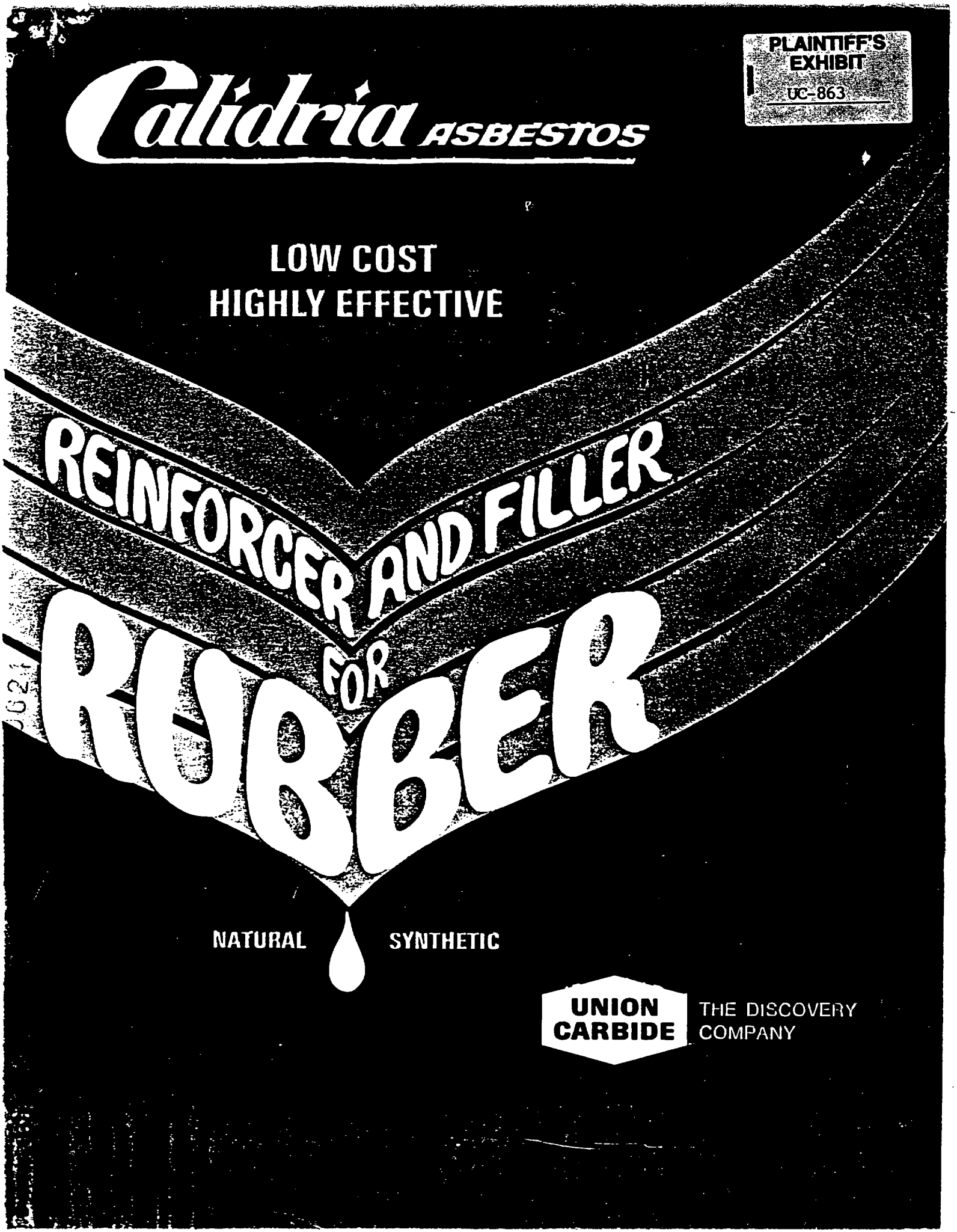


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Two Grades of **Calidria** Asbestos for Rubber

HIGH-PURITY ASBESTOS

— an exceptionally pure, light-colored, non-abrasive asbestos fiber for all rubber systems.

T-135

— a high-purity asbestos uniquely bonded with titania for use in white or light-colored systems.

Property Benefits:

LOW-COST FILLER AND REINFORCER — "Calidria" asbestos is unique among low-cost rubber fillers. It is a reinforcing filler, providing dimensional stability and improved strength with minimum effect on other physical properties. It does this by optimizing the polymer/filler interaction through its small particle size, high length/diameter ratio, and relatively large surface area. This high-purity fiber is also low in magnetite and other contaminants that adversely affect physical properties. Rubber manufacturers can add high loadings of "Calidria" asbestos to both natural and synthetic rubber to take advantage of these property benefits.

GOOD ABRASION RESISTANCE — "Calidria" asbestos markedly improves the abrasion resistance of rubber. In tests on the DeMattia abrasion tester, this high-purity fiber gives equal or better abrasion resistance than other asbestos products.

TYPICAL PHYSICAL PROPERTIES

	High-Purity	T-135	
Specific Gravity	2.45	2.45	—
Moisture Content	2.0-3.0	2.0-3.0	% by weight
Nature of Surface Charge	Cationic	Cationic	—
Magnetite Content	0.7	0.5	% by weight
Oil (DOP) Absorption	120	100	lb. per 100 lb.
Surface Area	60	60	sq. m. per g.
Length/Diameter (Aspect Ratio)	200/1	200/1	—
Brightness (G.E. Photovoltmeter)	75	86	%
pH in Water (2% slurry)	9	9	—

A00220

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ACL Doc 16074 · Page 2 of 130 asbestosclaims.law/library/16074/2

DETACH HERE

cessing Benefits:

PERSION, MINIMUM RUGOSITY — The orm fibers of "Calidria" asbestos disily in rubber compounds with conveng equipment. They also permit smooth g and extrusions with a minimum of gosity.

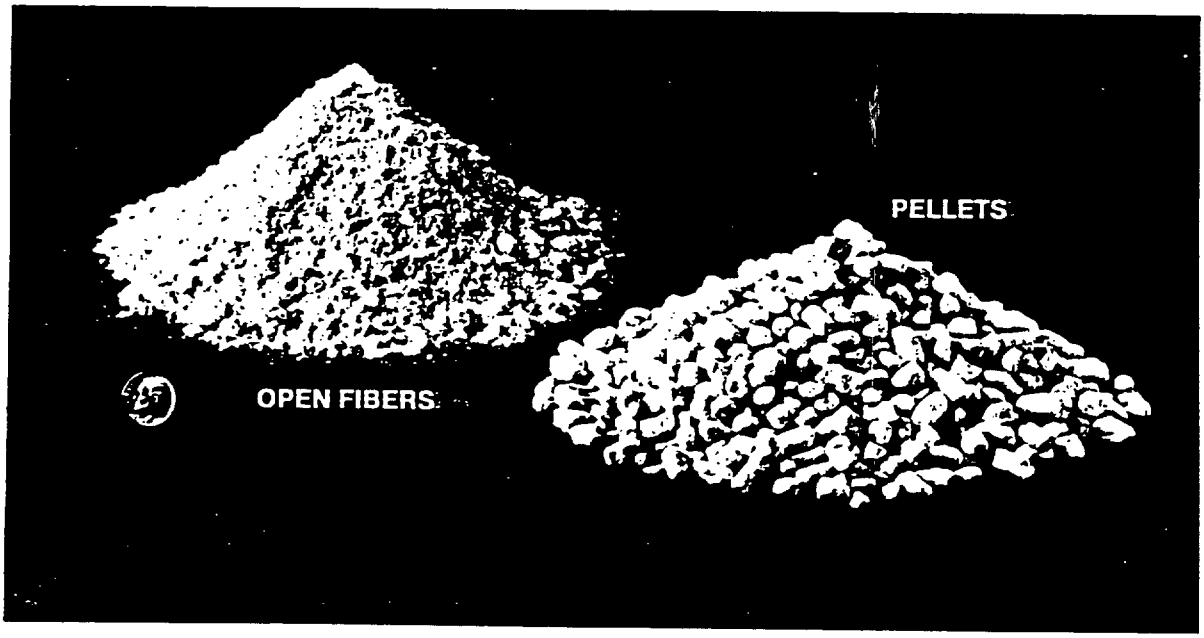
EXTENDED DIE LIFE—Because of its high purity, "Calidria" asbestos has a minimum of magnetite and rock particles that can wear dies. Thus, nylon dies can be used to extrude rubber compounds containing "Calidria" asbestos with minimum wear.

CONTROLLABLE CURES—The low magnetite and uniform pH of 9 in "Calidria" asbestos gives more controllable cure rates in rubber compounds containing this unusual fiber.

SEPARATE TiO_2 ADDITIONS ELIMINATED—Rubber manufacturers adding TiO_2 as a pigment for non-black systems can save an additional step by using "Calidria" asbestos T-135. This titanated asbestos product provides sufficient TiO_2 for pigmentation at the same time it provides high-purity asbestos as a reinforcing filler. The TiO_2 is uniformly distributed on the asbestos fibers, aiding dispersion when added to the rubber system.

Handling Benefits:

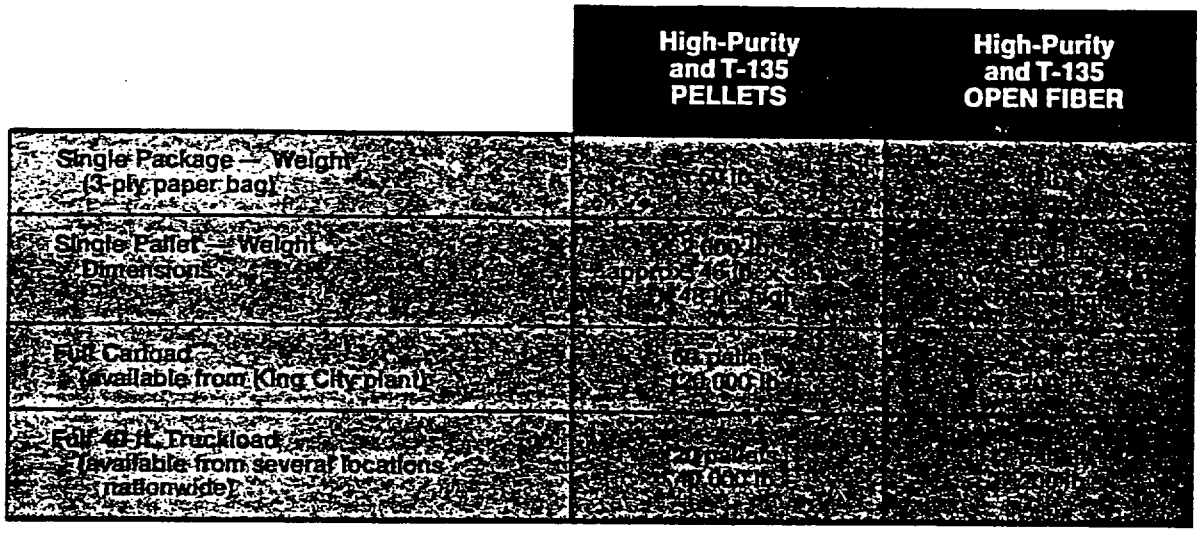
PELLETS REDUCE DUST—"Calidria" asbestos is available as either dust free pellets or open fibers, packed in bags. The pellets are so rugged that they can be handled in bulk with minimum dust. This popular feature, available exclusively with "Calidria" asbestos, allows cleaner operations during materials handling and addition to rubber. It also allows easier handling and storage, lower freight costs, and better automatic feed, as described on the next page.



