BUSINESS CONFIDENTIAL

PROJECT REPORT

THE RELATIONSHIP OF THE APPARENT PARTICLE DENSITY DISTRIBUTION AND THE INTERIOR PORE VOLUME TO THE HARD RESIN PARTICLE CONTENT OF VINYL SUSPENSION RESINS

AUTHORS: J. W. Fields

SUPERVISOR: J. J. Brezinski

DATE: August 15, 1967

PROJECT NO.: 347K10

FILE NO.: 8151

SUMMARY The comparison of the hard resin particle count of 10 mil pigmented, hot processed flexible film, with the apparent particle density distribution (patterned after the Kureha Limited procedure) reveals that an excellent correlation exists between these two measurements. Resins with a high concentration of particles with an apparent density less than 1.225 showed low hard resin particle content in these films. Of the nine resins studied, the QXOL-7 resins (2 blend samples) showed lowest hard resin particle count and highest concentration of low density particles.

A lesser correlation was observed between the hard resin particle content and the interior pore volume of these resins as determined by the mercury intrusion method; again, however, the two QXOL-7 resins evaluated, which had the highest interior pore volume, also exhibited the lowest hard resin particle count.

The data suggests that the density measurement can be used to predict the hard resin particle content of suspension vinyl resins and should prove useful for the characterization of existing resins and in process studies of existing and new suspension resins.

Procedures for the determination of the total interior pore volume (and apparent pore size distribution) as well as of the apparent particle density distribution of powdered poly(vinyl chloride) resins are attached. Also attached is the procedure used to define the hard resin particle content of the processed films.

INTRODUCTION This study was undertaken to define the extent of correlation which exists between the hard resin particle content of processed compounds with the total interior pore volume and the apparent particle density distribution of the resin. The assumption is made that resins characterized by high interior pore volume and low particle density should be characterized by low hard resin particle content in fabricated end products.

RESEARCH AND DEVELOPMENT DEPARTMENT
CHEMICALS AND PLASTICS
UNION CARBIDE CORPORATION
South Charleston, West Virginia

DISCUSSION The resin samples evaluated (described in Table I) include two UCC vinyl chloride-ethylene copolym rs produced in production autoclaves at Texas City (QXOL-7 Blends 1 and 2) and seven competitive vinyl samples. The competitive resins studied included: Wacker VH-89299, Ethyl 185, Diamond 35, and Kureha resins S-9007, 825M and 825L. Several of these resins have been recommended for use in blown PVC bottles and rigid film applications.

INTERIOR PORE VOLUME The interior pore volume of the resins was measured using the AMINCO-WINSLOW Porosimeter. The measurement of the total pore volume is made by forcing mercury under increasing pressure through a graduated capillary into the open pores of a powdered resin sample. The volume of mercury forced into the pores is defined by the chang of mercury level in the capillary. Only those pores which are open to the outer surface of the particle are penetrated by th mercury and therefore reflected in the total pore volume measurem nt.

The attached test method (Appendix A) was submitted to ASTM Task Group D20(XV-H) by Dr. J. J. Brezinski. The instrument used in this evaluation has a maximum applied pressure limitation of 3000 psi which limits the minimum pore diameter penetration to 0.058 microns. This instrument is now being modified to permit measurements up to 5000 psi maximum pressure (0.035 micron minimum pore penetration). The pressure increase could change the total interior pore volume significantly for resins which contain a sizeable number of pores with diameters below 0.058 microns.

RESULTS Limited correlation of hard resin particle content and total interior pore volume was observed though five of the nine samples agreed in general (Table I). Notably, the two QXOL-7 resin samples, Blend 1 and Blend 2, which showed the highest interior pore volume (0.24 cc/gm.), also exhibited the lowest hard resin particle count.

The poor correlation in several of the samples may be due to a significant internal pore volume not measured at a pressure of 3000 psi (0.058 microns) minimum size penetrated by the mercury. These assumptions will be checked when the instrument is modified to permit 5000 psi measurement (0.035 micron) minimum size penetrated).

PARTICLE DENSITY DISTRIBUTION During a visit to Kureha Limited of Japan, Dr. F. E. Bailey, Mr. A. J. Constantin and Mr. D. E. Richardson obtained a general test method for the definition of the apparent particle density distribution of suspension resins. The attached test method (Appendix B) was patterned after the brief description of the procedure available.

The assumption in this procedure is that resins having a significant volume of internal pores will float in higher specific gravity liquids due to the buoyancy contributed by air present in the internal pores. The more buoyant particles should contain less regions of solid poly(vinyl chloride) and might then be expected to process more readily in rigid or flexible systems resulting in lower hard resin particle content in the processed compounds.

Like internal porosity measured by mercury intrusion, the opening of the pore reservior to the outside surface of the particle may play a role in defining the density distribution parameter which correlates with hard resin particle ratings. Dr. Bailey has indicated that Kureha Limited uses 1.225 specific gravity as an arbitrary cut-off point to predict the hard resin particle characteristics of a resin sample. Resins that float in a liquid of this specific gravity and in liquids of higher gravities (have a high percentage of particles of apparent density less than 1.225) are less likely to be hard resin particles in end products due to their higher interior pore volume. The tubes of graduated specific gravity were prepared using increasing concentrations of zinc chloride in distilled wat r. Details are presented in Appendix B.

