Monsanto

FROM NAME & LOCATION D. R. Cova - T3C

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SUBJECT MONOCHLOROBIPHENYL (MCBP) PHYSICAL PROPERTIES AND RESIDUE DISPOSAL

REFERENCE

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I. Physical Properties of Monochlorobiphenyl

As you requested, we have developed a list of physical properties of monochlorobiphenyl. These are listed in Table I and Figure 1 attached to this memo. I hope these properties will be sufficient. If not, we can determine others.

II. Quality of Aroclor 1242 Made From MCBP Residue

We have made a number of batches in the laboratory of Aroolor 1242 from monochlorobiphenyl fractionation residue. These were made from laboratory-generated rsidue by the chlorination/isomerisation procedure described in the Process for Engineering Design. Table II gives the results of analyses of these batches and compares them to the specifications for Aroclor 1242 and also to some typical analyses of Aroclor 1242 made from biphenyl either in the laboratory or in the Aroclor Department at the W. G. Krummrich Plant.

Aroclor 1242 made from residue meets all the specifications listed with the exception of refractive index and dielectric constant. Dielectric constant is lower and the refractive index higher than normal. Color, acidity, and inorganic chlorides, per se, were not measured, but since the material meets these specifications after being subjected to the corrosion test, there is no doubt that it would meet these same specifications before the test. We have made material which has met the thermal chemical chlorides and Monsanto stability specifications. These two specifications are difficult to meet in the laboratory because of the necessity for extreme cleanliness and careful technique. Material made from residue compared well (with respect to these two tests) with material made from biphenyl in the laboratory. These two tests should be no problem in the plant. We have not had flash points determined for Aroclor 1242 made from residue by this process. There is little doubt but that the material would pass this specification, but we will have flash points determined on a couple of batches. Finally, to be on the safe side we will have more pour point determinations carried out.

GLC analyses show about 1% less of the highly chlorinated homologs in Aroclor 1242 made from residue as compared to W. G. Krummrich Plant Aroclor 1242.

III. Aroclor 1016 From MCBP Residue

At the last review we discussed the possibility of converting MCBP residue to Aroclor 1016 by first chlorinating the distilled residue to 42.5% chlorine (to lower 4,4'-dichlorobiphenyl content) then fractionating in the same fashion as is now done in making Aroclor 1016. Table III gives analyses of such a product. In the fractionating to make this material, 20% of the still charge was left as residue for conversion to Aroclor 1254. This is the same percentage as is used in making Aroclor 1016 at the W. G. Krummrich Plant. Table III shows that the material is out of specification on five tests. Specific gravity, refractive index and viscosity are higher than the specification ranges. Since the material was over chlorinated by 1/2% chlorine, higher than normal viscosity and specific gravity were expected. The A.C. inorganic chlorides is also out of specification, but this may be a problem of laboratory technique rather than a problem intrinsic to the process or material. High boiling homologs (HBH) is also out of specification.

As was discussed at the last review, the HBH analysis is a short GLC procedure which is not completely accurate in quantifying the content of pentachlorobiphenyls and more highly chlorinated biphenyls. Table III gives the results of analysis by a long GLC procedure for these highly chlorinated homologs. As can be seen, this product compares favorably with Aroclor 1016 made at the W. G. Krummrich Plant (0.7% versus ~1.0%).

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TABLE I

PHYSICAL PROPERTIES OF MONOCHLOROBIPHNYL

Appearance:	Depending on temperature (freezing point is near room temperature), This product is either a colorless liquid or a semi-solid to solid mass of large white crystals.
Refractive Index Spec. @ 25°C	1.6092-1.6112
Specific Gravity @ 20-1/2°C	1.161
" " @ 54°C	1.133
" " @ 70°C	1.120
" " Spec. @ 25°C/15.5°C	1.152 -1.162
Flash Point (Open Cup)	154°C
Thermal Conductivity @ 27°C =	$27.7 \times 10^{-4} \frac{cal}{°C\ cm\ sec}$
Thermal Conductivity @ 81°C =	$27.2 \times 10^{-4} \frac{cal}{°C\ cm\ sec}$
Specific Heat @ 0°C	0.31 cal/g°C
" " @ 50°C	0.34 cal/g°C
" " @ 100°C	0.375 cal/b°C
" " @ 150°C	0.41 cal/g°C
" " @ 200°C	0.445 cal/g°C
Vapor Pressure @ 140°C	10 Torr
" " @ 160°C	26 Torr
" " @ 180°C	58 Torr
" " @ 200°C	115 Torr
" " @ 220°C	210 Torr
" " @ 240°C	355 Torr
" " @ 273°C	760 Torr
Kinematic Viscosity @ 100°F	4.04 cs.
Kinematic Viscosity @ 210°F	1.22 cs.

