UNION CARBIDE THE DISCOVERY COMPANY

PERFORMANCE DATA

Calidria ASBESTOS

PLAINTIFF'S EXHIBIT

UC-3963

POLYESTER PREMIXES— COMPARATIVE COST AND PERFORMANCE DATA

A07822

F-42355

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UCC 014966

POLYESTER PREMIXES – COMPARATIVE COST AND PERFORMANCE DATA

CALIDRIA R-G 110 Asbestos, a relatively new product of UNION CARBIDE, has been found to offer the polyester premix market decided product improvements, at reduced costs. Superior properties are obtained with R-G 110 as the sole reinforcing fiber at costs 1/3 to 1/2 those normally associated with Grade 7 chrysotile in similar compounds. In high performance fiber glass premixes, R-G 110 is also superior in providing mechanical properties and processing improvements at lower cost.

A high purity product, CALIDRIA Asbestos has an unusually high fiber content that is converted by a proprietary process to a product that is up to five times as effective, pound for pound, as currently used commercial grades of asbestos, that contain large amounts of ineffective inert materials.

Polyester premix compounds, largely for the electrical, automotive, refrigeration, electronics and industrial equipment fields, usually contain various types of low-cost chrysotile shorts or float-type mineral additives to provide:

- Lower shrinkage during molding.
- Controlled flow.
- Improved heat resistance.
- Uniform distribution of other fibers throughout the molded piece.
- Lower product cost.

The asbestos usually selected are Canadian Grades 7TF and 7RF. Other fibers, such as glass and sisal, are frequently used to provide specific properties. Some formulations also include fillers, pigments, and special additives for mold release.

EVALUATION PROCEDURES

PREMIX PREPARATION

All premix compounds were prepared from Rohm and Haas, "Paraplex" P-43 polyester resin. The resin was mixed with 10 per cent by weight styrene monomer and 1 per cent by weight benzoyl peroxide catalyst. Two types of asbestos were used: Canadian 7TF8 and CALIDRIA R-G 110. The limestone used was sized to permit 98% to pass a 325 mesh screen. Chopped fiber glass strand, 1/8-inch, and sisal fiber, 1/2-inch, were added to the high performance compounds.

MIXING

Sample premix compounds were mixed in a "Baker-Perkins" mixer. The resin system was added to the mixer followed by asbestos, limestone, sisal, and glass, in order, for a total of 30 minutes, but in no case was the compound mixed for more than 5 minutes after the glass fibers were added in order to minimize attrition of fiber length. The premixes were extruded from a "Hobart" mixer fitted with a 3/16-inch plate for further homogenization.

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TEST SAMPLES

Test samples were compression molded from the extruded premix in a 10 x 10 x 1/8-inch plaque mold for 5 minutes at 150°C. with an average 4000 psi. pressure. All specimens for mechanical testing were cut from the 10 x 10-inch plaques.

VISCOSITY SAMPLES

Samples for viscosity determinations were prepared in a "Hobart" mixer. Asbestos and/or limestone was added to the resin system and mixed for 20 minutes. Viscosity measurements were made with a "Burrell-Severs" capillary rheometer.

HIGH PERFORMANCE PREMIX

CALIDRIA R-G 110 Asbestos plus limestone was substituted for 7TF8 asbestos in a high performance premix which contained glass and sisal as primary reinforcement. Both premixes containing CALIDRIA R-G 110, (Table 1 below) exhibit physical properties as good as, or better than, the conventional premix containing 7TF8 asbestos. The overall cost of raw materials is below that of the conventional premix. The relative cost figures used to calculate comparative costs are shown in Table 4, page 5.

The lower ultimate compound cost can be achieved, because the higher purity and greater asbestos fibril liberation in CALIDRIA R-G 110 permit the use of lesser quantities of CALIDRIA Asbestos and the incorporation of additional quantities of low cost limestone. A comparison of the property characteristics of CALIDRIA R-G 110 and 7TF8 is shown in Table 2 on page 4.

