification. From the console, the operator can also check such operations as transducer calibration from the remote sensor sites to further assure accurate measurement. An optional printer can provide direct printout for hard-copy needs.

The instrument can be used to verify costs from outside suppliers, control internal flow operations, and determine the billing to downstream industrial customers.

Besides calculating totalized flow, the unit can monitor points along a pipeline for variations in basic flow conditions, such as a sudden change in pressure. It can also provide data to downstream processing operations and control such functions as merging the correct mix from multiple streams of liquids or gases.

The basic system accepts any combination of up to 16 analog inputs, and provides two analog outputs. Expanding the 16 analog inputs is accomplished by adding more I/O modules.

Other major oil and chemical companies currently utilizing the system include Shell Oil, Continental Carbon and Dow Chemical. They are using it for such applications as measuring ethane-propane mixed streams, measuring crude oil flow through long-distance pipelines, and metering at custody transfer points along pipelines. ■

Microflo measurement system is a product of UGC Industries, Inc., Box 3736, Shreveport, LA 71103.

Circle 804 opposite last page.

Model 1806 microcomputer, around which the flow measurement is based, is manufactured by Process Computer Systems, Inc., 5467 Hill 23 Drive, Flint, MI 48507.

Circle 805 opposite last page.

PVC makers move to mop up monomer emissions

Production improvements lead the drive by U.S. polyvinyl chloride producers to meet strict federal limits on suspected carcinogen vinyl chloride.

Twin derricks move cleaning devices from one reactor to the next at Georgia-Pacific Plaquemine, La., PVC plant.

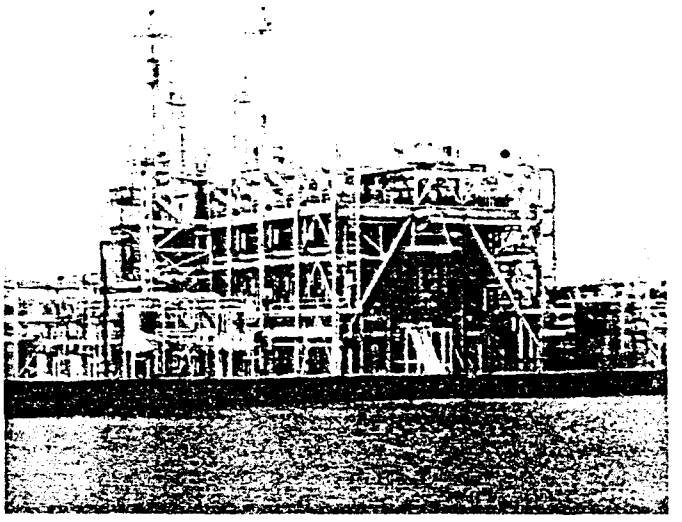


Photo: Georgia-Pacific Corp.

☐ U.S. manufacturers of polyvinyl chloride are girding themselves for stringent strictures on vinyl chloride monomer (VC) levels.

For instance, when a U.S. Occupational Safety and Health Administration (OSHA) standard for VC comes into full force on April 1, the ceiling for worker exposure to the monomer will harden, eliminating today's option that allows plants to run at up to 25 ppm without using respirators.

A link—which became a cause célèbre in early 1974—between VC and a rare liver cancer called angiosarcoma is spurring the clampdown from the pre-April 1974 limit of 500 ppm. And U.S. plants are not alone in facing stiff VC curbs: exposure regulations also are tightening in Western Europe and Japan. Sweden, like the U.S., has adopted a 1-ppm limit. Most other nations are heading for monomer ceilings in the 5-25-ppm range, though.

SOME SUCCESS—Through new or improved manufacturing methods, many operators of larger and newer PVC plants already claim to be under 1 ppm—at least for most normal operations, if not during upsets or maintenance or in every single part of the plant. They've been buttoning up their facilities to hold in fugitive emissions (such as leakage through flanges), changing both polymerization formulations (recipes) and vessel-cleaning procedures to cut down the frequency of opening up reactors, and adopting improved techniques for stripping residual VC from product PVC resin.