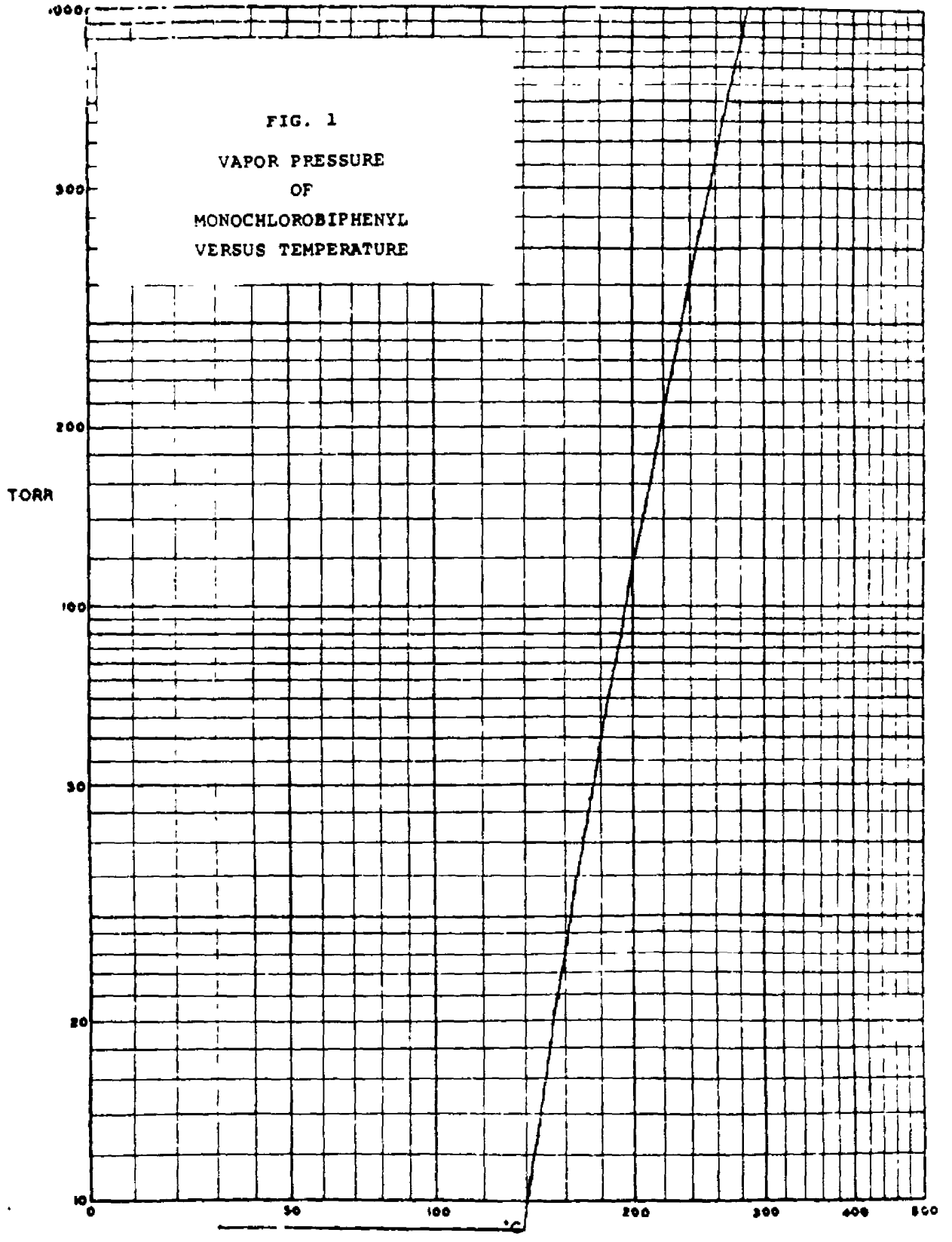
FIG. 1
VAPOR PRESSURE
OF
MONOCHLOROBIPHENYL
VERSUS TEMPERATURE
TORR
1000
500
200
100
50
20
10
0
50
100
200
300
400
500
°C