AG0221

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PACKAGING AND AVAILABILITY



EASIER HANDLING AND STORAGE — "Calidria" asbestos pellets are over twice as dense as the open fibers. One ton of pellets occupies only 46 cu. ft. of space compared to over 100 cu. ft. for one ton of typical open fiber products. By using pellets, rubber manufacturers can speed handling and cut storage space in half.

LOWER FREIGHT COSTS TOO — A box car can be loaded to its full 120,000 lb. capacity when pellets are specified. In comparison, only 83,200 lb. of open fiber can be loaded in the same car. Thus, pellets can save up to 20% on rail shipping costs by permitting use of lower tariffs. The high density of "Calidria" asbestos pellets also offers savings in truck freight costs in many parts of the country, while substantial savings in ocean shipping costs can be made by shipping pellets overseas.

FEED AUTOMATICALLY—"Calidria" asbestos pellets are ideally suited for operations using automatic feed equipment. They flow quickly and smoothly through the equipment, with a minimum of dust to clog the system. Producers using Banbury mixers will find the high bulk density of the pellets permits optimum loadings.

Why is "Calidria" asbestos different?

"Calidria" asbestos is a high-purity, short-fiber chrysotile asbestos obtained from a unique deposit about 160 miles south of San Francisco, California. Unlike conventional deposits that extend through the host rock, this deposit is essentially free of hard, consolidated rock masses. Further, the ore assays up to 60% asbestos fiber compared to other deposits which contain from 6 to 10% asbestos.

Special hydraulic beneficiation techniques developed by Union Carbide efficiently break down the fiber bundles and remove the rock and impurities from the asbestos fiber. As a result, "Calidria" products are over 95% pure asbestos whose fibers have been over 98% liberated from fiber bundles. These high-purity fibers are then sold as open fibers or are pelletized for convenient, dust-free handling and storage.

"Calidria" asbestos T-135 is a high-purity asbestos fiber to which are bonded uniformly dispersed particles of TiO_2. The strong attraction between the positively charged asbestos and the negatively charged TiO_2 prevents agglomeration of the TiO_2, aiding dispersion in rubber systems.

A00222

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ACL Doc 16074 · Page 4 of 130 asbestosclaims.law/library/16074/4



1. CANADIAN ASBESTOS AS-MINED
These fiber bundles are straight and tightly bonded, surrounded by masses of rock. In this form, the fibers defy separation from each other and from the host rock.



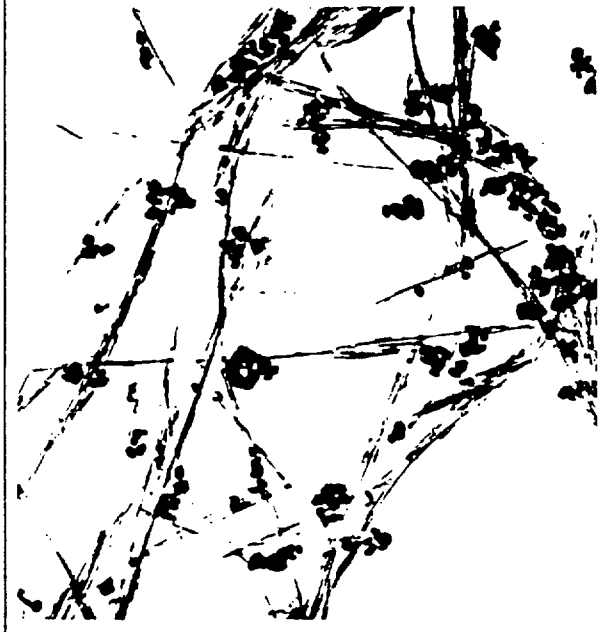
2. "CALIDRIA" ASBESTOS AS-MINED
Here the fibers are randomly oriented and essentially free of hard rock masses. Further, the ore assays up to 60% asbestos, considerably more than the Canadian ore.



3. "CALIDRIA" ASBESTOS IF DRY-PROCESSED
The most exacting dry processes do not completely break down the fiber bundles into individual fibers. Union Carbide developed a special wet process to do this.



4. WET-PROCESSED "CALIDRIA" ASBESTOS
Union Carbide's process separates 98% of the fibers from the fiber bundles. These fibers can be bought open or in convenient, dust-free pellets whose fibers disperse quickly when added to rubber.



5. T-135 WITH UNIFORMLY DISPERSED TiO_2
The TiO_2 particles are kept dispersed by a strong attraction between the positively charged asbestos and the negatively charged TiO_2. This gives good dispersion of the TiO_2 in rubber.

A06221

Typical Performance Data

NATURAL RUBBER (NR)

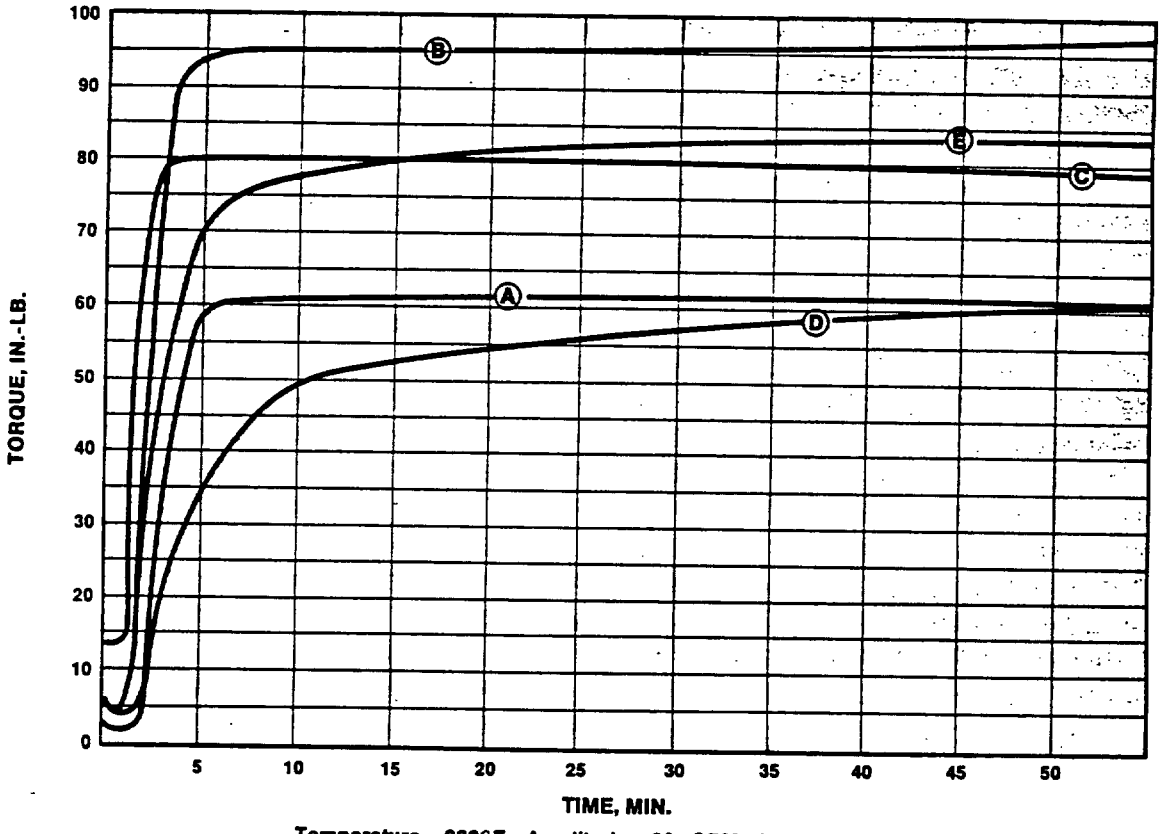
In extensive tests in natural rubber, "Calidria" asbestos has been found to be an effective filler and reinforcer. As shown in Columns A and B at the right, 20 and 65 parts of "Calidria" high-purity asbestos per hundred rubber were added to a black, sulfur-cured system. The asbestos addition gave moderate increases in tensile, hardness, and tear die C properties while substantially increasing the modulus at 100%, 200%, and 300% elongation.

Similarly, high tensile, hardness, modulus, and tear die C properties were obtained in a non-black system containing 50 pphr of "Calidria" asbestos and 15 pphr of precipitated silica. These data are shown in Column C.

To test the effectiveness of "Calidria" asbestos in alternate curing systems, 65 pphr of the fiber were added to natural rubber having a faster sulfur cure (Column D). As a comparison, 65 pphr of "Calidria" asbestos was also added to natural rubber having the sulfur cure previously used (Column E). "Calidria" asbestos was the only filler added to each system. The data in Columns D and E show that "Calidria" asbestos contributed to the high properties obtained in both systems.

In all systems, optimum processing safety was obtained as noted by the Mooney scorch values. In addition, "Calidria" asbestos gave fast, controllable cures, as shown by the curves below.

CURE CHARACTERISTICS • Monsanto Oscillating Disc Rheometer



Temperature—320°F.; Amplitude—3°; OPM—3; Preheat—60 sec.