TABLE 1

Comparative Physical Properties and Costs of a Conventional Polyester-Glass Premix Compound vs. CALIDRIA Asbestos-Glass Premix Compounds

	Composition, % by Weight		
	Conventional Premix	CALIDRIA Asbestos Premixes	
Polyester resin system	40	35	40
Fiber glass, 1/8", chopped strand	15	10	7.5
Sisal, 1/2", chopped	10	10	10
Asbestos, Canadian 7TF8	10	–	–
Asbestos, CALIDRIA R-G 110	–	5	7.5
Limestone	25	40	35
Relative Properties & Costs			
Izod, ft.-lb./inch	1.0	1.1	0.9
Flex strength, psi. x 10^{-3}	8.5	8.1	8.7
Flex modulus, psi. x 10^{-6}	1.2	1.3	1.4
Cost, $/lb.	0.151	0.128	0.132

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POLYESTER PREMIXES – COMPARATIVE COST AND PERFORMANCE DATA

LOW COST PREMIX FORMULATIONS

Asbestos fibers yield increased flexural strength, modulus, and heat distortion temperature (HDT) when used as the sole reinforcement in low-cost moldings. CALIDRIA R-G 110 may be substituted for 7TF8 with additional improvements in impact resistance, strength, and HDT.

Table 3 presents data for a series of CALIDRIA R-G 110 reinforced, low-cost premixes showing the variation of properties with changes in composition. These data show that very acceptable properties can be attained with CALIDRIA R-G 110 at a total raw material cost of less than 8¢/lb.

TABLE 2

Typical Asbestos Characteristics

	R-G 110	7TF8
Specific Gravity	2.45	2.50
Reflectance, Photovolt, %	68	65
Surface Area, BET-Nitrogen, $m.^2/g.$	55	15
Magnetite Content, %	1.5	3.5
Oil Adsorption, lb. DOP/100 lb. asbestos	110	50
Particle Size, Wet Screen, Retained on 325M, %	12	11
Dry Bulk, Aerated, $lb./ft.^3$	5	19
Total Available Asbestos, % fiber in package	85	25

TABLE 3

Comparative Physical Properties and Costs of a Conventional Polyester Premix Compound vs. CALIDRIA Asbestos Premix Compounds

	Composition, % by Weight					
	Conventional Premix		CALIDRIA Asbestos Premixes			
Polyester compound	60	60	40	40	30	30
CALIDRIA R-G 110	–	20	15	10	20	10
7TF8 Asbestos	40	–	–	–	–	–
Limestone	–	20	45	50	50	60
Relative Properties & Costs						
Izod, ft. lb./in.	0.2	0.3	0.3	0.3	0.3	0.3
Flex strength, psi. X 10^{-3}	9.1	11.4	11.0	9.4	8.8	8.1
Flex Modulus, psi. X 10^{-6}	1.16	1.0	1.7	1.1	1.3	1.2
HDT, °C.	74.0	76.7	–	77.9	79.7	78.5
Cost, $/lb.	0.132	0.137	0.097	0.093	0.080	0.074

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COST DATA

In order to determine relative compound costs, the following delivered prices were assumed:

TABLE 4

Relative Cost Figures

	$/lb.
1. Polyester system (including styrene monomer and catalyst)	0.20
2. Fiber glass, chopped 1/8" strand	0.30
3. Sisal, chopped 1/2"	0.20
4. 7TF8 Asbestos	0.030
5. CALIDRIA R-G 110 Asbestos	0.075
6. Limestone	0.01

These costs, while not necessarily accurate at any particular location, provide relative data which are useful, as shown below in typical cost comparison calculations.

	Conventional Premix			CALIDRIA R-G 110 Premix		
	% by Wt.	Per Lb. Cost	Premix Cost	% by Wt.	Per Lb. Cost	Premix Cost
Polyester	60	X 0.20	0.12	40	X 0.20	0.08
7TF8 Asbestos	40	X 0.03	0.012	–	–	–
R-G 110 Asbestos	–	–	–	10	X 0.075	0.0075
Limestone	–	–	–	50	X 0.01	0.005
Overall Compound Cost/Lb.			$0.132			0.0925