However, a few smaller and older PVC plants apparently are limping along without making much headway toward OSHA's limit. New engineering controls for VC either can't mesh very well into these installations' equipment setups, or can't be economically justified.

Adding to their dilemma, the U.S. Environmental Protection Agency (EPA), at presstime, was on the verge of proposing standards to regulate VC emissions to neighborhoods around plants. Many of the steps needed to satisfy the OSHA ceiling undoubtedly will go hand in hand with efforts required to meet EPA's standards. However, compliance with the latter may demand sizable additional outlays.

"If an operator was staggered by the OSHA rules, the coupe-de-grâce will be EPA's," predicts one industry source. Already, Uniroyal Chemical, a division of Uniroyal Inc. (New York) has revealed plans to close its decades-old Painesville, Ohio, PVC plant (*Chem. Eng.*, Oct. 13, p. 67) because of the "exceedingly large capital expenditures" needed to satisfy OSHA and EPA standards. At least some industry spokesmen expect one or two other older and smaller PVC plants to shut down, too.

CAPTURING FUGITIVE VC—Before the VC health hazard was recognized, fugitive emissions were the largest source of monomer losses, according to an EPA analysis. But companies are clamping down.

"One of the first things we did was to tighten all the flanges," says a Continental Oil Co. (Stamford, Conn.) spokesman. And throughout the industry, flanged pipe couplings are replacing leak-prone threaded couplings, and welded joints sometimes are eliminating both.

"We are continuing to look for better gasket materials and pump seals," adds John Nelson, vice president of manufacturing for B. F. Goodrich Chemical Co. (Cleveland, Ohio), the largest U.S. PVC producer. EPA, for its part, plans to insist on double-sealed or canned

pumps (or an equivalent); the agency also will call for rupture disks under relief valves, to avoid leaks if a valve reseats improperly.

The trend to larger-size polymerization reactors, aimed primarily at boosting productivity, also helps stem fugitive emissions, because one large vessel has only half the possible leakage points of two smaller units of the same total capacity. Industry had relied on less-than-7,500-gal reactors for 85% of its output as late as 1972, but now much bigger vessels are favored. For instance, Georgia-Pacific Corp. (Portland, Ore.) uses 20,000-gal vessels at its new Plaquemine, La., plant, and Shintech, Inc. (Freeport, Tex.) features 35,000-gal units at its Freeport installation. Massive, 55,000-gal reactors already are employed by Germany's Chemische Werke Hüls AG (Marl) and BASF AG (Ludwigshafen).

COPING WITH CLEANING—The opening of reactors for manual cleaning can also allow monomer to escape. Pre-venting vessels and flushing them with an inert gas prior to opening is limiting VC losses, especially at the handful of smaller and older plants where workers wearing respirators still do the necessary chipping and scraping by hand. However, companies are striving to reduce the frequency of the manual cleaning.

"Balancing the reactant recipe" can thwart the formation of deposits in the first place, says A. B. Steele, operations manager for Union Carbide Corp.'s Performance Plastics Dept. He adds that firms are regularly improving their understanding of fouling and how to cope with it through changes in recipe and operating conditions. But the recipe work remains highly proprietary. Continental Oil, for example, declines further comment on a "clean-wall formulation" that it says it developed last year—but it has told EPA that the frequency of reactor openings might be cut to once every 200 batches. However, in Italy, ANIC SpA (Milan) does identify its proprietary additive as an "inorganic colloid," which minimizes deposits and makes those that do form softer and easier to remove.

Special reactor-wall surfaces can also help. For instance, Shintech uses a chemical coating, developed by its half-owner, Shin-Etsu Chemical Industry Co. (Tokyo). Before each polymerization batch, walls are "thinly coated with a chemical, so thin you can see the basic structural material, stainless steel," reveals Teruhiko Aihara, assistant general manager of Shin-Etsu's PVC div. and a member of the Japanese firm's board. "Scale just does not stay on the walls." A simple, low-pressure water spray after each batch is enough to wash away any "specks" on the reactor. The technique already has proven itself in five years' commercial use by Shin-Etsu.