AUC22a

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ACL Doc 16074 · Page 6 of 130
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INGREDIENTS AND PHYSICAL PROPERTIES

NATURAL RUBBER (NR)	BLACK SYSTEM		NON-BLACK SYSTEM	TWO SULFUR CURING SYSTEMS	
	A	B	C	D	E
INGREDIENTS, pphr					
SMR-H5L	100	100	100	100	100
MT Carbon Black (1)	20	20	—	—	—
Precipitated Silica (2)	—	—	15	—	—
"Calidria" High-Purity Asbestos Pellets	20	65	50	65	65
Stearic Acid	1	1	1	4	1
Zinc Oxide	5	5	5	5	5
Sulfur	1.5	1.5	1.5	2.5	1.5
Mercaptobenzothiazole	0.5	0.5	0.5	—	0.5
Tetramethylthiuram Disulfide	1.5	1.5	1.5	—	1.5
Benzothiazyl Disulfide	—	—	—	0.7	—
Diphenylguanidine	—	—	—	0.3	—
MOONEY SCORCH, T_5MS1 @ 250°F., min. (ASTM D1646-68)	4	3	4	6	4
MOLD CURE	20 min./ 320°F.	20 min./ 320°F.	20 min./ 300°F.	20 min./ 320°F.	20 min./ 320°F.
PROPERTIES					
Hardness, Shore A (ASTM D2240-68)	60	80	80	77	78
Tensile, psi (ASTM D412-68)	1,900	2,100	2,200	2,025	2,000
Elongation, % (ASTM D412-68)	450	350	250	350	350
Modulus, psi (100%) (ASTM D412-68)	425	900	1,350	800	900
(200%) (ASTM D412-68)	650	1,200	1,775	1,100	1,100
(300%) (ASTM D412-68)	1,025	1,800	—	1,700	1,500
Tear Die C, ppi (ASTM D624-54)	250	300	425	350	350
Compression Set, (22 Hr./158°F.), % (Method B) (ASTM D395-67)	40	50	55	60	60

(1) Cabot Corp.'s "Sterling" MT
(2) PPG's "Hi-Sil" 233

A00221

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Typical Performance Data

ETHYLENE PROPYLENE DIENE MONOMER (EPDM)

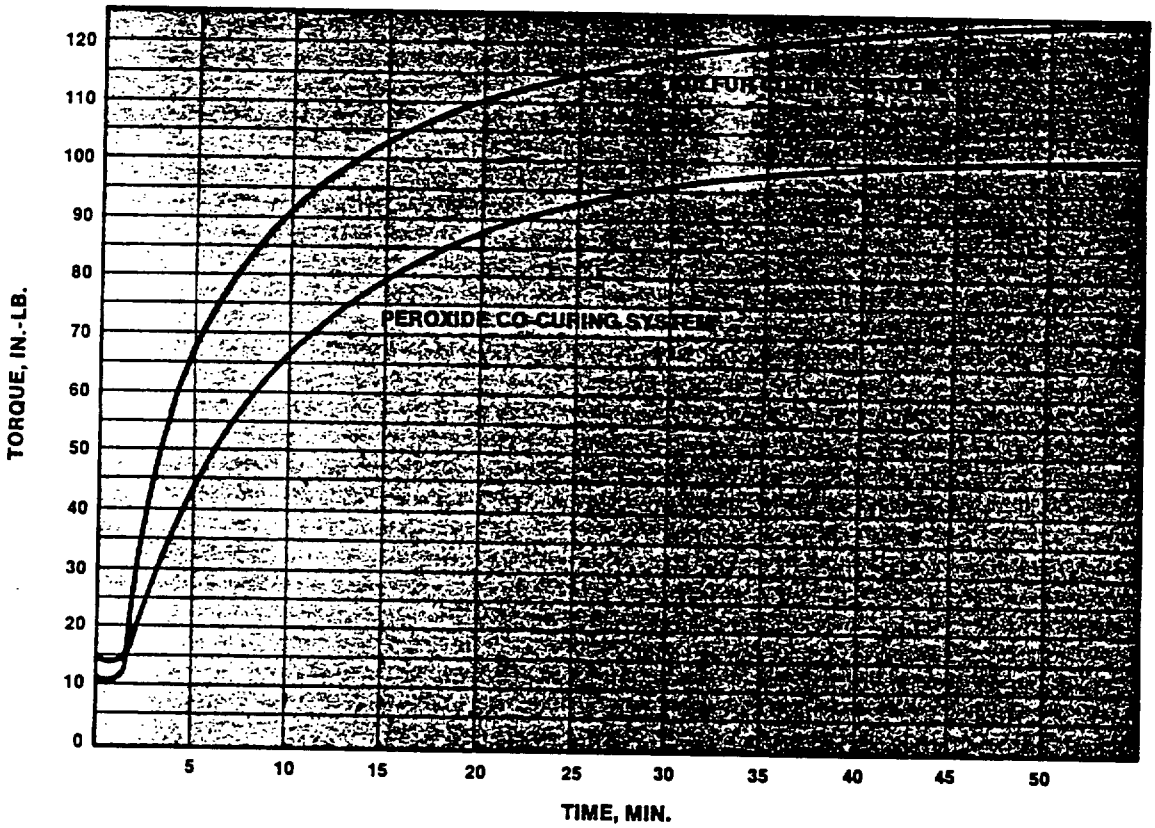
"Calidria" asbestos also increased the properties of EPDM, particularly the modulus and tear die C values. As shown in Columns A and B at the right, 50 and 65 parts of "Calidria" high-purity asbestos per hundred rubber were added to a black, sulfur-cured system. The system containing 65 parts of "Calidria" asbestos had substantially higher modulus and tear die C properties than the system containing 50 parts of the fiber. In addition, hardness and tensile strength increased slightly with the larger filler addition.

Columns C and D compare the addition of 50 and 65 pphr of "Calidria" asbestos in black EPDM using a peroxide co-curing system. Although properties are not as high as with the sulfur-curing system, the effect of "Calidria" asbestos in improving tensile, hardness, modulus, and tear properties is clearly shown.

In Columns E and F, 50 pphr of "Calidria" asbestos were added to non-black EPDM using sulfur and peroxide co-curing systems respectively. The reinforcing effect of this high-purity fiber, working together with precipitated silica, is shown to yield high properties.

In all tests, processing safety was assured by the uniform Mooney scorch values. Controllable cure rates were obtained as the curves for each cure system closely followed the lines shown below.

CURE CHARACTERISTICS • Monsanto Oscillating Disc Rheometer



Temperature—320°F.; Amplitude—3°; OPM—3; Preheat—60 sec.

A00822

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ACL Doc 16074 · Page 8 of 130 asbestosclaims.law/library/16074/8

INGREDIENTS AND PHYSICAL PROPERTIES

ETHYLENE PROPYLENE DIENE MONOMER (EPDM)	BLACK, SULFUR-CURED SYSTEM		BLACK, PEROXIDE CO-CURED SYSTEM		NON-BLACK SYSTEM	
					SULPHUR-CURED	PEROXIDE CO-CURED
	A	B	C	D	E	F
INGREDIENTS, parts						
	100	100	100	100	100	100
	20	20	20	20	—	—
	—	—	—	—	15	15
	50	65	50	65	50	50
	1	1	—	—	1	—
	5	5	—	—	5	—
	1.5	1.5	—	—	1.5	—
	0.5	0.5	—	—	0.5	—
	1.5	1.5	—	—	1.5	—
	—	—	5	5	—	5
	—	—	4	4	—	4
MOONEY SCORCH						
	9	9	9	9	9	9
MOLD CURE	30 min./ 320°F.	30 min./ 320°F.	30 min./ 320°F.	30 min./ 320°F.	30 min./ 320°F.	30 min./ 320°F.
PROPERTIES						
Hardness, Shore A	81	85	80	83	85	81
Tensile, psi	1,950	2,100	1,900	2,000	2,150	2,000
Elongation, %	325	325	350	350	400	375
Modulus, psi (100%)	1,000	1,250	700	850	1,100	900
(200%)	1,400	1,500	950	1,000	1,200	1,075
(300%)	1,650	1,900	1,400	1,500	1,400	1,250
Tear Die C, ppi	275	375	250	300	375	275
Compression Set (22 Hrs./158°F.), % (Method B)	40	45	40	45	45	40

(1) Cabot Corp's "Sterling" S
(2) PPG's "Hi-Sil" 233

A00227

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ACL Doc 16074 · Page 9 of 130 asbestosclaims.law/library/16074/9

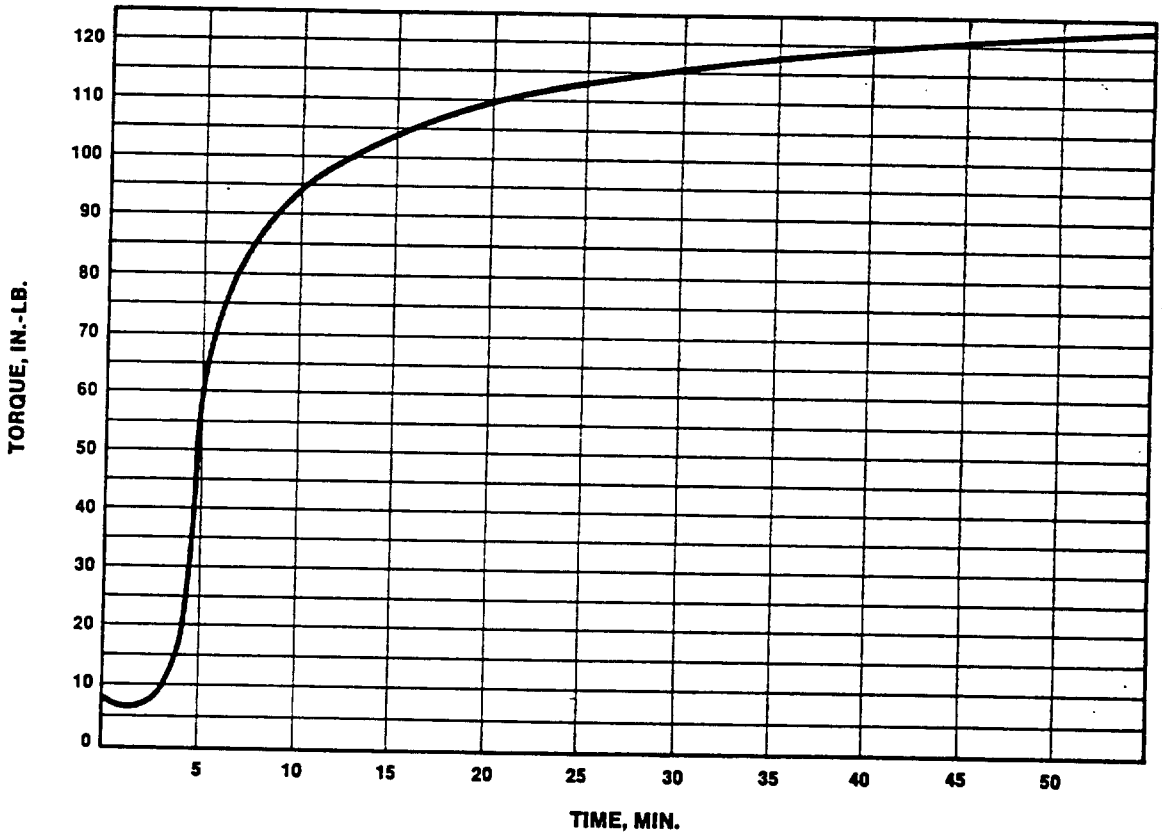
Experimental Data

STYRENE BUTADIENE RUBBER (SBR)

In this experimental SBR shoe-sole formulation, "Calidria" asbestos T-135 was used as a filler, reinforcer, and pigment. As shown at the right, the combined reinforcing characteristics of the T-135 and precipitated silica gave optimum tensile strength and excellent 300% modulus and tear die C properties. At the same time, the T-135 introduced sufficient TiO_2 for color flattening, eliminating the need for separate TiO_2 additions. The TiO_2 added with the asbestos fibers dispersed quickly and uniformly in the formulation.