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TABLE II

QUALITY OF AROCLOR 1242 MADE FROM
MCBP RESIDUE BY CHLORINATION/ISOMERIZATION

-	Specification	Product Made in the Lab From Residue	Product Made From Biphenyl
Distn Range	>325°C at 10%, <360°C at 90%	335/346	
Refractive Index @ 25°C	1.6240-1.6260	1.6285	
Pour Point	<-14°C	-16°C	-16 to -18°C average
Power Factor @ 100°C, 60 cycles, Max.	0.5 Internal 2.0 Customers	0.38	
Dielectric Constant (60 cycles, 100°C)	4.75-4.95	4.69	
Resistivity	-	6.8×10^{13}	
Dielectric Strength @ 25°C	>35 KV	>50 KV	
Thermal Chemical Chlorides	<0.65 ppm	0.36-0.85	0.64, 0.88*
Monsanto Stability	<0.4 ppm	0.14-0.73	0.03*
Westinghouse Hydrolyzable Chlorine	<1.0 ppm	0.40	0.92*
Hydrolytic Stability	<0.5 ppm	0.06	0.55*
Corrosion	0.0	0.0	
A.C. Color	<60	15	
A.C. Condition	Clear	Clear	
A.C. Acidity	<0.010	0.001	
A.C. Inorganic Chlorides	<0.05 ppm	0.05	
Viscosity @ 100°C	82-92 SUS	87.5	

TABLE II (Continued)

	SPECIFICATION	PRODUCT MADE IN THE LAB FROM RESIDUE	PRODUCT MADE FROM BIPHENYL
High-Boiling Homologs (short GLC method)	-	∿ 5%	∿ 6-8%
Total Penta-Hexa-Hepta-etc Chloro-biphenyls (by long GLC method)	-	∿ 4%	∿ 5%

* These analyses are for Aroclor 1242 made from biphenyl in the laboratory. Material made from residue genrally compares quite favorably with that from biphenyl. Thermal chemical chlorides and Monsanto stability require extra-ordinary precautions and cleanliness in the laboratory in order to achieve a satisfactory result. In other words, a bad result may very well be the result of contamination rather than due to some intrinsic property of the material or process.

TABLE III

AROCLOR 1016 MADE FROM MCBP RESIDUE BY CHLORINATION TO 42.5% CHLORINE THEN FRACTIONATION (MIC 227280)

	SPECIFICATION	ANALYTICAL RESULT
Sp. Gr. at 25/15.5°C	1.362-1.372	1.385
Acidity (mg KOH/g)	0.010 max.	0.001
Refractive Index at 25°C	1.6215-1.6235	1.6267
Inorganic (Free) Chlorides	0.05 ppm max.	0.02 ppm
Pour Point	-14°C or lower	-17
Dielectric Constant (60 Hz at 100°C)	4.70-4.90	4.76
Resistivity	500 min.	24,150 x 10^9
Monsanto Stability Test (as Chlorides)	0.4 ppm max.	0.30 ppm
Hydrolysis Stability Test (as Chlorides)	0.5 ppm max.	0.28 ppm
Distillation Range		
10% Distilled by Weight	323°C min.	334°C
90% Distilled by Weight	356°C max.	345°C
Dielectric Strength @ 25°C KV	35 min.	48 KV
Flash Point, °F	338 min.	428°F
Fire Point	None to B.P.	None to B.P.
Corrosion Test (6 hrs. 210°C with bright Al foil) Change in wt. of Al %	0.0	0.0
A.C. Color (APHA)	60 max.	10
A.C. Condition	Clear	Clear
A.C. Acidity (mg KOH/g)	0.010 max.	0.001
A.C. Inorganic (Free) Chlorides	0.05 ppm max.	0.07 ppm

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TABLE III (Continued)

	SPECIFICATION	ANALYTICAL RESULT
Viscosity @ 100°F (SUS)	71-81	86.5
High-Boiling Homologe	0.4% max.	0.54, 0.58%
Penta-Hexa-Hepta-etc. Chlorobiphenyls (by long GLC method)	~1.0%*	0.7%

* This is not a specification but a representative analysis of Aroclor 1016 from the W. G. Krummrich Plant Aroclor Department.

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TABLE XXIX

FLASH AND POUR POINTS FOR AROCLOR 1242'

	Specification	Samples
Flash Point	338-392°F	402, 412
Pour Point	-14°C or lower	-17, -15, -16