4.E.1

PLAINTIFF'S EXHIBIT

UC-2964

UNION CARBIDE

THE DISCOVERY COMPANY

Resin-Grade 144 Asbestos

- **Effective, low-cost thickening agent and thixotrope for epoxy resin systems**
- **Imparts excellent aging characteristics to epoxy resin systems**
- **Effective with amine hardeners**

UCC 016381

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Typical physical properties

Specific Gravity, g. per ml.	2.45
Moisture Content, % by wt.	2.0, maximum
Surface Area, sq. meters per gram	60, appr.
Reflectance, G. E. Brightness	72-76
Nature of Surface Charge	Electropositive (cationic)
pH in Water	9.5
Bulking Value, gallons per 100 lb.	4.8
Oil Absorption (DOP), pounds per 100 lb.	120
Refractive Index, n_D 25° C.	1.54-1.56
Wet Bulk Density in Water, ml.	
as received, 20 g. per liter; 3-hr. settling	700
after dispersion, 2 g. per liter; 1-hr. settling	900-1,000
Dry Bulk Density, lb. per cubic foot	4
Shipping Density, lb. per cubic foot	12-14
Standard Package Weight, lb.	35

Resin and amine hardener evaluation

METHOD OF INCORPORATING THE THIXOTROPE:

In preparing the test samples used in determining data for Tables 1, 2 and 3, the thixotrope—Resin-Grade 144 Asbestos—was added to the liquid resin or hardener at 25°C. and dispersed in a "Cowles" Dissolver at 2400 rpm. for 5 minutes.

VISCOSITY MEASUREMENTS:

Viscosities of the prepared test samples were measured on a Brookfield Model RVF Viscometer at 2 and 20 rpm.

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Table 1 shows performance data of bisphenol-based resins, BAKELITE ERL-2774 and ERL-2795, with up to 4 PHR. of Resin-Grade 144 Asbestos. Vertical drawdown was excellent, and even higher asbestos loading should result in even higher vertical drawdown.

Table 1 THICKENING OF BISPHENOL-BASED RESINS WITH RESIN-GRADE 144 ASBESTOS

Ingredient	Parts by Weight											
BAKELITE ERL-2774 Resin-Grade 144 Asbestos	100 1			100 2			100 3			100 4		
Brookfield RVF Viscosity, cps. X 10^{-3}	RPM.		Thixotropic Index (T. I.) (a)	RPM.		Thixotropic Index (T. I.)	RPM.		Thixotropic Index (T. I.)	RPM.		Thixotropic Index (T. I.)
	2	20		2	20		2	20		2	20	
24 hours	34	22	1.5	137	39	3.5	250	53	4.7	464	87	5.3
7 days	32	20	1.6	132	36	3.6	244	54	4.5	430	76	5.7
30 days	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	480	94	5.1
Vertical Drawdown, mil (c)												
Room Temperature	(b)			(b)			(b)			125		
45 days	(b)			(b)			(b)			125		

Ingredient	Parts by Weight											
BAKELITE ERL-2795 Resin-Grade 144 Asbestos	100 1			100 2			100 3			100 4		
Brookfield RVF Viscosity, cps. X 10^{-3}	RPM.		Thixotropic Index (T. I.)	RPM.		Thixotropic Index (T. I.)	RPM.		Thixotropic Index (T. I.)	RPM.		Thixotropic Index (T. I.)
	2	20		2	20		2	20		2	20	
24 hours	18	3.8	4.7	38	6.3	6.0	70	11	6.4	91	13	6.9
7 days	16	3.7	4.3	35	6.8	5.1	68	12	5.5	122	22	5.5
30 days	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	125	25	5.0
Vertical Drawdown, mil												
Room Temperature	(b)			(b)			(b)			80		
45 days	(b)			(b)			(b)			70		

(a) Thixotropic Index (T. I.) = $\frac{\text{viscosity at 2 rpm.}}{\text{viscosity at 20 rpm.}}$

(b) Not run.

(c) Vertical Drawdown: A 2-inch wide drawdown was made on a horizontal sandblasted steel panel. The panel was immediately raised to a vertical position and any sag noted. If no sag occurred in 10 minutes, the procedure was repeated and the thickness increased until sagging occurred.

Table 2 presents data that show the effectiveness of Resin-Grade 144 Asbestos as a thickener of several types of BAKELITE amine hardeners. Generally, other thickeners are not effective with amine hardeners.