This experimental formulation was cured with an augmented sulfur system having a short cure cycle at 320°F. By augmenting the sulfur with hexa/resorcinal, a cure rate with optimum scorch values was obtained that is adaptable to injection molding.

CURE CHARACTERISTICS • Monsanto Oscillating Disc Rheometer



Temperature—320°F.; Amplitude—3°; OPM—3; Preheat—60 sec.

A00227

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ACL Doc 16074 · Page 10 of 130
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INGREDIENTS AND PHYSICAL PROPERTIES

STYRENE BUTADIENE RUBBER (SBR)		
INGREDIENTS, pphr		
SBR-1502		100
Precipitated Silica (1)		40
"Calidria" Asbestos T-135		25
Napthenic Oil		5
Stearic Acid		2
Zinc Oxide		5
Sulfur		2.5
Diorthotolylguanidine		1.2
Benzothiazyl Disulfide		0.8
Resorcinol		4.2
Hexamethylenetetramine		3.2
MOONEY SCORCH, T_5MS1 @ 250°F., Min.	(ASTM D1646-68)	9
MOLD CURE		10 min./ 320°F.
PROPERTIES		
Hardness, Shore A	(ASTM D2240-68)	80
Tensile, psi	(ASTM D412-68)	2,700
Elongation, %	(ASTM D412-68)	425
Modulus, psi (100%)	(ASTM D412-68)	800
(200%)	(ASTM D412-68)	1,425
(300%)	(ASTM D412-68)	1,975
Tear Die C, ppi	(ASTM D624-54)	400

(1) PPG's "Hi-Sil" 233

A0022

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Any of our offices below will be glad to give you complete information on properties, applications, and prices of "Calidria" asbestos.

Calidria ASBESTOS

Sales Offices

Atlanta, Georgia 30329	17 Executive Park Dr.	404-633-6161
Baltimore, Maryland 21207	Beltway Bldg. 6707 Whitestone Rd.	301-944-8211
Boston, Massachusetts 02194	300 First Ave., Needham Heights	617-444-5400
Buffalo, New York 14225	3343 Harlem Rd.	716-837-6450
Charlotte, North Carolina 28210	6230 Fairview Rd.	704-364-1400
Chicago, Illinois 60606	120 South Riverside Plaza	312-822-7000
Cincinnati, Ohio 45227	West Street and Madisonville Rd.	513-272-0206
Cleveland, Ohio 44114	1300 Lakeside Ave., N.E.	216-621-4202
Clifton, New Jersey 07012	935 Allwood Rd.	201-778-2900
Dallas, Texas 75207	2710 Stemmons Freeway	214-631-0010
Detroit (Southfield, Michigan Sales Office)		313-354-0800
Houston, Texas 77027	3737 Greenway Plaza Dr.	713-621-1000
Indianapolis (Cincinnati, Ohio Sales Office)		317-255-3181
Kansas City (St. Louis, Mo. Sales Office)		913-362-2200
Los Angeles, California 90058	2770 Leonis Blvd.	213-583-3061
Memphis (Atlanta, Ga. Sales Office)		901-396-5375
Minneapolis, Minnesota 55416	3030 Excelsior Blvd.	612-927-4221
Moorestown, New Jersey 08057	Route 38 and Pleasant Valley Rd.	609-235-6200
New York, New York 10017	270 Park Ave.	212-551-6423
Philadelphia (Moorestown, New Jersey Sales Office)		215-923-3200
Pittsburgh, Pennsylvania 15220	P'kway Center, 875 Greentree Rd.	412-922-5700
Southfield, Michigan 48075	26500 Northwestern Highway	313-354-0800
St. Louis, Missouri 63105	10 South Brentwood Blvd.	314-726-0324
San Francisco, California 94106	One California St.	415-982-1360
Seattle, Washington 96118	4726 Rainier Ave., South	206-723-8660

UNION CARBIDE THE DISCOVERY COMPANY

UNION CARBIDE CORPORATION • MINING AND METALS DIVISION • 270 PARK AVENUE, NEW YORK, N. Y. 10017

Marketing and Technical Center: P.O. Box 579, Niagara Falls, N. Y. 14302 Tel.: 716-285-3311

Plant: P. O. Box K, King City, California 93930 Tel.: 408-385-5961

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CALIDRIA ASBESTOS

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"Calidria" Asbestos Resin Grade-144 & Resin Grade-244

"Calidria" Asbestos - A chrysotile fiber obtained from a unique short-fiber deposit, which is essentially free of hard consolidated rock masses typical of other asbestos ores. A proprietary "wet process" breaks down the fiber bundles, removes rocks and other contaminents and provides 98% liberated, efficient fibrils of uniform quality.

RG-144 - A highly-refined grade of "Calidria" Asbestos used as a viscosity control agent in epoxys, vinyl plastisols, asphaltic compounds, polysulfide and butyl rubber sealants, silicone and casein adhesives. Unlike other thixotropes, RG-144 can be used effectively with amine hardeners in epoxy systems and has an indefinite shelf life. It costs only about 1/4 as much as pyrogenic silica, and is generally used at addition levels of 1 - 1 1/2%.

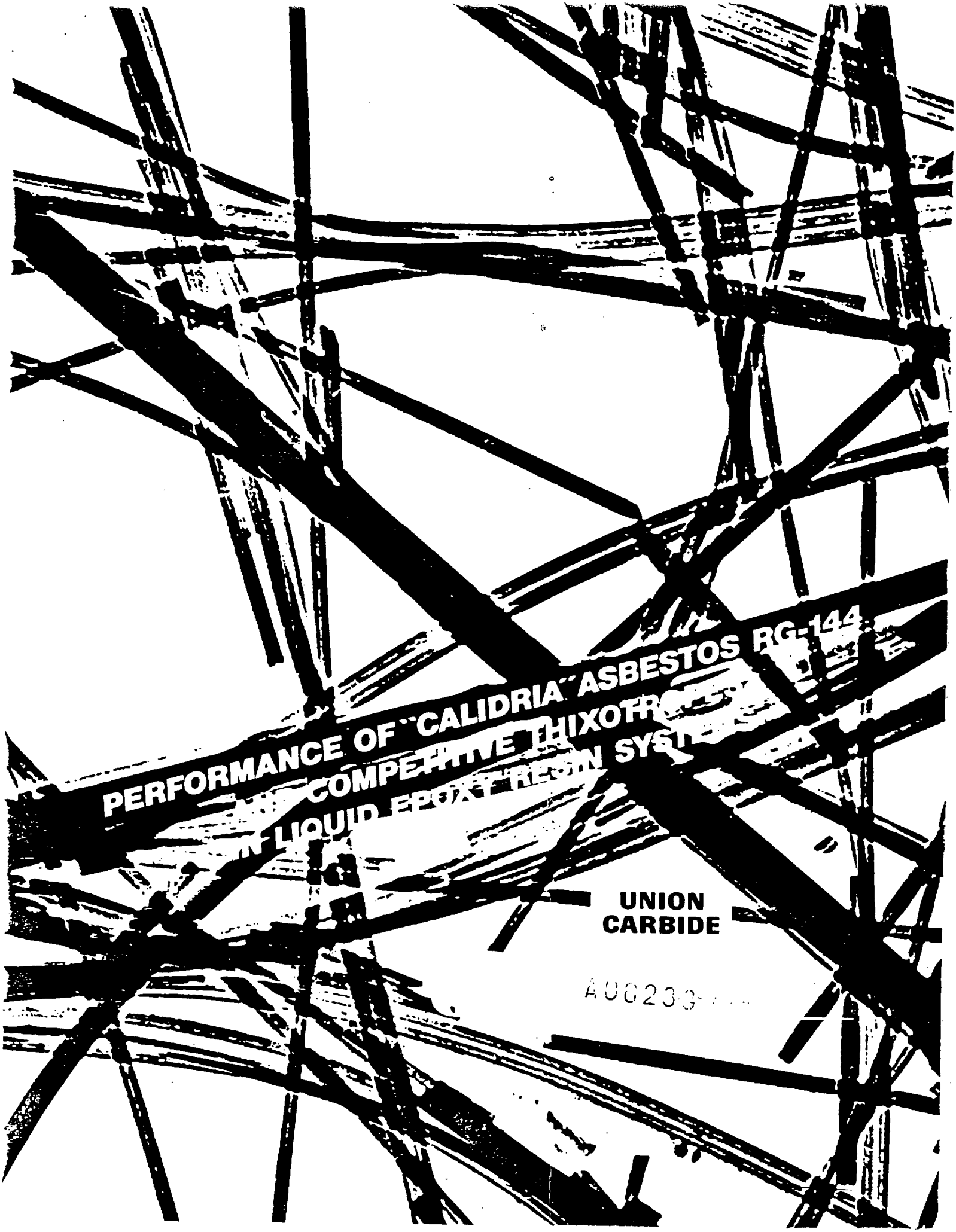
RG-244 - Very highly refined "Calidria" fiber which has been surface-modified for use as a thickening agent and thixotrope in polyester spray-up and hand lay-up resins, in vinyl sealants, in epoxys, and in a variety of adhesives, coatings and mastics. In many systems RG-244 does not contribute color or opacity - a characteristic that makes it particularly attractive in polyester gel coats. It offers ease of dispersion with minimum settling and stable rheological properties. RG-244 costs less and is generally used at lower levels than other thixotropes.

Packages of RG-144 and RG-244 are sealed with polyethylene overwraps to ensure moisture protection and are readily available at many warehousing points.

Typical Physical Characteristics

Property	RG-144	RG-244
Moisture Content, % by Wt.	2.0 max.	2.0
pH in Water, 2% Slurry	9.0	9.0
Surface Area, m^2/gm	60	60
DOP Oil Absorption, lb/100 lb.	120	350
Refractive Index n_d 25°C	1.54-1.56	1.54-1.56
Reflectance, GE Brightness %	72-76	88
Bulking Value, gal./100 lbs.	4.8	4.9
Single Bag Weight	35 lbs.	10 lbs.
Single Pallet Weight	1,400 lbs.	400 lbs.
Truckload, 17 Pallets	23,800 lbs.	6,800 lbs.
Rail Carload, 52 Pallets	72,800 lbs.	20,800 lbs.

A00232


PERFORMANCE OF "CALIDRIA" ASBESTOS RG-144
COMPETITIVE THIXOTR
LIQUID EPOXY RESIN SYS
UNION
CARBIDE
A00238

PERFORMANCE OF *CALIDRIA* R-G 144 AND COMPETITIVE THIXOTROPES

in Liquid Epoxy Resin Systems

CALIDRIA R-G 144 Asbestos is a highly purified fiber product that is an effective, low-cost thickening agent and thixotrope for epoxy resin systems. Produced by UNION CARBIDE's proprietary process, an unusually high fiber content is obtained, that is both grit-free and non-abrasive.