The percent of resin of density higher than 1.225 was compared with the hard resin particle count of the pigmented films (Table I). Seven of the nine samples agreed very well e.g., resin samples exhibiting a high weight percent of particl s with densities less than 1.225 had the lowest hard resin particl count and conversely, resins with higher density particles had the highest fisheye count. Notably, the QXOL-7 resin samples exhibited the lowest concentration of resin with density above 1.225.

The test method requires approximately three hours to perform a single evaluation. For routine analysis this test time may be reduced considerably with the use of gravity tubes of 1.225 specific gravity liquids and higher. Several of the density distribution graphs obtained in this study are attached. (Figures I and II)

HARD RESIN PARTICLES The hard resin particle count was determined on 10 mil pigmented pressed film using a controllable light viewing source for counting. The data, as shown in Table I, represents the fisheye count at the highest wattage setting of 300 foot lamberts of brightness. This count appears to be the most significant in this type of comparative evaluation.

The details of the method used to process these compounds and prepare the 10 mil rating film is attached to this report. The compound used contained 47 phr of FLEXOL DOP, 1.1 phr of Mark M and a mixture of dyes. Processing conditions used in the Plasti-Corder were 110°C jacket temperature, 80 rpm rotor speed and five minutes processing time. These are very mild processing conditions intentionally selected to obtain a critical hard resin particle measurement. Maximum illumination was employed in viewing the 10 mil pressed film.

CONCLUSIONS From the comparative evaluation of apparent particle density distribution, internal pore volume and hard resin particle count, the following tentative conclusions and recommendations appear justified:

(1) Resins that contain a high percent of particles with apparent density less than 1.225 have the lowest fisheye count in hot processed pigmented films. As the percent of particles with density above 1.225 is increased the hard resin particle count is increased. An excellent correlation between these two analyses is evident.

(2) This study suggests that the measurement of apparent particle density distribution can be used to monitor the suitability of resins for rigid and flexible applications requiring low hard resin particle count and should be of value for process studies on existing and new suspension resin.

(3) Pore volume, as measured by mercury intrusion, shows only a limited correlation with the hard resin particle content when a 3000 psi maximum pressure for mercury intrusion is used. The correlation will be rechecked when the instrument is modified to permit measurements up to 5000 psi.

(4) The two QXOL-7 resins tested, which showed the lowest hard resin particle count in hot processed, pressed, 10 mil film, also showed the highest pore volume and the lowest percent of particles with an apparent density high r than 1.225.

J. W. Fields
J. W. Fields

JWF:js

Notebook Reference: 1-JWF2
Attachments - 1 Table
2 Figur s
Appendix A, B and C

TABLE I

HARD RESIN PARTICLE CONTENT, INTERIOR PORE VOLUME, AND APPARENT PARTICLE DENSITY DISTRIBUTION OF SELECTED RESINS

RESIN	η_{inh}	HARD RESIN PARTICLES, /ft^2 (a)	TOTAL INTERIOR PORE VOLUME, CC/GRAM (b)	APPARENT DENSITY DISTRIBUTION: PERCENT OF RESIN GREATER THAN 1.225 APPARENT DENSITY (c)
QXOL-7, Blend-1 (d)	0.93	50	0.254	3
QXOL-7, Blend-2 (d)	0.93	75	0.233	14
Wacker-VH 89299 (e)	0.68	140	0.115	51
Ethyl-185 (e)	0.69	200	0.78	53
Diamond-35 (e)	0.70	250	0.65	76
Kureha-S9007 (e)	0.71	550	0.118	70
Kureha-825M (f)	0.79	70,000	0.084	91
Kureha-850M (f)	0.78	200,000	0.067	96
Kureha 825L (f)	0.72	250,000	0.086	97

(a) Hard resin particle rating film prepared from compounds processed with the C. W. Brabender Plasti-Corder.

(b) Interior pore volume determined with mercury intrusion technique using an AMINCO-WINSLOW Porosimeter.

(c) Apparent particle density distribution evaluation--description is attached in Appendix A.

(d) Vinyl chloride - ethylene copolymers. Blend 1 contains 1.07 percent ethylene, Blend 2, 0.98 percent ethylene.