RELYING ON WATER—PVC makers in the U.S. (and even more so in Western Europe and Japan) use water sprays themselves as the main means to keep reactors clean. A number of proven techniques are available, including the HRC system from Goodrich Chemical, which features a 6,000–8,000-psi spray, and a rival method from Pfaudler Co. (Rochester, N.Y.), which works at much lower pressure (several hundred psi) but consumes more water.

Overall, water cleaning can halve or even further reduce the frequency of opening reactors for manual cleaning, depending on vessel design and the PVC-resin grades being made, notes Harry Connors, vice president and general manager, Plastics Div., Diamond Shamrock Corp. (Cleveland, Ohio). But on a 0–100 scale, he adds, it's "closer to being 50% effective than it is to being 100% effective" in reducing cleaning frequency.

A patent-pending system invented and manufactured by Georgia-Pacific promises to raise the score. Computer positioning of a water-spray nozzle is the key. The specially designed nozzle is programmed to come within an inch or so of reactor walls, heads and internals, a spokesman says, in contrast to conventional systems in which nozzles oscillate within the vessel sometimes a few feet away from surfaces.

The firm's Plaquemine plant features two such units, handling four and five reactors, respectively. Two tall derricks, shown in the photo on p. 25, move the system's cleaning heads into and out of the reactors, and from one vessel to the next. A 200-gal/min flow of 5,000–6,000-psi water ensures cleaning.

SOLVENTS GAINING?—Non-aqueous cleaning fluids had been proposed even a decade ago as a way of doing a more thorough job. Actual use remains limited, though, because of obstacles such as high capital cost, complexity of solvent-recovery equipment, solvent traces left in the reactor, and solvent safety and environmental hazards. However, with better reactor cleaning now a priority, producers of PVC seem more anxious to tackle the problems.

A number of solvents rate as possibilities: ethylene dichloride, featured in a system from Stauffer Chemical Co. (Westport, Conn.); methyl-ethyl ketone, used by Union Carbide at its Texas City, Tex., PVC plant; M-Pyrol, GAF Corp.'s (New York) *n*-methyl-2-pyrrolidone solvent; tetrahydrofuran, favored by Monsanto; and dimethyl formaldehyde.

The Union Carbide solvent-washing system has been running for about ten years. But Carbide's Steele points out that the firm has the solvent available at Texas City for a myriad of other tasks there, so extensive special facilities did not have to be built for the PVC-reactor cleaning chore. Carbide washes vessels with the solvent after every 5–15 batches.

GAF, another pioneer in solvent cleaning, is working to bring to market a complete process/equipment package using M-Pyrol. An already piloted solvent-recovery step rates as the key to GAF's new push. In it, water is added to spent solvent to precipitate polymer, which is then removed by centrifugation; the solvent/water mixture is distilled to recoup the M-Pyrol.

PURIFYING POLYMER—The PVC product in the reactor also needs cleaning to remove VC. Stripping by post-polymerization venting of head gases from the reactor eliminates some monomer, which then passes through a refrigerated-condenser system and is recycled. However, significant quantities of VC remain, and they give emissions problems in subsequent resin processing and handling operations.

To avoid specifying diverse point controls on all the various post-stripping operations, EPA plans to set a limit on VC content in resin leaving the stripping step: 2,000 ppm for dis-