Comparative evaluations have shown that up to 50 per cent less CALIDRIA R-G 144 Asbestos is required than other commonly used thickeners, to provide equivalent viscosity and thixotropic properties, in liquid epoxy resin systems. Because CALIDRIA Asbestos is much lower in price, its cost-performance is outstanding.

Figures 1 and 2 compare the relative differences in viscosity and thixotropy of BAKELITE Epoxy Resin ERL-2774 solutions containing equivalent concentrations of CALIDRIA R-G 144 Asbestos, micro-crystalline silicate, and pyrogenic silica.

The superiority of CALIDRIA R-G 144 is again indicated, as shown in Figures 1 and 2, in that its use does not require amine-type additives usually recommended with the use of pyrogenic silicas.

Figures 3 and 4 show the superior performance of CALIDRIA R-G 144 Asbestos in BAKELITE Resin Hardener ZZL-0814, in comparison with equivalent mixtures of micro-crystalline silicate and pyrogenic silica.

RESIN AND AMINE HARDENER EVALUATION

In preparing test samples used in determining data for the following graphs, the thixotropes were 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.

IMPORTANT: This information is not to be taken as a warranty or representation for which we assume legal responsibility nor as permission or recommendation to practice any patented invention without a license. It is offered solely for your consideration, investigation, and verification.

A00234

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Niagara Falls, New York 14302	P. O. Box 579	716-285-3311
King City, California 93930	P. O. Box K	408-385-5961

Atlanta, Georgia 30329	17 Executive Park Dr.	404-633-6161
Baltimore, Maryland 21207	Beltway Bldg. 6707 Whitestone Rd.	301-944-8211
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San Francisco, California 94111	One California St.	415-765-1244
Seattle, Washington 96118	4726 Rainier Ave., South	206-723-8660

UNION CARBIDE CORPORATION
MINING AND METALS DIVISION
270 PARK AVENUE, NEW YORK, N. Y. 10017

THE DISCOVERY COMPANY

A00235

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Calidria ASBESTOS

RG-244

...a chemically modified, highly refined fiber with a mineral coating that gives:

HIGHER VISCOSITY AT LOW LOADINGS—"Calidria" asbestos RG-244 builds more viscosity at a given concentration than pyrogenic silica or other thickeners. Part of this viscosity increase comes from hydrogen bonding between the mineral coating and the resin system—the same way that pyrogenic silica builds viscosity. What makes RG-244 more efficient is that the fibers enhance flow resistance. On a lb.-for-lb. basis, RG-244 builds over twice as much viscosity as pyrogenic silica.

BETTER FLOW AT HIGH SHEAR RATES—"Calidria" RG-244 also improves flow at high shear rates because of its inherent thixotropic characteristics. This property is especially desirable in spray-up applications where less resistance to flow is desired during pumping and spraying.

SAVINGS FROM BETTER PERFORMANCE—By increasing viscosity and thixotropy more efficiently than other materials, "Calidria" asbestos RG-244 allows users to obtain their desired properties with less mineral additive. This reduction lowers costs and reduces any detrimental effect of thickeners on other resin properties.

LOW COSTS TOO—"Calidria" asbestos RG-244 costs less per lb. than similar thickeners. Thus, users save two ways—on unit cost *and* cost performance.

FAST WETTING, EASY DISPERSION—Conventional mixing equipment can be used to disperse "Calidria" RG-244 quickly and easily. In fact, this unique product wets out and disperses considerably faster than most other thixotropes.

BETTER SHELF LIFE, LESS SETTLING—Systems containing "Calidria" asbestos RG-244 can be stored for long periods without any significant change in viscosity or thixotropy. Settling during storage is minimized, and systems containing RG-244 can be remixed easily. In all these respects, RG-244 surpasses most other thickeners.

NO COLOR OR OPACITY—"Calidria" asbestos RG-244 is a highly refined fiber with a clear mineral coating that does not add color to most systems. At the same time, RG-244 has a refractive index that matches many systems, so that it does not add opacity. These features make RG-244 especially well suited for use in clear polyester gel coats.

REDUCED DUSTING—"Calidria" RG-244 is a fibrous material containing a minimum of dust. It therefore reduces dusting during materials handling and additions to resin systems.

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TYPICAL PHYSICAL PROPERTIES

Specific Gravity	2.45	—
Moisture Content	2.0	% max. by weight
Nature of Surface Charge	Neutral	—
Magnetite Content	0.3	% max. by weight
Refractive Index	1.54 to 1.56	n_D 25° C.
Oil (DOP) Absorption	300 to 350	lb. per 100 lb.
Surface Area	>60	sq. m. per g.
Fiber Diameter	0.025	microns
Length/Diameter (Aspect Ratio)	200 avg.	—
Bulking Value	4.9	gal. per 100 lb.
Dry Bulk Density (aerated)	1.0	lb. per cu. ft.

PACKAGING AND AVAILABILITY

Single Package—Weight (3-ply paper bag sealed in polyethylene)	10 lb.
Single Pallet—Weight —Dimensions (full pallets covered by waxed cardboard)	350 lb. approx. 53 in. x 44 in. x 61 in. high
Full Carload (available from King City plant)	52 pallets 18,200 lb.
Full 40-ft. Truckload (available nationwide)	17 pallets 5,950 lb.

"Calidria" asbestos RG-244 is stocked at Union Carbide's shipping locations throughout the United States and is available from several distributors.

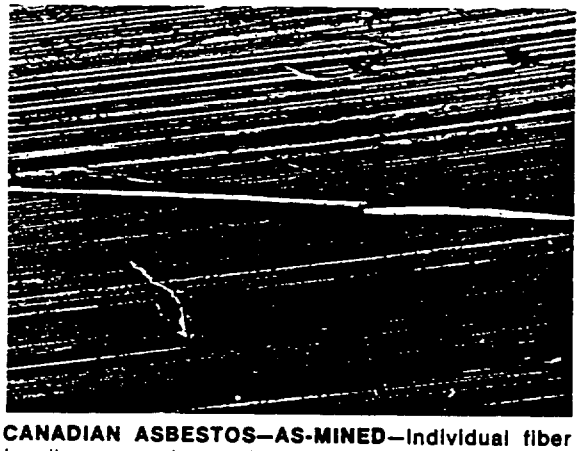
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Why is "Calidria" asbestos different?

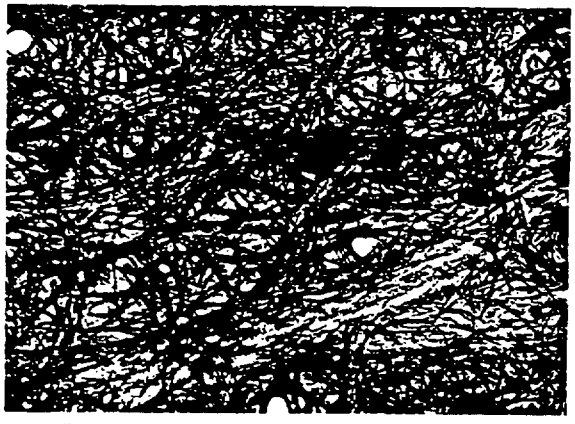
"Calidria" products are made from high-purity, short-fiber chrysotile asbestos obtained from a unique deposit about 160 miles south of San Francisco, California. Unlike conventional deposits that extend through the host rock, this deposit is essentially free of hard, consolidated rock masses. Further, the ore assays up to 60% asbestos fiber compared to conventional deposits which contain from 6 to 10% asbestos.

Special hydraulic beneficiation techniques developed by Union Carbide efficiently break down the fiber bundles and remove the rock and impurities from the asbestos fiber. As a result, all "Calidria" products are over 95% pure asbestos whose fibers are 98% liberated from fiber bundles.

RG-244 is made by additional refining to achieve over 99% purity. The fibers are then chemically coated by a patented process to form this unique, highly efficient thickener and thixotrope.



CANADIAN ASBESTOS—AS-MINED—Individual fiber bundles are straight and tightly bonded, surrounded by consolidated rock masses. In this form, the fibers defy separation from each other and from the host rock.



"CALIDRIA" ASBESTOS—AS-MINED—Here the fibers are randomly oriented and essentially free of hard rock masses. Further, the ore assays up to 60% asbestos, considerably more than the Canadian ore.



"CALIDRIA" ASBESTOS—IF DRY-PROCESSED—Even the most exacting dry processes do not completely break down the fiber bundles into individually liberated fibers. Union Carbide technology developed a special wet process to liberate the fibers.



"CALIDRIA" ASBESTOS—UNIQUELY WET-PROCESSED — Union Carbide's process separates 98% of the fibers from the fiber bundles. RG-244 fibers are over 99% pure asbestos and chemically coated to provide an efficient thickener and thixotrope.

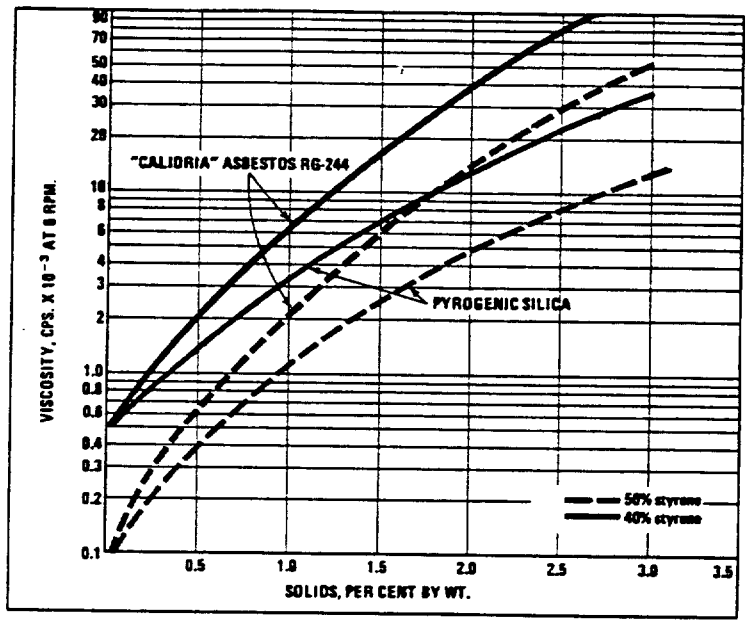
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Union Carbide trial exhibit UC-863: Union Carbide Calidria Asbestos Product Brochures for Rubber, Resins, Thixot... Published by AsbestosClaims.Law
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Typical Performance Data/General Purpose UNPROMOTED Polyester Resins

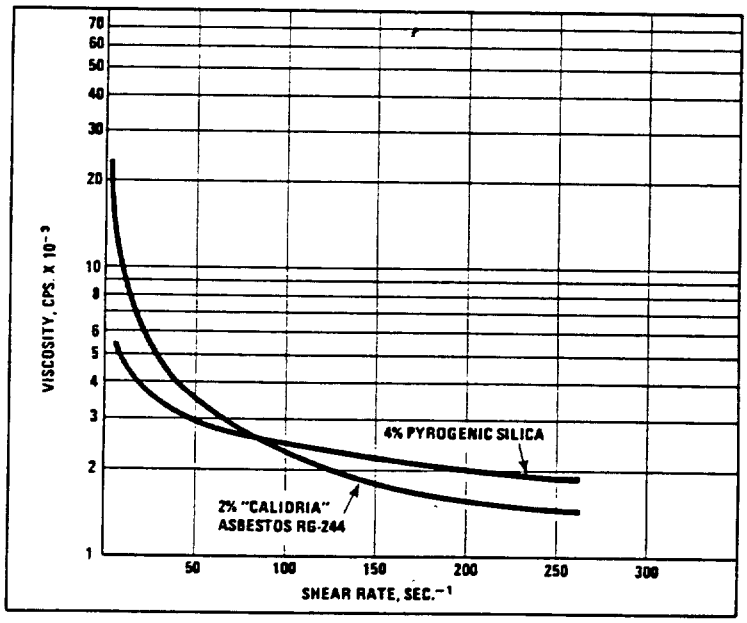
HIGHER VISCOSITY AT GIVEN CONCENTRATION

On a lb.-for-lb. basis, "Calidria" asbestos RG-244 builds substantially more viscosity in these 2 polyester systems than pyrogenic silica. RG-244 builds twice as much viscosity at a 1% concentration and 4 times as much viscosity at 3% concentration. Thus, users can use less RG-244 to obtain their desired viscosity.