VISCOSITY CONTROL

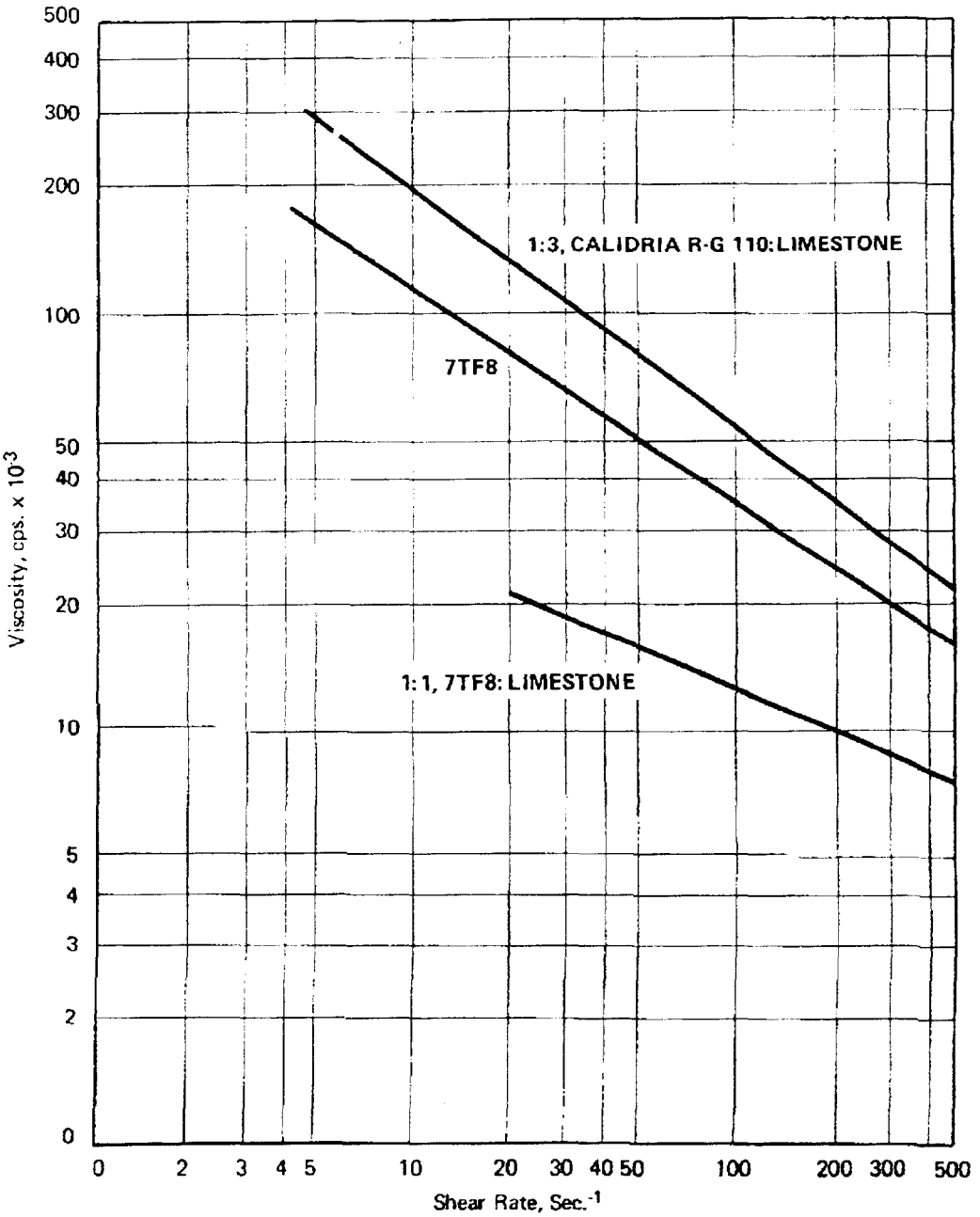
Samples of polyester resin, asbestos, and limestone containing a total of 30 per cent mineral additive were prepared to demonstrate the viscosity control capabilities of CALIDRIA R-G 110 compared to 7TF8. A comparison of the two is shown in Figure 1, page 6. Higher viscosities are obtained with a 1:3 mixture of CALIDRIA R-G 110 and limestone than with an equal quantity of 7TF8. A curve for a 1:1, 7TF8:limestone mix is included to show that the same performance cannot be obtained. These data illustrate the ability of CALIDRIA R-G 110 to impart flow control characteristics to a polyester premix formulation which surpass the effect achieved with 7TF8.