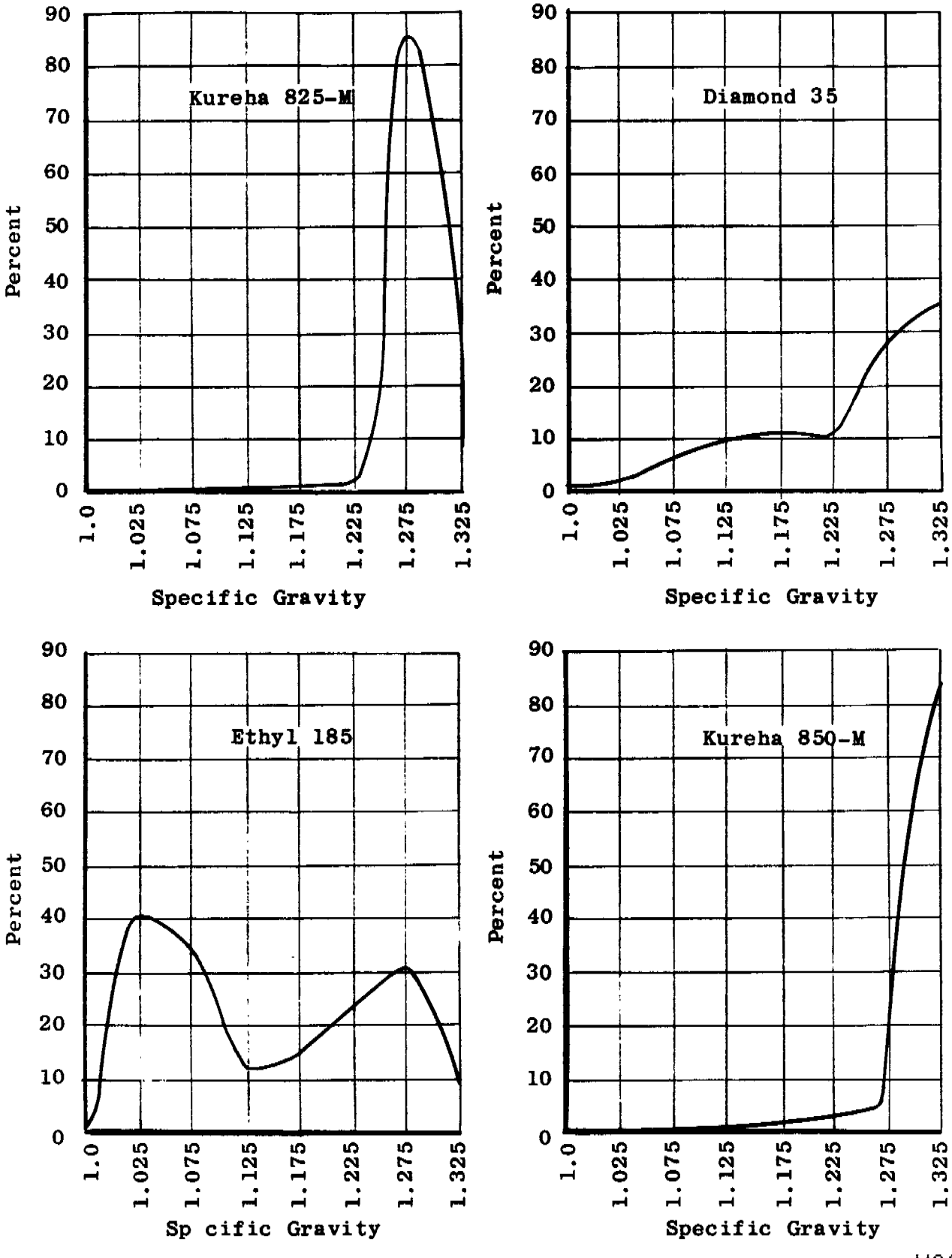
(e) Poly(vinyl chloride) homopolymers

(f) Blends of PVC homopolymers with vinyl chloride-vinyl cetyl ether copolymers.