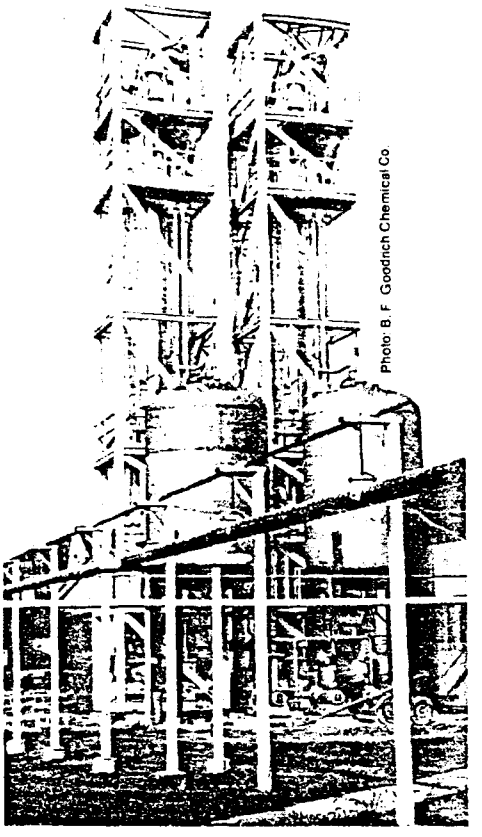
rsion resins and 400 ppm for her PVC grades, including ose made by the predominnt suspension process. If VC ere is held at a low level, the gency figures there simply on't be enough potential loss worry about later on, both the PVC plant and at fabritors.

Heating the reactor product place can boost VC liberion rate during venting. owever, temperature control critical; too high a temperare or heating for too long can amage product quality, parcularly with easily degraded ispersion resins (hence their igher VC limit). PVC makers, evertheless, are turning to the se of vacuum and heat, the tter through external steam ckets and, more recently, dect steam-sparging. Some rms are working on additives at stabilize resins to better ithstand the rigors of the ripping operation.

Continuous stripping, simarly, can help reduce VC conent. Little used so far, the approach got a boost in August rom Goodrich Chemical. The firm nnounced an advanced system that t has already or will install at all its ive PVC plants within a month. Goodrich admits that setting up the tripping system poses high initial osts, but this has not deterred several other PVC makers from already aking out licenses to use the new echnology.

The closely guarded technique vorks by steam-stripping resin slurry n a countercurrent-flow column. The method is faster and more efficient than batch procedures, Goodrich claims. It has tried the system on suspension resins, but not yet on dispersion grades.

CLEANING VENT GASES—VC escaping to the atmosphere in offgases—especially from the refrigerated-vent-condenser in the monomer-recovery system—also draws EPA's attention. The agency plans to put a 10-ppm ceiling on such losses in offgases. Control technology is already available, or nearly so, with consideration centering on incineration, carbon adsorption, and solvent scrubbing, as well as some new cleanup developments. But technical and economic feasibility still remain unproven on a large scale, contends an expert at the Society of the Plastics Industry, Inc. (New York).



Continuous stripping columns remove residual monomer from PVC resin at Goodrich plant.

Combustion to oxidize VC to carbon dioxide, water and hydrochloric acid is generally discounted: flares, direct-flame afterburners and steam boilers all suffer cost penalties, especially because they require protection against acid corrosion, scrubbing of the hydrochloric from off gases, and supplementary fuels when handling dilute VC streams. Catalytic afterburners seem somewhat more favored; industry sources hint that some new catalytic VC-destruction techniques are now in the offing.

PVC makers are looking with considerable interest at carbon adsorption, says Calgon Corp. (Pittsburgh, Pa.), which claims to be working with a half-dozen or so firms on pilot-plant projects or design specifications. A spokesman stresses that in work so far there have been no problems with unloading spent beds for VC recovery, or with bed clogging or monomer polymerization in the beds.

Tenneco Chemicals (Saddle Brook, N.J.) installed in February the first fullscale carbon system, which it says meets the 10-ppm limit.

Adsorption on resinous or polymeric materials is undergoing some preliminary investigation by Rohm and Haas Co. (Philadelphia), because they may retain more VC than carbon does.

Another alternative, solvent scrubbing, has chalked up years of experience as an economy-prompted technique for recovering VC for recycle in plants operated by Goodrich Chemical, Union Carbide and Firestone Plastics Co. (Pottstown, Pa.). Solvents include ethylene dichloride, acetone and methyl-ethyl ketone.

Early last month, Union Carbide extended the technology to emission control by commissioning a system for vent-condenser purge gas at its Texas City PVC installation. The $500,000+ setup uses cold methyl-ethyl ketone. Carbide hopes to recycle and reuse the recovered monomer.