HIGHER VISCOSITY AT LOW SHEAR RATES · BETTER FLOW AT HIGH SHEAR RATES

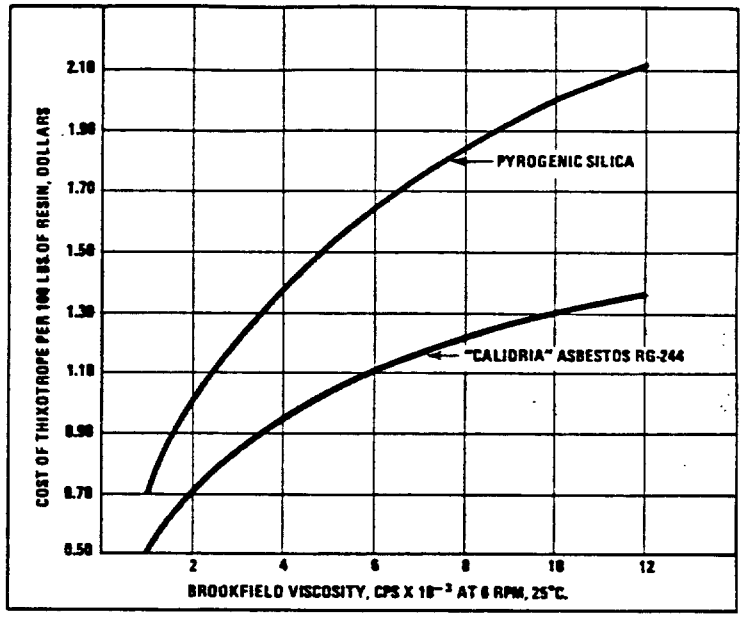
2% "Calidria" asbestos RG-244 gives better thixotropic properties than 4% pyrogenic silica in this unpromoted polyester resin containing about 50% styrene. The RG-244 system has better flow at high shear rates, allowing easier pumping and spray-up. As the shear rate is reduced, the RG-244 resin has better viscosity and sag resistance.



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SAVINGS USING "CALIDRIA" ASBESTOS RG-244 · UNPROMOTED Polyester Resins

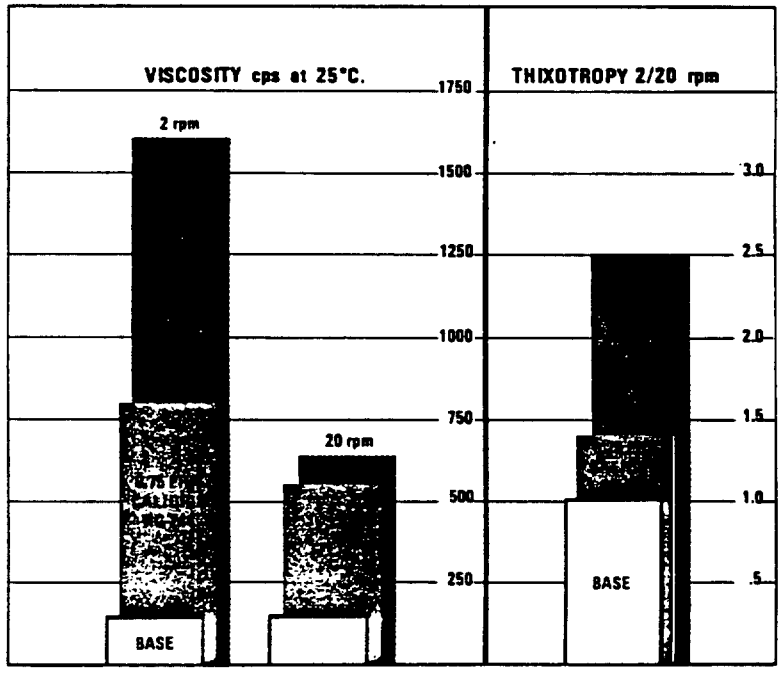
The better performance and lower cost of "Calidria" asbestos RG-244 allow substantial savings. In the typical unpromoted polyester resin system shown at the right, "Calidria" RG-244 builds a given viscosity for about one-half the cost of pyrogenic silica.



Typical Performance Data / General Purpose PROMOTED Polyester Resins

IMPROVES BOTH VISCOSITY AND THIXOTROPY

"Calidria" asbestos RG-244 also effectively improves the viscosity and thixotropy of promoted polyester resins. In many cases, the improved viscosity and thixotropy provided by RG-244 will be sufficient to meet user needs. Should higher values be required, a small addition of ethylene glycol or a similar additive will improve the viscosity, thixotropy, and stability of the RG-244 dispersion. At the right is an example of these improvements in a typical polyester resin containing a cobalt-type accelerator.



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Union Carbide trial exhibit UC-863: Union Carbide Calidria Asbestos Product Brochures for Rubber, Resins, Thixot… Published by AsbestosClaims.Law
ACL Doc 16074 · Page 24 of 130 asbestosclaims.law/library/16074/24

Performance Data/Heat-Curable VINYL PLASTISOL Sealants

sbestos RG-244 improves the vis-
at-curable vinyl plastisols without
ir inherently good adhesion prop-
, RG-244 provides excellent anti-
s at both low (275 to 375 deg. F.)
and high (above 350 deg. F.) fusion tempera-
tures. An example of how RG-244 improves
the viscosity of a high-fusion temperature
structural sealant without detracting from ad-
hesion is shown below:

ION FOR HIGH-FUSION TEMPERATURE STRUCTURAL SEALANT

IGREDIENT	PARTS BY WEIGHT
OH-2 Resin	100
cizer 10-10	60
cizer 10A	40
Plasticizer	10
ım Stabilizer	2
)E Silane Y-5162 Adhesion Promoter	0.25
ıate	130
stos RG-244	5

ion to cold-rolled steel after 45 minutes cure at 350° F.

roperties	440 psi
/8 inch)	
) seconds	
om temperature	63 g. at 40 psi
0° F	76 g. at 40 psi
room temperature	73 g. at 40 psi
A scale after 24 hr. at room temperature	76

ı of "Calidria" Asbestos RG-244

alidria" asbestos RG-
nating resins can be
osonic" disperser op-
ure. Pressures above
iscosities. In general,
244 requires less en-
sion than comparable
nic silica.

"COWLES" DISSOLVER

A "Cowles" dissolver can disperse "Calidria" asbestos RG-244 in 5 to 10 minutes at 3500 rpm, using a 3-in. impeller in a 3-quart container. Under these conditions a 1% loading can be mixed for 1 hour while a 2% loading can be stirred for 30 minutes without degrading. Large volumes of RG-244 can be dispersed easily by scaling up the equipment.

A00243

Any of our offices below will be glad to give you complete information on properties, applications, and prices of "Calidria" asbestos.

Calidria ASBESTOS

Marketing and Technical Center

Niagara Falls, New York 14302	P. O. Box 579	716-285-3311

Plant

King City, California 93930	P. O. Box K	408-385-5961

Sales Offices

Atlanta, Georgia 30329	17 Executive Park Dr.	404-633-6161
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MINING AND METALS DIVISION
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F-70-090
9/70-5M

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UNION CARBIDE

Calidria

Resin-Grade 144 Asbestos

A00154

- Effective, low-cost thickening agent and thixotrope for epoxy resin systems
- Imparts excellent viscosity control to resin systems (coatings, adhesives, sealants, caulks, mastics)

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Calidria 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, CALIDRIA 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 CALIDRIA 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 CALIDRIA Resin-Grade 144 Asbestos have excellent aging characteristics
- Reduced dust

A06155

- Unlike other thixotropes, it is effective with amine hardeners
- CALIDRIA Resin-Grade 144 Asbestos is substantially lower in cost than commonly used refined silicas or modified clays
- No amine salts are necessary for viscosity build-up or thixotropic stabilization (with the exception of the low-viscosity, cycloaliphatic epoxides)

Typical physical properties

Specific Gravity	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.	120-140
Refractive Index, n_D25° 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
% Magnetite	0.6
Screen Size, Typical; % plus 325 mesh	Nil
Fiber Diameter, microns	0.025
Length/Diameter, microns	200 avg. (1000 maximum)