BUSINESS CONFIDENTIAL
347K10

FIGURE 1

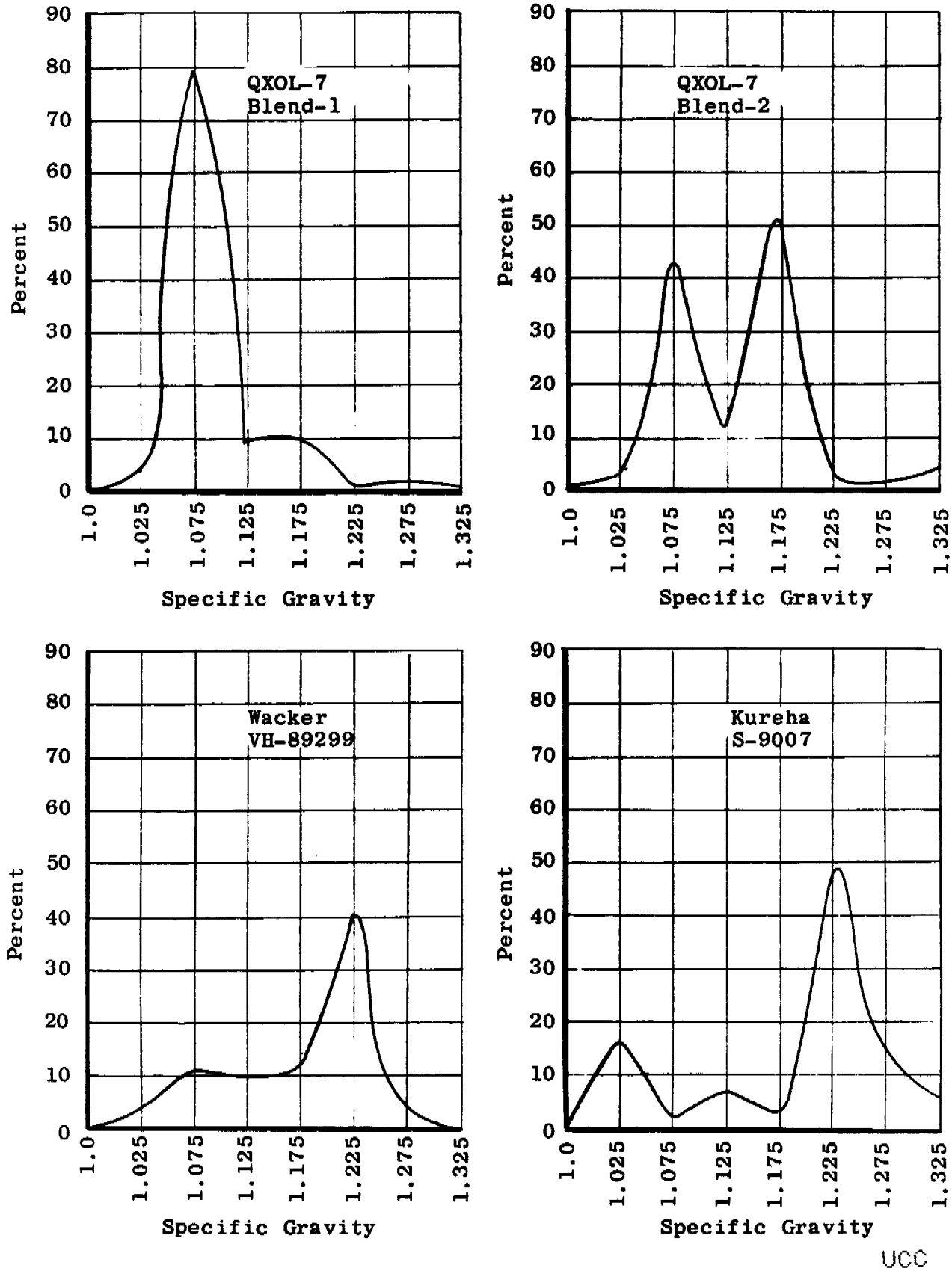
APPARENT PARTICLE DENSITY DISTRIBUTION



BUSINESS CONFIDENTIAL
347K10

FIGURE 2

APPARENT PARTICLE DENSITY DISTRIBUTION



UCC
041775

APPENDIX A

TENTATIVE METHOD FOR

INTERIOR POROSITY OF VINYL RESIN POWDERS

BY MERCURY INTRUSION POROSIMETRY

Scope

1. The method describes a procedure for the measurement of the interior pore volume and the apparent pore diameter distribution of poly(vinyl chloride) powder samples. The measurements are made by forcing mercury under increasing pressure through a graduated capillary into the open pores of the resin sample. The volume of mercury forced into the pores is defined from the change of the mercury level in the capillary; the apparent pore diameter distribution can be defined from the incremental volume change as the pressure on the mercury is increased.

Significance

2. The method is intended to compare differences in the total interior pore volume of porous vinyl resins. In general, in certain formulations, resins of higher porosity are better dry-blending resins; thus, the interior porosity measurement provides a measure of one of the criteria useful for the prediction of the dry-blend properties of vinyl resins.

Limitations

3. Only those pores open to the outside surface of the resin sample are filled with the mercury. The "apparent" pore diameter distribution defined is not physically significant if there are large openings within the sample which are connected to the surface by narrow pores.

The pressure applied limits the extent of the open pores filled; thus, at approximately 5000 psi the minimum diameter pore penetrated is about 0.035 micron while at 3000 psi the minimum diameter is 0.058 micron.

Definition

4. The interior pore volume (cc/gm) can be defined from the total change in the volume of mercury observed above an applied pressure of 56 psia (corresponding to an apparent pore diameter of 3.1 microns). Normally, the maximum applied pressure used with poly(vinyl chloride) powders is 3000 to 5000 psia. The total interior pore volume definition thus should include reference to the maximum pressure used, as shown in the following:

Maximum Pressure Used, psia	Interior Pore Volume Designation
3000	cc/gm (3M)
5000	cc/gm (5M)
X000	cc/gm (XM)

Apparatus

5. (a) Mercury Intrusion Porosimeter with minimum pressure rating of 3000 psi. with auxiliary equipment. A suitable instrument is manufactured by the American Instrument Company, Inc., Silver Spring, Maryland.

(b) Analytical balance - 100 gram capacity, capable of measuring to ± 0.0001 grams.

(c) Glass wool.

(d) Silicone grease (high vacuum).

(e) Isopropanol, reagent grade.

(f) Mercury.

Procedure

6. Preparation of Penetrometer and Sample

(a) Always use the penetrometer designed for powdered samples. Add a small amount of loosely packed glass wool to the head end of the capillary, then add a very small amount of silicone grease on the lip of the penetrometer. Weigh the penetrometer and the other parts of the assembly, including the glass cap, the O-ring and stainless steel lock ring. Record the weight.

(b) Add a suitable amount of the sample resin powder to the penetrometer and then place on the glass cap and the O-ring and screw on the stainless steel lock ring. Weigh the assembled penetrometer and subtract from the weight, 6(a), to obtain the weight of the resin sample.

Note 1. Sample size is of some importance. Weights from 0.15 to 0.50 grams can be used. As a general rule, the higher the bulk density of the sample the larger the sample size required. For typical general purpose dry-blend resins, a sample size of about 0.3 grams is recommended; for highly porous resins, the sample size of 0.10 to 0.15 grams should be used.

Assembly and Preliminary Conditions

7(a) Place the penetrometer, stem down into the filling device. Lift the bracket so that the mercury pool is just below the lower tip of the penetrometer (1/8" to 1/32"). If necessary, carefully adjust the mercury volume in the filling device.

(b) Apply silicone grease to the connecting parts of the vacuum chamber, to the stopcocks and to the bottom side of the vacuum chamber. Lock in place and close the stopcock.

(c) Connect the vacuum pump to the nipple at the lift end of the porosimeter. Turn on the vacuum meter switch, start the pump, and evacuate until the vacuum gauge reaches <60 microns. (Note 2).

Note 2. A suitable cold trap placed in the line between the sample and the vacuum pump will minimize volatiles entering the pump.

(d) Close the vacuum toggle valve.

(e) Tilt the filling device until the penetrometer tip is immersed in the mercury pool.

(f) Carefully open the stopcock on the filling device to the atmosphere until the 0-15 psi gauge reads 14.7 psi. The mercury will rise in the capillary to fill the penetromet r. To insure complete envelopment of the particles of the resin by mercury, gently tap the penetrometer lock cap.