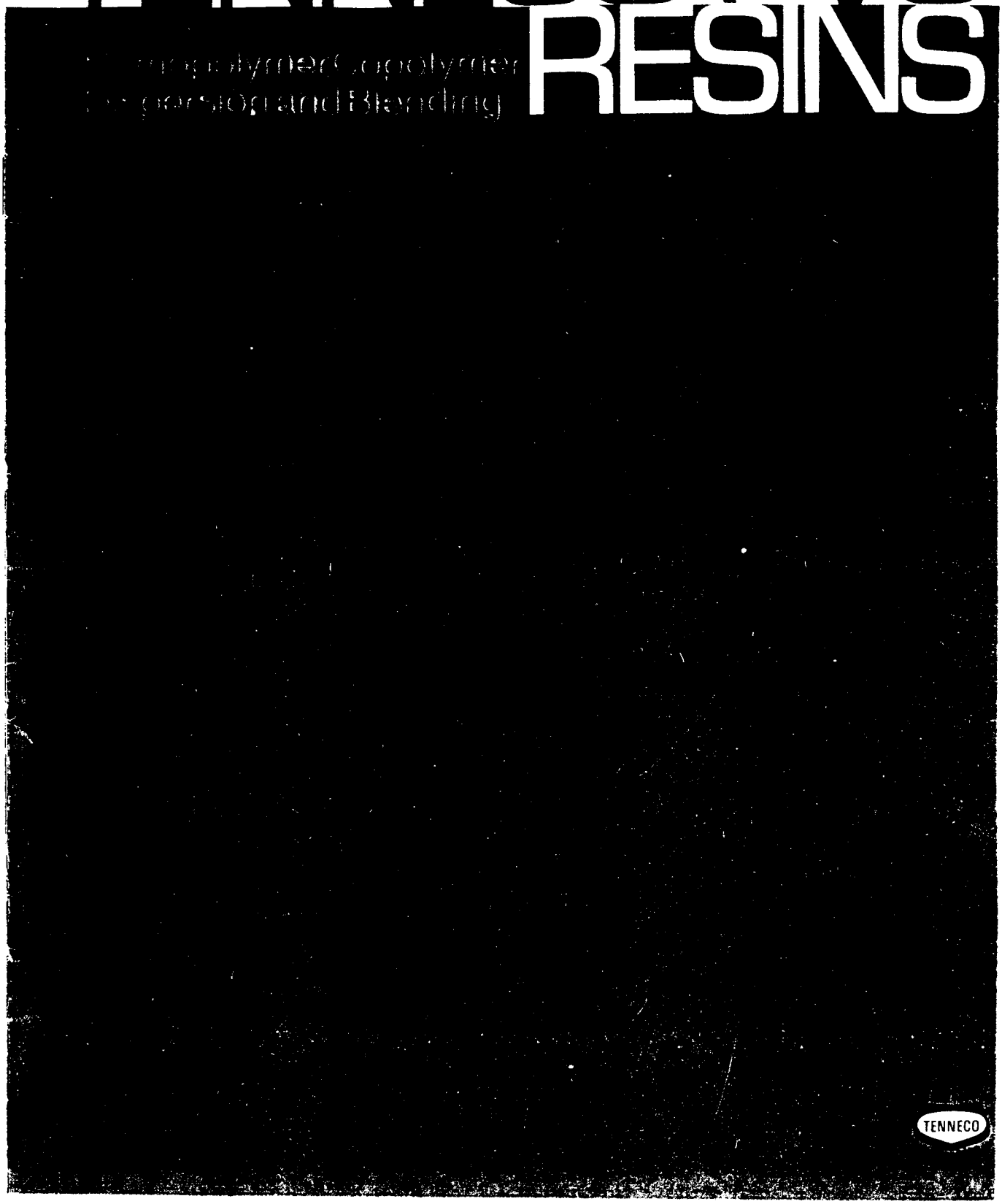
A no-moving-parts, dry process called oxyphotolysis rates as the newest control candidate. Developed by Robintech, Inc. (Fort Worth, Tex.), Shin-Etsu's partner in the Freeport PVC plant, the technique destroys VC to form carbon dioxide, water and chlorine in an undisclosed manner believed to involve ultraviolet radiation. Other hydrocarbon pollutants can also be handled. A pilot plant for VC elimination now is going up at Freeport, and should be running early next year. John Ertell, manager of Robintech's PVC Div., claims that according to lab work oxyphotolysis will turn out cheaper than incineration, carbon adsorption or solvent scrubbing.