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A00150

Typical applications

Figure 1 THICKENING EFFICIENCY IN LIQUID EPOXY RESINS

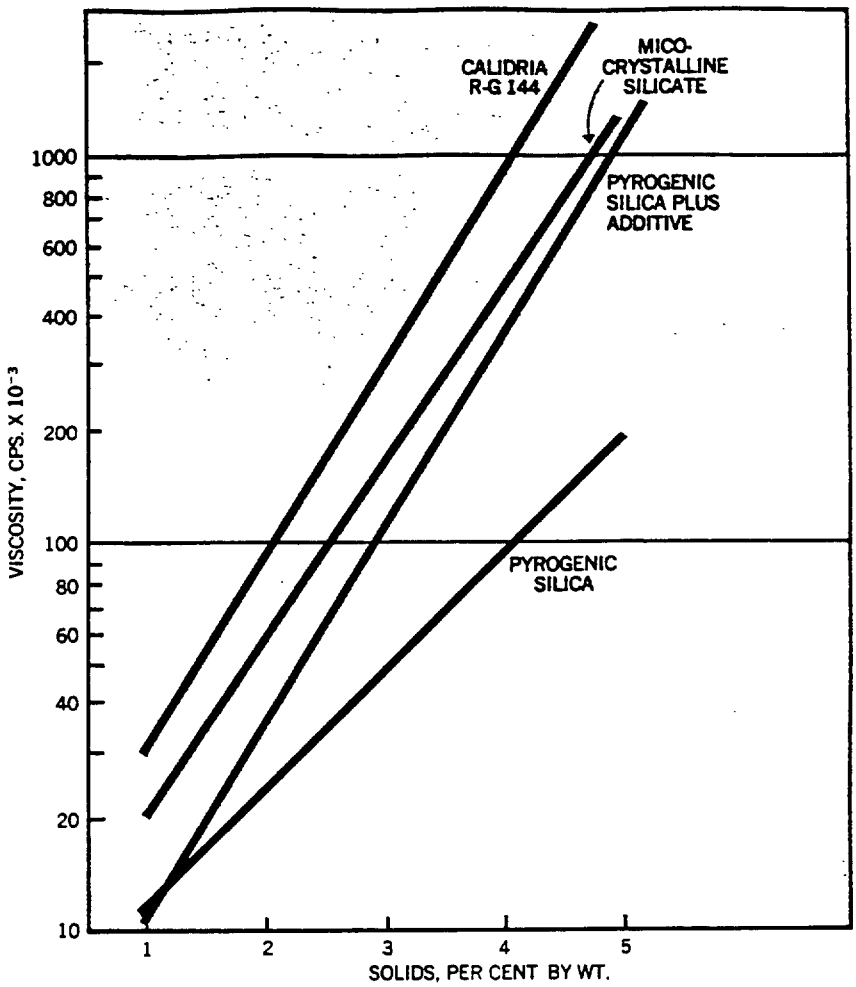


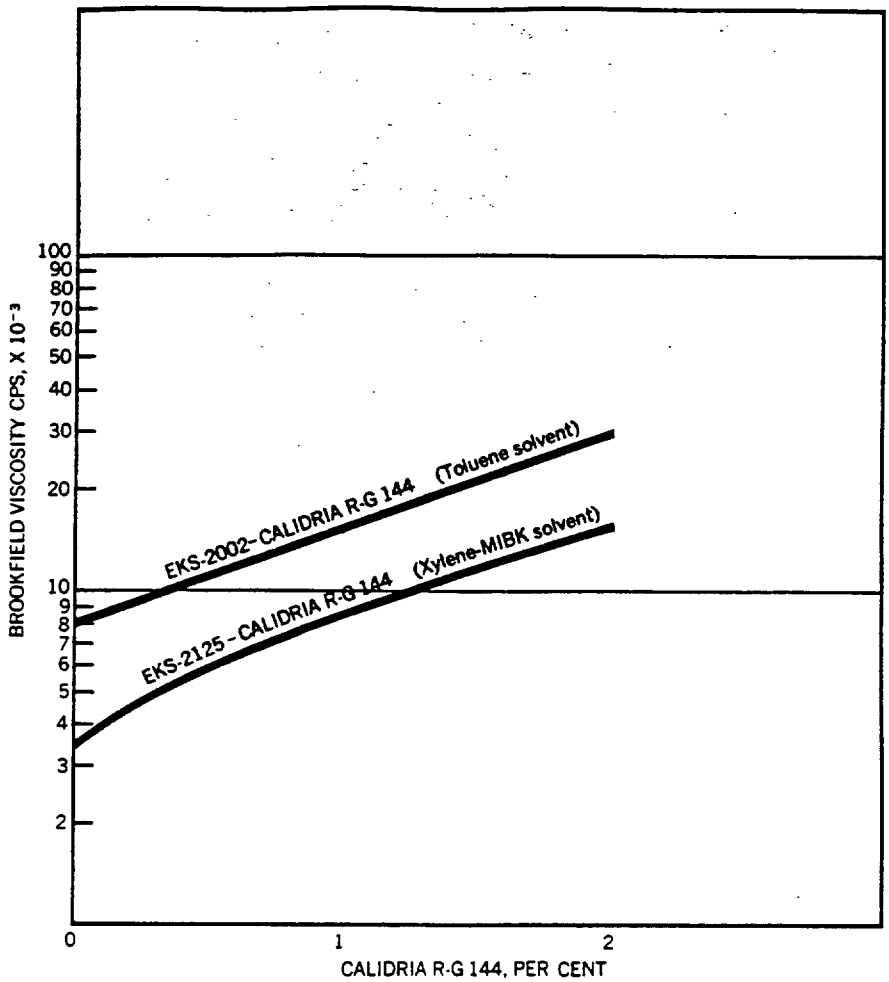
Figure 1 illustrates the effective, low-cost thickening and viscosity control properties of CALIDRIA Resin-Grade 144 Asbestos in epoxy resin systems. It compares relative differences in viscosity of BAKELITE Epoxy Resin ERL-2774 solutions containing equivalent concentrations of CALIDRIA R-G 144 Asbestos, micro-crystalline silicate, and pyrogenic silica.

Figure 2 illustrates the ability of CALIDRIA R-G 144 Asbestos to control viscosity in two different solvent-epoxy systems used in many epoxy coatings and paints.

A00157

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Figure 2 VISCOSITY CHARACTERISTICS OF *CALIDRIA* R-G 144 IN BAKELITE® EPOXY SOLUTIONS



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—CALIDRIA 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.

A00152

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

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

Ingredient	Parts by Weight											
BAKELITE ERL-2774	100			100			100			100		
CALIDRIA Resin-Grade 144 Asbestos	1			2			3			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	100			100			100			100		
CALIDRIA Resin-Grade 144 Asbestos	1			2			3			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 (c)												
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 CALIDRIA Resin-Grade 144 Asbestos as a thickener of several types of BAKELITE Amine Hardeners. Generally, other thickeners are not effective with amine hardeners.

A00159

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

Formulation	Parts by Wt. BAKELITE ZZL-0814.....100 CALIDRIA Resin-Grade 144 Asbestos.....4			Parts by Wt. BAKELITE ZZL-0820.....100 CALIDRIA Resin-Grade 144 Asbestos.....4			Parts by Wt. BAKELITE ZZL-0854.....100 CALIDRIA Resin-Grade 144 Asbestos.....4		
Brookfield RVF Viscosity, cps. X 10^{-3}	RPM. 2	RPM. 20	Thixotropic Index (T. I.)	RPM. 2	RPM. 20	Thixotropic Index (T. I.)	RPM. 2	RPM. 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, cycloaliphatic epoxide, BAKELITE ERL-4221, with CALIDRIA 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 CALIDRIA Resin-Grade 144 Asbestos for viscosity build-up or thixotropic stabilization.

Table 3 THICKENING OF A LOW-VISCOSITY, CYCLOALIPHATIC EPOXIDE WITH *CALIDRIA* RESIN-GRADE 144 ASBESTOS AND "Armac" C

Ingredient	Parts by Wt.
BAKELITE ERL-4221	100
CALIDRIA Resin-Grade 144 Asbestos	7
"Armac" C	5

Brookfield RVF Viscosity, cps. X 10^{-3}	RPM. 2	RPM. 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 CALIDRIA 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 CALIDRIA 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 CALIDRIA Resin-Grade 144 Asbestos, it was possible to hold a 40-mil thickness at 80°C. until gelled (65 minutes).

A00160

UNION CARBIDE THE DISCOVERY COMPANY

UNION CARBIDE CORPORATION
ASBESTOS
270 PARK AVENUE, NEW YORK, N. Y. 10017

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	BOSTON, MASSACHUSETTS 02194	300 First Ave., Needham Hgts.	617-444-5400
	BUFFALO, NEW YORK 14225	3343 Harlem Rd.	716-837-6450
	CHARLOTTE, NORTH CAROLINA 28210	6230 Fairview Rd.	704-364-1400
	CHICAGO, ILLINOIS 60606	120 South Riverside Plaza	312-822-7000
	CINCINNATI, OHIO 45227	West Street and Madisonville Rd.	513-272-0206
	CLEVELAND, OHIO 44114	1300 Lakeside Ave., N.E.	216-621-4202
	CLIFTON, NEW JERSEY 07012	935 Allwood Rd.	201-778-2900
	DALLAS, TEXAS 75207	2710 Stemmons Freeway	214-631-0010
	DETROIT, MICHIGAN 48221	10421 West Seven Mile Rd.	313-341-3131
	HOUSTON, TEXAS 77027	3839 West Alabama Ave.	713-621-1000
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	MOORESTOWN, NEW JERSEY 08057	Route 38 and Pleasant Valley Rd.	609-235-6200
	NEW YORK, NEW YORK 10017	270 Park Ave.	212-551-4641
	PHILADELPHIA (MOORESTOWN, NEW JERSEY SALES OFFICE)		215-923-3200
	PITTSBURGH, PENNSYLVANIA 15220	P'kway Center, 875 Greentree Rd.	412-922-5700
	ST. LOUIS, MISSOURI 63105	10 South Brentwood Blvd.	314-726-0324
	SAN FRANCISCO, CALIFORNIA 94106	22 Battery St.	415-982-1360
	SEATTLE, WASHINGTON 98118	4726 Rainier Ave., South	206-723-8660