(g) Tilt the filling device to the vertical position and remove the penetrometer.

Pososity Measurement

8(a) Make certain that the alcohol reservoir is in the lowest position.

(b) Unscrew and remove the pressure cap and transfer the penetrometer to the pressure vessel. Turn on the fluorescent light and adjust the penetrometer so the graduations are clearly visible.

(c) Open the bleeder valve on the pressure vessel cap, making certain that the pressure chamber O-ring has been set properly; screw the cap down to hand pressure tightness.

(d) With the alcohol reservoir raised to the highest position, allow the isopropanol to flow into the pressure chamber and overflow out the bleeder valve, then close the bleeder valve tightly.

(e) Close the pressure release valve on the front panel, then open the 0-600 psi gauge cut-off valve (0-300 psi gauge on instruments with a 3000 psi maximum rating).

(f) Using the hand pump, increase the pressure gradually (Note 3). Record the penetrometer readings at the following pressure levels:

3.5	58.5	240
7.5	70.5	285
11.5	85	335
16.5	102	390
22.5	123	460
29.5	146	535
37.5	171	
47.0	205	

Note 3. The mercury level will normally stabilize almost instantly; if a slow decrease is observed at any pressure, wait till the level stabilizes before taking the reading.

(g) The gauge is valved off using the cut-off valve when 240 psi is reached on the 0-300 psi gauge and 535 psi is reached on the 0-600 psi gauge.

(h) Continue using the hand pump until the maximum pressure is reached (3000 or 5000 psi), recording the penetrometer readings at the following pressure levels: (Note 4)

285	860	2550
335	1010	3000
390	1180	3550
460	1380	4000
535	1600	4550
635	1880	5000
735	2220	

Note 4. An alternate schedule which may be followed is to record the penetrometer reading and the pressure after approximately each 0.004 cc increment of volume change of mercury as indicated by the stem reading. The general instructions of paragraphs 8(a)-8(h) apply.

(i) Carefully open the pressure release valve to insure that the 0-5000 (or 0-3000) psi gauge is not damaged.

(j) When the pressure on the gauge reads 0 psi, then and only then open the 0-600 (or 0-300) psi gauge cut-off valve slowly.

(k) Return the alcohol reservoir to the lowest position. Open the bleeder valve and allow 3-4 minutes for the alcohol level to drop before removing the cap.

(l) Remove the penetrometer, unscrew the cap and dispose of the contaminated resin in a container for chemical waste - necessary because of mercury contamination of the sample. Recover as much of the clean mercury as possible for future use.

(m) Wash the penetrometer with toluene (to remove silicone contamination) and acetone in that order. Make certain that the penetrometer is clean and dry before reuse.

Calculations

9(a) The penetrometer stem readings and the pressure readings are used to determine the total interior pore volume and to describe the apparent internal pore size distribution of the resin sample. The data is first treated to convert the pressure readings to total absolute pressure; a plot of the penetrometer reading vs. the total pressure yields a profile of the apparent internal pore size distribution.

(b) Calculation of total absolute pressure (Refer to Table I and Data Form I).

From 0 to 14.7 psi, it will be necessary to subtract the head pressure of mercury from the 0-15 psi gauge reading. Refer to Table I for the correct Hg pressure corresponding to the range on the penetrometer and subtract this value from the 0-15 psi gauge reading. Record this pressure in the total absolute pressure column on Data Form I.

After the penetrometer has been removed from the filling device and placed in the pressure vessel, penetrometer readings are obtained under pressure when pressure readings are taken on the 0-600 psi and 0-5000 psi gauges or (0-300 and 0-3000). To calculate total absolute pressure:

1. Add 14.7 to the 0-600 psi or 0-5000 psi gauge reading (or 0-300 and 0-3000).

2. Referring to Table I, subtract the head pressur of mercury corresponding to the appropriate penetrometer range from the number obtained in (1) above.

3. Record this figure in the total absolute pressur column. Continue until all calculations have been completed.

4. Make a plot of the penetrometer readings vs. the total absolute pressure on suitable semi-log graph paper (See Figure 1). Use a French curve to draw the porosity curve. This curve represents a profile of the apparent internal pore size distribution. From the porosity curve drawn, read off the penetrometer stem reading (cc) at 56 psia and at 5000 psia (or 3000 psia if this was the maximum pressured used). Calculate the total interior pore volume using the following relationship:

$$\text{Total interior pore volume, cc/gm (5M or 3M)} = \frac{\text{Stem reading at 56 psia - stem reading at 5000 psia (or 3000 psia)}}{\text{Sample weight, grams}}$$

Report

10. Report the total interior pore volume of the sample including the maximum pressure employed during the measurement. Thus, when 5000 psia is employed, the results are reported as cc/gm (5M).