Another alternative cleanup technique is being groomed by PPG Industries, Inc. (Pittsburgh, Pa.). The firm credits the method "with tremendous potential," but is keeping details under wraps; outsiders hint that the new process involves catalytic technology.

Nicholas R. Iammartino

TENNECO PVC RESINS

Homopolymers/Copolymers
Dispersion and Blending



TENNECO

COLORITE 007250

Tenneco Chemicals has served the vinyl industry for many years as a leading source for a broad line of PVC products. With our totally integrated production capability—from natural gas to polymer—Tenneco offers its customers the in-depth resources of industry's leading chemical complex... your headquarters for PVC performance.

Shown on the following pages are typical performance characteristics of Tenneco PVC homopolymer, copolymer, dispersion and blending resins. For complete information contact your nearest Tenneco sales office.

Typical Applications: Flooring • Calendering • Film and sheet products • Coatings on cloth, paper and metal • Phonograph records • Wire and cable insulating material • Pipe and conduit • Wall siding

Note: Tenneco's material safety data sheet should be consulted for information on hazards and precautions in the handling and use of these products.

TENNECO PVC RESINS

Vinyl Homopolymer

Product	Description	Inherent Viscosity 0.2 g/100 ml cyclohexanone @30°C (D-1243)	Relative Viscosity 1% by wt. cyclohexanone @ 25°C	Typical Applications
TENNECO 10R	Low molecular weight, low gel	0.64	1.78	Unplasticized clear sheet
TENNECO 175	Low molecular weight with uniform particle size.	0.65	1.81	Specialty molding and extrusion compound
TENNECO 195	Low-medium molecular weight with excellent heat stability, rapid fluxing and moderate plasticizer absorption properties.	0.74	1.94	Unplasticized clear sheet, pipe extrusion and injection molding
TENNECO 200	Low-medium molecular weight with uniform particle size and moderate plasticizer absorption characteristics.	0.80	2.04	Compounds for extrusion, calendering and injection molding where ease of processing at lower temperatures is essential.
TENNECO 225	General purpose, medium molecular weight with uniform particle size and moderate plasticizer absorption characteristics.	0.96	2.28	Flexible calendering, wire and cable compounds, film and sheeting, specialty extrusion and critical moldings.
TENNECO 225F	Medium molecular weight with low gel content and contamination levels.	0.96	2.28	Packaging film, medical tubing.
TENNECO 225PG	Medium molecular weight with closely controlled particle size and absorption characteristics.	0.96	2.22	Critical pressure pipe and conduit extrusion on single and multiple screw extruders.
TENNECO 250	Medium-high molecular weight with good plasticizer absorption and uniform particle size to give excellent extrusion rates.	1.01	2.38	Wire and cable compounds and profile extrusions, including dry blends.
TENNECO 250-3	High molecular weight with good plasticizer absorption, excellent heat stability and uniform particle size for excellent extrusion rates.	1.07	2.48	Superior physical properties in flexible compounds for wire and cable, tubing and specialty extrusions.