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FIGURE 1

VISCOSITY PROFILES: POLYESTER-MINERAL SYSTEMS[a]



[a] 30 per cent solids

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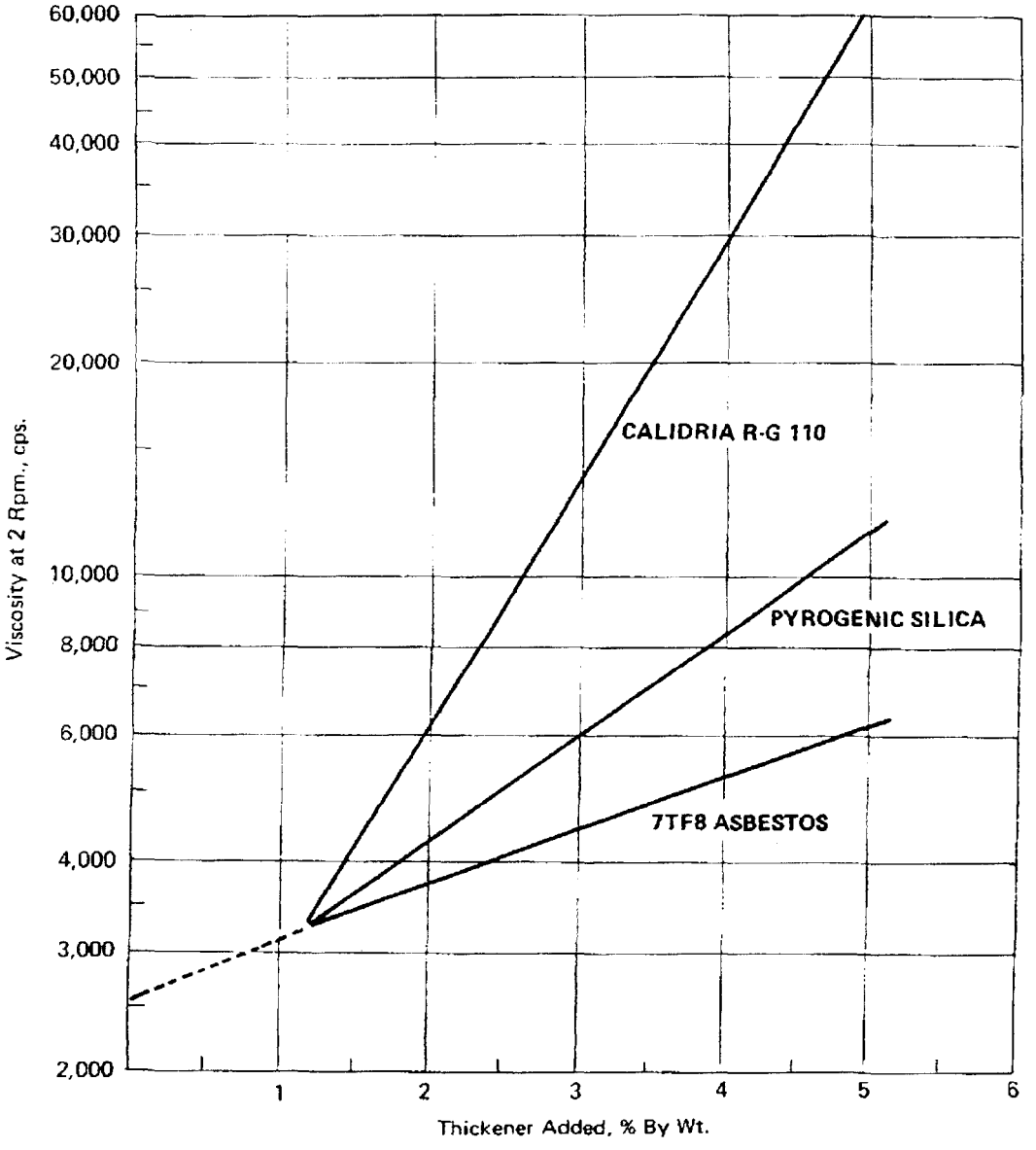
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ASPHALTIC COMPOUND VISCOSITY CONTROL

CALIDRIA R-G 110 Asbestos is also particularly adapted to use in asphaltic and similar compounds where good bodying is required at low concentrations, such as in automotive undercoating and sound deadening applications. Because of its fine particle size, high fiber content and high purity, R-G 110 is essentially non-abrasive and ideally suited to meet the demanding performance of air-less spray applications. Comparative thickening efficiency is shown in Figure 2.

FIGURE 2

COMPARATIVE THICKENING PERFORMANCE
OF VARIOUS MATERIALS IN COAL TAR RESIDUE



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Calidria ASBESTOS

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