APPENDIX B

TABLE I

EXAMPLE

CALCULATION OF APPARENT PARTICLE DENSITY DISTRIBUTION
QXOL-7 BLEND -2
(10.0 gram sample used for each tube)

SPECIFIC GRAVITY OF LIQUID IN GRADIENT TUBE	WEIGHT OF RESIN IN TOP HALF OF GRADIENT TUBE	PERCENT OF RESIN IN TOP HALF OF GRADIENT TUBE	POINT TO BE PLOTTED SUBTRACT - LINE 1 FROM 2; 2 FROM 3;etc.
	(A)	(B)	(C)
(1) 1.00	0 grams	0 percent	0
(2) 1.025	0.293	2.9	2.9
(3) 1.075	3.213	32.1	29.2
(4) 1.125	3.785	37.8	5.7
(5) 1.175	8.608	86.1	48.3
(6) 1.225	8.726	87.3	1.2
(7) 1.275	9.283	92.8	5.5
(8) 1.325	10.00	100.0	7.2

% of Resin with apparent particle density of 1.225
= 1.2 + 5.5 + 7.2 = 14.9

APPENDIX B

TENTATIVE TEST METHOD

APPARENT PARTICLE DENSITY DISTRIBUTION

(1) PURPOSE

This method defines the apparent particle density distribution of virgin vinyl resins in the specific gravity range of 1.00 to 1.325. The procedure is patterned after the method used at Kureha Limited of Japan where experience indicates that the percent by weight of particles of apparent density greater than 1.225 can be correlated with the hard resin particle content of the resin.

(2) PRINCIPLE

The technique involves the use of a series of cylinders of increasing density (variable concentrations of zinc chloride in water). The resin particles which float in each of the cylinders are collected, dried and weighed.

(3) EQUIPMENT

(1) Density gradient tubes constructed as shown in the attached drawing.

(2) Zinc chloride crystals, commercial grade.

(3) Moisture Teller Oven capable of maintaining an 85°C temperature or equivalent.

(4) Methanol, AAA quality.

(5) Triple beam balance, capable of weighing to ± .01 grams.

(6) Cork or rubber stopper 1 5/8 inch diameter.

(7) Polyethylene squeeze bottles,one-pint capacity.

(8) Distilled water.

(9) Calibrated hydrometers to cover the specific viscosity range of 1.0 to 1.325.

(4) PROCEDURE

(1) In a large beaker prepare specific gravity solutions of 1.0 (water),1.025, 1.075, 1.125, 1.175, 1.225, 1.275 and 1.325,using a 0.1/99.9 hydrochloric acid/distilled water solution and zinc chloride crystals. The solutions may be prepared by first dissolving zinc chloride crystals in distilled water at a 50:50 by weight ratio. Allow this mixture to come to room t mperature(23 ± 1°C) b fore preparing the gradient tubes. The amount of solution prepared should be governed

by the number of samples to be evaluated in approximately five days. The solutions, allowed to cool to room temperature, should be checked immediately prior to each evaluation with suitable calibrated hydrometers to insure proper gravity. Th solutions may be corrected individually by the addition of small amounts of distilled water or of a 50/50 distilled water/ zinc chloride solution.

(2) Make certain that all movable parts of the gradient tubes are lubricated with petroleum jelly and that the slides are in an open position.

(3) Fill the density tubes to within 1.5 inches of the top with the proper specific gravity solution; fill a one-pint polyethylene squeeze bottle with each solution. Label both the tube and bottle accordingly.

(4) Add 10 ± 0.1 grams of the resin to be evaluated to each tube.

(5) Place a cork or rubber stopper into the top of each tube and mix thoroughly by shaking for at least one minute.

(6) Wash the cork to remove any attached particles and wash down the sides of the tubes with the proper squeeze bottle to insure that the powder returns to the surface of the liquid.

(7) Allow 15 minutes for the resin to settle in the tube.

(8) Close the slides on the density tubes.

(9) Pour off the top half of the liquid and resin contained in the top half of the tube into a 9.0 cm diameter Buchner funnel on a tared No. 2 filter paper, using plant vacuum to draw the liquid through. Wash the top half of the density tube into the funnel with distilled water making certain that all resin is washed into the funnel. Wash the resin with approximately 400 cc of distilled water to remove the residual salts from the resin.

(10) Wash the resin with approximately 100 cc of methanol to remove the excess water.

(11) Dry the resin sample plus filter in a Moisture Teller Oven, or equivalent, for 15 minutes at 85°C or until dry.

(12) Determine the exact weight of the resin which was contained in the top half of the gradient tubes.

(5) CALCULATIONS

(a) Calculate the percent of resin recovered from each tube using the following equation:

$$\text{Percent Recovered} = \frac{\text{wt of resin recovered}}{\text{wt of resin added to tube}} \times 100$$

(b) The apparent particle density distribution may be established as shown in the following example by plotting the appropriate points vs. the specific gravity of the solutions.

SPECIFIC GRAVITY OF GRADIENT TUBE SOLUTIONS	WEIGHT PERCENT of RESIN IN TOP HALF OF GRADIENT TUBE	PERCENT FIGURE USED IN PLOT
1.0	0	0
1.025	3	3
1.075	32	29
1.125	38	6
1.175	85	47
1.225	87	2
1.275	92	5
1.325	100	8

(c) The percent by weight of resin, which has an apparent particle density of >1.225, is obtained by adding the percent figures in the last column which apply to the specific gravity tube of 1.225, 1.275 and 1.325 (and higher if others are used). Thus, in the example, this number is 2+5+8 = 15 percent.

(6) REPORT

(a) Analyst and date.