TENNECO

Vinyl Copolymer

Product	Description	% Acetate	Inherent Viscosity 0.2 g/100 ml cyclohexanone @ 30°C (D-1234)	Relative Viscosity 1% by wt. cyclohexanone @ 25°C	Typical Applications
TENNECO 314	Low molecular weight with good heat stability and low fluxing temperatures	14.5	0.44	1.45	Vinyl asbestos floor tile. Excellent wetting action with heavy filler load
TENNECO 391	Low molecular weight, high acetate with good heat stability and low fluxing temperatures	15.0	0.46	1.50	Fast flow record compounds and dry blend for fast pressing cycles and light weight records.
TENNECO 315	Medium molecular weight with excellent heat stability and closely controlled particle size for ease of processing	13.0	0.50	1.56	Vinyl asbestos floor tile. Excellent wetting action with heavy filler loading
TENNECO 315R	Medium molecular weight with low volatiles, uniform particle size and excellent heat stability	13.0	0.50	1.56	Record compounds and dry blends where excellent audio quality is required
TENNECO 389	Medium-high molecular weight with uniform particle size, good dry flow characteristics and excellent heat stability	12.5	0.54	1.63	Specially designed for single resin systems making dry blend compounds for records of critical audio quality
TENNECO 390	High molecular weight, low acetate with outstanding heat stability and uniform fluxing characteristics	9.5	0.68	1.85	Rigid calendered sheet for vacuum forming and graphic arts printed stock, as well as flooring
TENNECO 382	High molecular weight, low acetate with excellent heat and initial color stability	9.5	0.68	1.85	Vinyl asbestos floor tile having excellent physical properties. Also used as a secondary resin for phonograph record compounds.

TENNECO PVC RESINS

Vinyl Dispersion

TENNECO dispersion resins are "low soap" resins of exceptionally high purity which provide outstanding clarity, heat stability, air release, water-blush resistance and metal adhesion

Plastisols made with TENNECO dispersion resins exhibit low viscosities and yield values—ideal for many applications. Fast fusion and gelation are obtained with TENNECO copolymer resins in applications such as sealants, adhesives, and molding.

Product	[1]Relative Viscosity	[2]Brookfield Viscosity, poises 1 day, 20 rpm	[2]Severs Viscosity, poises @ 100 psi	% Volatiles	% Methanol Extractibles	[2]Gelation Time min @ 160F	[2]Hot Bar Fusion °F
TENNECO 1716	2.4	30	160	1.0	1.5	18	178
TENNECO 1730	2.4	40	240	0.4	0.6	17	172
TENNECO 1732	2.4	45	75	1.0	1.5	17	167
TENNECO 1742	3.2	50	75	1.0	1.6	23	182
TENNECO 1755	2.4	60	200	0.4	0.5	19	177
TENNECO 1757	2.8	50	200	0.4	0.5	23	184
TENNECO 0565 COPOLYMER 4.2% Acetate	2.4	125	300	0.8	0.5	11	147
TENNECO 501	2.2	70	95	0.9	—	31	—
TENNECO 521 COPOLYMER 4.0% Acetate	2.0	105	110	0.9	—	26	—
TENNECO 530	2.48	67	105	0.5	—	28	—

Vinyl Blending

[1] 1% By Weight in Cyclohexanone @ 25° C. 2) 50 phr DOP.
Tenneco 1730 Blending Resin: DOP, Nuostabe* V-1216, 50, 50, 40, 3.
Tenneco 1755 Blending Resin: Duramite, DOP, Nuoplaz* 849, Nuostabe* V-1420, 70/30, 10, 50, 5, 3.
*Registered TM of Tenneco Chemicals