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UNION CARBIDE THE DISCOVERY COMPANY

UNION CARBIDE CORPORATION
ASBESTOS
270 Park Avenue, New York, N. Y. 10017

Sales Offices

United States	ATLANTA, GEORGIA 30309	1371 Peachtree St., N. E.	404-876-3331
	BALTIMORE, MARYLAND 21207	6660 Security Blvd.	301-944-8211
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	TULSA, OKLAHOMA 74114	2901 South Harvard	918-742-5524

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UNION CARBIDE Resin-Grade 144 Asbestos

Resin-Grade 144 Asbestos

. . . a highly purified fiber product that is an effective, low-cost thickening agent and thixotrope for epoxy resin systems. By means of a special refining technique developed by UNION CARBIDE, Resin-Grade 144 Asbestos is made completely grit-free and non-abrasive—this latter characteristic makes it especially valuable in spray application.

Other desirable features of Resin-Grade 144 Asbestos include:

- Disperses easily in liquid resin or hardener with a "Cowles" Dissolver or similar mixers
- Overmixing will not destroy the thixotropy of the resin-asbestos mixture
- Epoxy systems containing Resin-Grade 144 Asbestos have excellent aging characteristics
- Negligible dusting
- Unlike other thixotropes, it is effective with amine hardeners
- Resin-Grade 144 Asbestos is substantially lower in cost than commonly used refined silicas or modified clays
- With the exception of the low-viscosity, cyclo-aliphatic epoxides, no amine salts are necessary for viscosity build-up or thixotropic stabilization

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Table 2 THICKENING OF AMINE HARDENERS WITH RESIN-GRADE 144 ASBESTOS

Formulation	Parts by Wt. BAKELITE ZZL-0814.....100 Resin-Grade 144 Asbestos.....4			Parts by Wt. BAKELITE ZZL-0820.....100 Resin-Grade 144 Asbestos.....4			Parts by Wt. BAKELITE ZZL-0854.....100 Resin-Grade 144 Asbestos.....4		
Brookfield RVF Viscosity, cps. × 10^{-3}	RPM. 2	20	Thixotropic Index (T. I.)	RPM. 2	20	Thixotropic Index (T. I.)	RPM. 2	20	Thixotropic Index (T. I.)
24 hours	187	36	5.3	67	32	2.1	102	23	4.5
7 days	172	34	5.1	66	32	2.1	104	23	4.6
30 days	177	34	5.2	67	35	1.9	104	24	4.4
Vertical Drawdown	Mil			Mil			Mil		
Room Temperature (R. T.)	70			40			40		
50°C.	20			—			—		
80°C.	—			40			40		
30 days at R. T.	70			40			40		
30 days at 80°C.	—			40			40		

Table 3 shows the thickening of a low-viscosity, cyclo-aliphatic epoxide, BAKELITE ERL-4221, with Resin-Grade 144 Asbestos and "Armac" C, a long chain aliphatic amine salt. BAKELITE ERL-4221 is the exception that requires an amine salt to be used with Resin-Grade 144 Asbestos for viscosity build-up or thixotropic stabilization.

Table 3 THICKENING OF A LOW-VISCOSITY, CYCLO-ALIPHATIC EPOXIDE WITH RESIN-GRADE 144 ASBESTOS AND "Armac" C

Ingredient	Parts by Wt.
BAKELITE ERL-4221	100
Resin-Grade 144 Asbestos	7
"Armac" C	8

Brookfield RVF Viscosity, cps. × 10^{-3}	RPM. 2	20	Thixotropic Index (T.I.)
Initial	262	42	6.3
8 Weeks at 25°C.	268	36	7.4
7 Weeks at 40°C.	243	38	6.4

Systems evaluation

BAKELITE ERL-2774/ZZL-0814

With a Resin-Grade 144 Asbestos loading of 4 per cent on both resin and hardener, it was possible to hold a 70-mil thickness at room temperature. Higher loadings on the amine should result in much higher vertical drawdown.

BAKELITE ERL-2774/ZZL-0820

A 4-per cent loading of Resin-Grade 144 Asbestos resulted in a 40-mil thickness that did not sag within 40 minutes at 80°C. The system was gelled at that time.

BAKELITE ERL-2774/ZZL-0854

With a 4-per cent loading of Resin-Grade 144 Asbestos, it was possible to hold a 40-mil thickness at 80°C. until gelled (65 minutes).

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