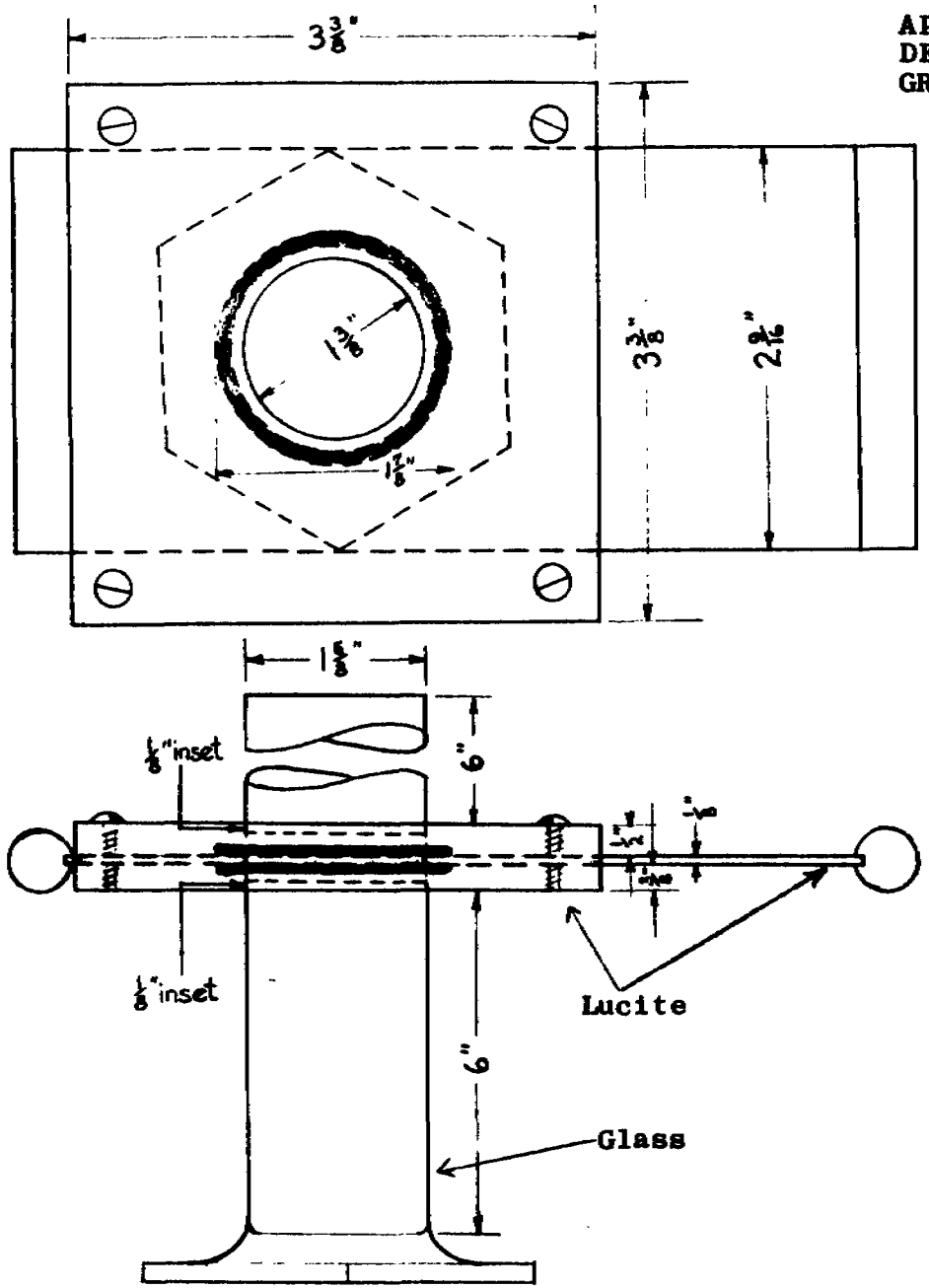
(b) Complete sample identification.

(c) Weight percent of resins in all density tubes.

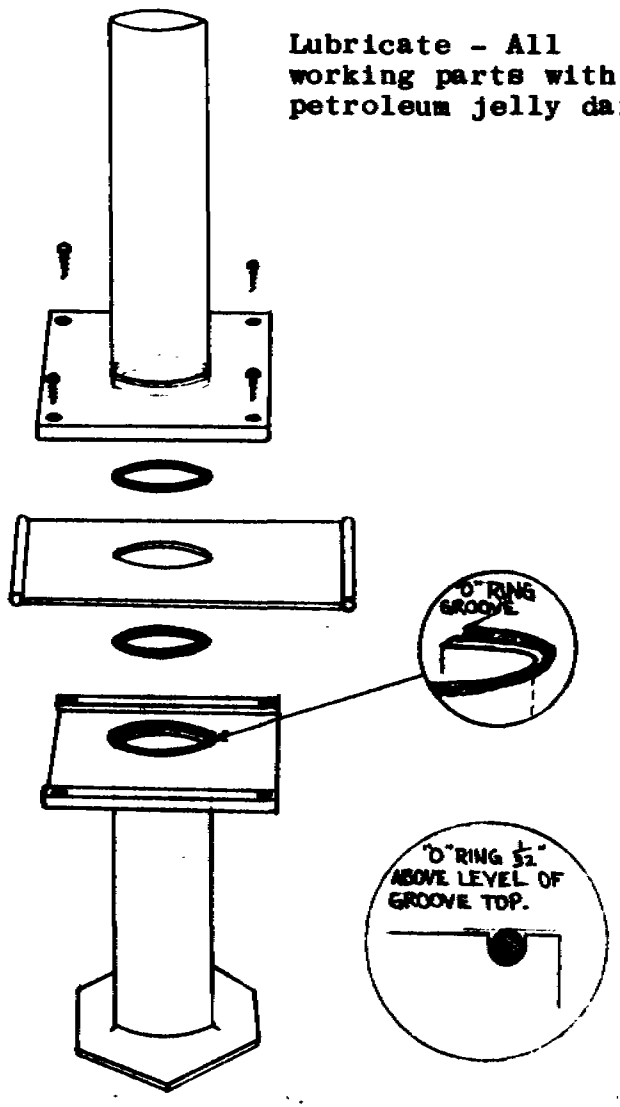
(d) Weight percent of resin with apparent particle density >1.225.