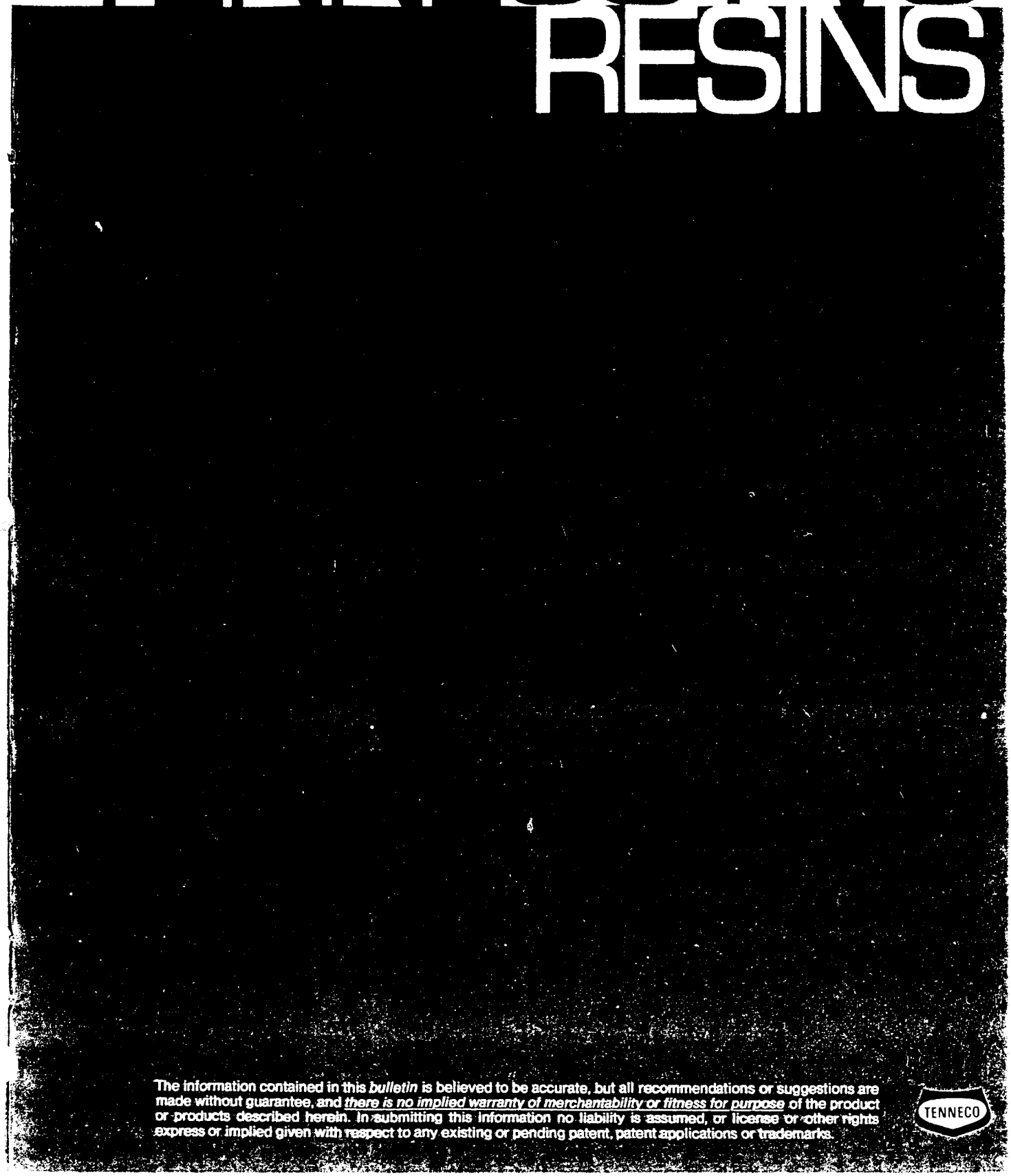
TENNECO

Viscosity Converter

Inherent Viscosity, 0.2 gr. 100 ml cyclohexanone 30°C. ASTM D1243-66	1.20	1.10	1.00	.90	.80	.70	.60	.50	.40				
*Specific Viscosity, 0.4 gr. 100 ml nitrobenzene 30°C	.50	.45	.40	.35	.30	.25	.20	.15					
Relative Viscosity, 1.0% by wt. in cyclohexanone, 25°C.	2.70	2.60	2.50	2.40	2.30	2.20	2.10	2.00	1.90	1.80	1.70	1.60	1.50	1.40
K Value, Fikentscher	75		70		65		60		55		50		
Viscosity Number, ISO-R174-1961 (E)	150	140	130	120	110	100	90	80	70	60	50		
Intrinsic Viscosity (cyclohexanone)	1.20	1.10	1.00	.90	.80	.70	.60	.50	.40				
Molecular Weight (Weight Average) (000 omitted)	120	110	100	90	80	70	60	50	40				
Molecular Weight (Number Average) (000 omitted)	60	55	50	45	40	35	30	25	20				

*While use of nitrobenzene is not recommended for toxicity reasons, this scale is included for historical comparisons only.

TENNECO PVC RESINS



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