APPENDIX B
FIGURE I

APPARENT PARTICLE
DENSITY - DISTRIBUTION
GRADIENT TUBE



Lubricate - All working parts with petroleum jelly daily.



UCC
041786

APPENDIX C

MODIFIED HARD RESIN PARTICLE TEST

FORMULATION

Resin: 100 parts

Master Batch: 50 phr

Total Batch Size: 55 grams

MASTER BATCH

FLEXOL DOP	93.9%
Mark M	2.2%
Monastral Green	1.4%
Red Oxide	1.6%
Caprylyl Brown	0.9%

Dispersion placed in ball mill with stainless steel balls and rolled for 16-18 hours on can-roller.

PLASTICORDER CONDITIONS

Jacket Temperature	110°C
Rotor Speed	80°C
Processing Time	5 Minutes

10 mil film pressed at 140°C for one minute at 5000 psi in hydrolair press.

The hard resin particle count was determined by a visual count over a controlled light source using 1000 watts of illumination (which corresponds to 300 foot Lumens).

The particle count used is an average of three counts.

BUSINESS CONFIDENTIAL
347K10

Distribution List

Mr. W. H. Bauer, TNY
Dr. F. E. Bailey, Jr., 511
Mr. R. L. Baker, 514
Mr. G. P. Bigelow, NYO
Mr. O. T. Carlisle, 515
Mr. A. J. Costantin, 312
Mr. D. L. Engle, 511
Mr. J. F. Erdmann, 515
Mr. J. H. Field, 515
Dr. C. K. Fink, TNY
Mr. C. E. Fry, 511
Dr. J. E. Glass, 511
Mr. R. E. Gulick, 312
Mr. H. C. Gunst, 312
Mr. D. E. Hardman, NYO
Mr. T. F. Hartsing, 312
Mr. L. D. Harris, NYO
Mr. R. J. Hanna, 511
Mr. J. M. Herbert, NYO
Mr. G. G. Himmler, 312
Mr. J. L. Hockersmith, 312
Mr. R. J. Ireland, 312
Mr. S. Krumm, 312
Mr. L. G. Krauskoph, TNY
Mr. P. T. McCoy, TNY
Mr. L. A. McKenna, 312
Dr. C. W. McGary, 511
Mr. K. V. McCullough, 312
Mr. H. J. Pazinski, 312
Mr. W. Pinkasavage, 312
Mr. W. H. Reinking, 312
Mr. H. M. Rife, 511
Mr. D. E. Richardson, 515
Mr. J. W. Schilling, NYO
Mr. R. C. Thierfelder, 312
Mr. G. C. Shimpston, NYO
Mr. J. J. Smith, 511
Mr. T. R. Smith, 515
Mr. A. F. Sward, NYO
Dr. C. E. White, 312
Mr. R. N. Wheeler, 514
Mr. J. R. Wilkinson, NYO
Dr. N. L. Zutty, 312
Information Retrieval
Authors

9
18

UCC
041788

To: Attached Distribution

Subject: Correction of Project Report 8151

Date: August 25, 1967

Please correct the total interior pore volume values listed in Table I of the Project Report "The Relationship of the Apparent Particle Density Distribution and the Interior Pore Volume to the Hard Resin Particle Content of Vinyl Suspension Resins" by J. W. Fields, File No. 8151, August 15, 1967 to read as follows:

Ethyl 185	0.062 cc/gm
Diamond 35	0.065 cc/gm

J. John Brezinski

Distribution List

Mr. W. H. Bauer, TNY
Dr. F. E. Bailey, Jr., 511
Mr. R. L. Baker, 514
Mr. G. P. Bigelow, NYO
Mr. O. T. Carlisle, 515
Mr. A. J. Costantin, 312
Mr. D. L. Engle, 511
Mr. J. F. Erdmann, 515
Mr. J. H. Field, 515
Dr. C. K. Fink, TNY
Mr. C. E. Fry, 511
Dr. J. E. Glass, 511
Mr. R. E. Gulick, 312
Mr. H. C. Gunst, 312
Mr. D. E. Hardman, NYO
Mr. T. F. Hartsing, 312
Mr. L. D. Harris, NYO
Mr. R. J. Hanna, 511
Mr. J. M. Herbert, NYO
Mr. G. G. Himmler, 312
Mr. J. L. Hockersmith, 312
Mr. R. J. Ireland, 312
Mr. S. Krumm, 312
Mr. L. G. Krauskoph, TNY
Mr. P. T. McCoy, TNY
Mr. L. A. McKenna, 312
Dr. C. W. McGary, 511
Mr. K. V. McCullough, 312
Mr. H. J. Pazinski, 312
Mr. W. Pinkasavage, 312
Mr. W. H. Reinking, 312
Mr. H. M. Rife, 511
Mr. D. E. Richardson, 515
Mr. J. W. Schilling, NYO
Mr. R. C. Thierfelder, 312
Mr. G. C. Shipston, NYO
Mr. J. J. Smith, 511
Mr. T. R. Smith, 515
Mr. A. F. Sward, NYO
Dr. C. E. White, 312
Mr. R. N. Wheeler, 514
Mr. J. R. Wilkinson, NYO
Dr. N. L. Zutty, 312
Information Retrieval