UNION CARBIDE CALIDRIA Resin-Grade 144 Asbestos

A00161

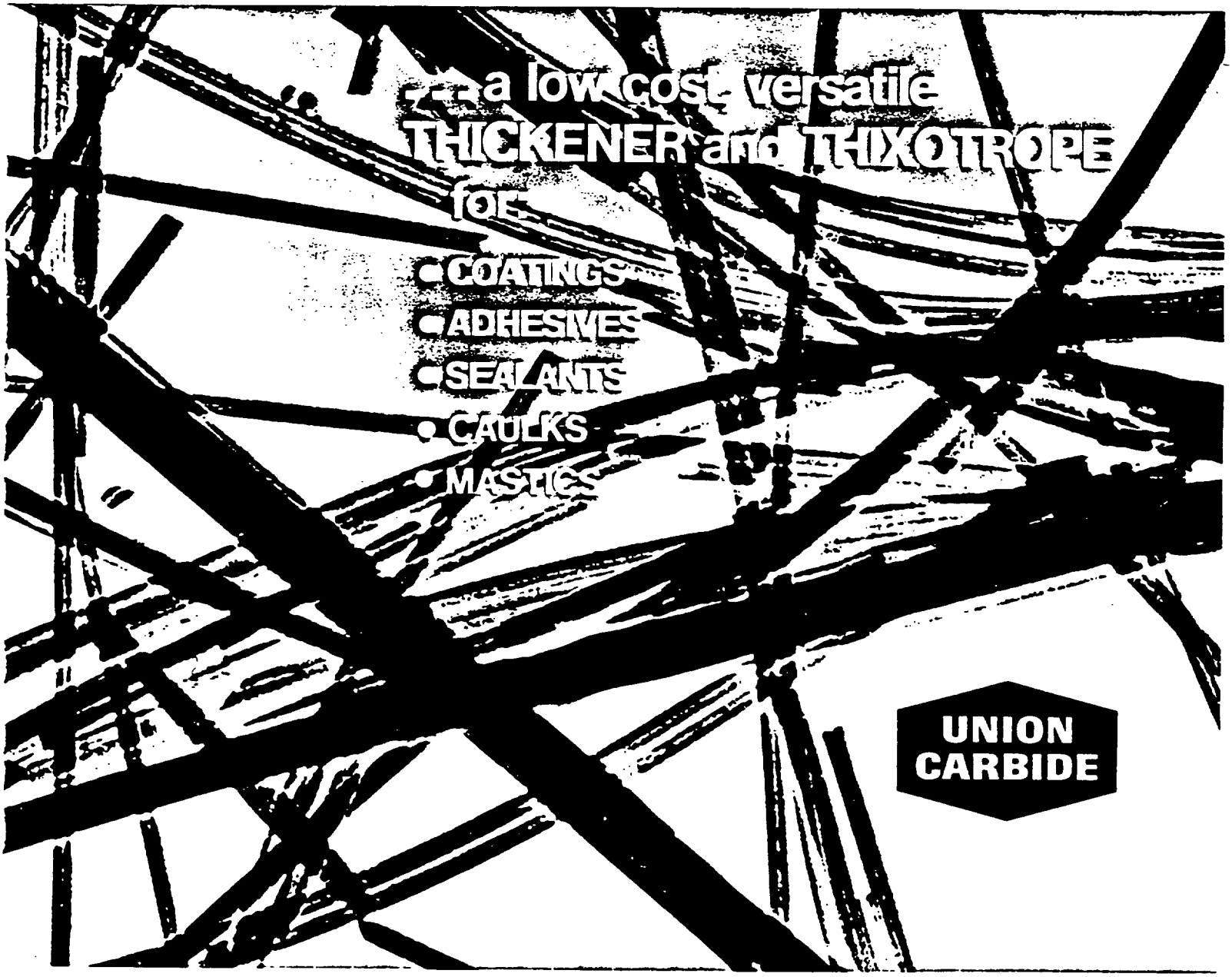
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ACL Doc 16074 · Page 34 of 130
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Calidria

RG-144



A06102

Calidria ASBESTOS RG-144

... a highly refined fiber that gives:

Effective Viscosity Control with Thixotropy

"Calidria" asbestos RG-144 is a low-cost thickener and thixotrope that can be used in a wide range of liquid resin systems . . . including epoxies, vinyls, acrylics, and asphaltics. It also gives thixotropic properties to paints and butyl-rubber compounds.

Lower Cost Flow Control

"Calidria" asbestos RG-144 costs much less than competitive thickeners and thixotropes. Thus, although larger additions may be needed to reach a given viscosity or thixotropy, RG-144 offers savings over other thickening agents.

Outstanding Thickener for Epoxies

"Calidria" asbestos RG-144 gives such a large increase in viscosity and thixotropy that up to 50% less material can be used in epoxies compared to other thickeners. This unique asbestos is also effective in amine hardeners for epoxy resins — another advantage compared to competitive thixotropes.

Fast Wetting, Easy Dispersion

Conventional mixing equipment can be used to disperse "Calidria" asbestos RG-144 quickly and easily. In fact, this product wets out and disperses faster than other thickeners.

Better Shelf Life, Less Settling

Systems containing "Calidria" asbestos RG-144 can be stored for long periods without any significant change in viscosity or thixotropy. Settling during storage is minimal, and systems containing RG-144 can be remixed easily. In fact, RG-144 is often used to effectively suspend pigments in paints.

No Shear Sensitivity

Systems containing "Calidria" asbestos RG-144 are not sensitive to shear energy. Overmixing will not destroy the thixotropy of the resin-asbestos mixture.

A06163

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ACL Doc 16074 · Page 36 of 130 asbestosclaims.law/library/16074/36

Typical Physical Properties

Specific Gravity	2.45	—
Moisture Content	2.0	% max. by weight
Nature of Surface Charge	Electropositive (cationic)	—
pH in Water	9.5	—
Magnetite Content	0.6	% max. by weight
Refractive Index	1.54-1.56	n_D 25°C.
Reflectance	72-76	G.E. brightness
Surface Area	55-60	sq. m. per gm.
Fiber Diameter	0.025	microns
Length/Diameter (Aspect Ratio)	200 average 1000 maximum	— —
Oil (DOP) Absorption	120-140	lb. per 100 lb.
Bulking Value	4.8	gal. per 100 lb.
Dry Bulk Density	4.0	lb. per cu. ft.
Wet Bulk Density in Water after dispersion (2.0 g. per liter), 1-hr. settling	900-1,000	ml.

Packaging and Availability

	RG-144 Open Fiber	RG-144 Pellets
Single Package — Weight (3-ply paper bag sealed in polyethylene)	35 lb.	50 lb.
Package Density	17 lb. per cu. ft.	40 lb. per cu. ft.
Single Pallet — Weight — Dimensions	1,400 lb. approx. 56 in. x 46 in. x 58 in. high	2,000 lb. approx. 47 in. x 40 in. x 48 in. high
Pallet Density	129 cu. ft. per ton	56 cu. ft. per ton
Full 50-ft. Carload (available from King City plant)	52 pallets 72,800 lb.	60 pallets 120,000 lb.
Full 40-ft. Truckload (available nationwide)	17 pallets 23,800 lb.	20 pallets 40,000 lb.

"Calidria" asbestos RG-144 is stocked at Union Carbide's shipping locations throughout the United States and is available from several distributors.

A06164

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Why is "Calidria" Asbestos Different?

"Calidria" products are high-purity, short-fiber chrysotile asbestos obtained from a unique deposit about 160 miles south of San Francisco, California. Unlike conventional deposits that extend through the host rock, this deposit is essentially free of hard, consolidated rock masses.

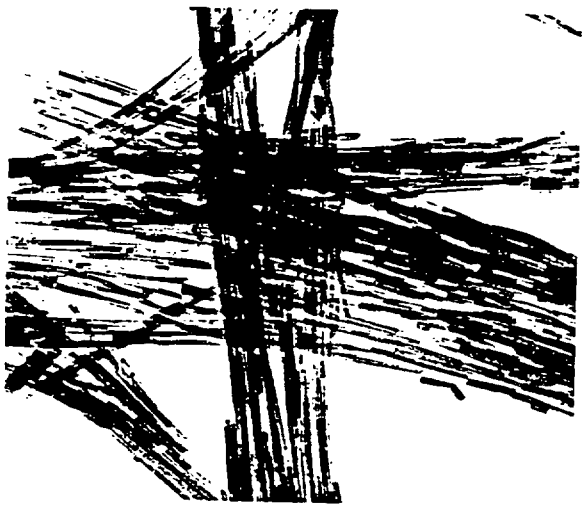
Special hydraulic beneficiation techniques developed by Union Carbide efficiently break down the fiber bundles and remove the rock and impurities from the asbestos fiber. As a result, all "Calidria" products are pure asbestos whose fibers are highly liberated from fiber bundles.



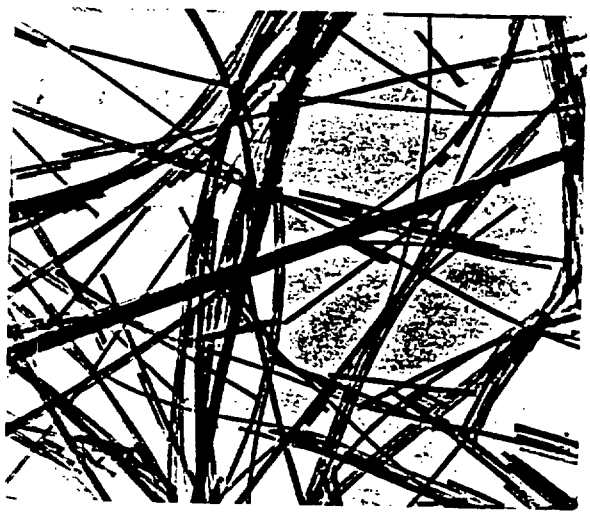
CANADIAN ASBESTOS—AS-MINED – Individual fiber bundles are straight and tightly bonded, surrounded by consolidated rock masses.



"CALIDRIA" ASBESTOS—AS-MINED – Here the fibers are randomly oriented and essentially free of hard rock masses.



"CALIDRIA" ASBESTOS—IF DRY-PROCESSED – Even the most exacting dry processes do not completely break down the fiber bundles into individually liberated fibers.



"CALIDRIA" ASBESTOS—UNIQUELY WET-PROCESSED – Union Carbide's process separates the fibers from the fiber bundles. RG-144 fibers provide an efficient thickener and thixotrope.

A00165

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ACL Doc 16074 · Page 38 of 130
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Typical Performance Data in VINYL PLASTISOLS Used as Fabric Coatings

"Calidria" asbestos RG-144 controls the flow behavior of vinyl-plastisol coating materials more efficiently and at lower cost than other thickeners. These coating materials — used in the manufacture of synthetic leathers, rainwear, awnings, and gaskets — are applied by pouring, dipping, and spreading. The plastisol must therefore be a non-viscous liquid that does not penetrate too deeply into the fabric.

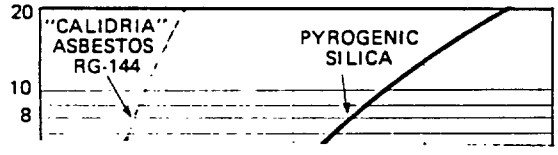
An addition of 0.5% "Calidria" asbestos RG-144 substantially improves the flow properties of a vinyl plastisol containing 50% plasticizer. It also gives excellent thixotropic properties, preventing seep-through and run-off and allowing greater film thicknesses. The film thickness can be easily controlled as the gelled plastisol shows no change in initial coating thickness.

As shown in the graph at the left below, RG-144 provides this viscosity improvement at a much lower cost than pyrogenic silica. In fact, only 0.5% RG-144 produces an equivalent thixotropic index at 3 and 30 rpm as 1% silica, as follows:

	Index
No Thickener	1
0.5% RG-144	4
1% Silica	4
2% Silica	3

"Calidria" absestos RG-144 is also more effective than pyrogenic silica in preventing the plastisol from seeping through the fabric. In this test, the fabric was stretched over a specially made frame, and 50 g. of plastisol were spread over the material. Any plastisol which seeped through the fabric dripped into a beaker and was weighed after 30 minutes. The results are shown in the table below.

COST OF VISCOSITY IN
DICCTYL PHTHALATE (DOP) PLASTICIZER



No seepage through the fabric occurred with a plastisol containing 0.5% "Calidria" asbestos RG-144. In contrast, 2% pyrogenic silica was needed to eliminate drip through, although ɔn a small amount of through to the under-

ams of Plastisol that eped through Fabric	
dria" stos 144	Pyrogenic Silica
5	25
5	22
0	18
0	9
0	0

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A00166

Attention: "Calidria" Asbestos

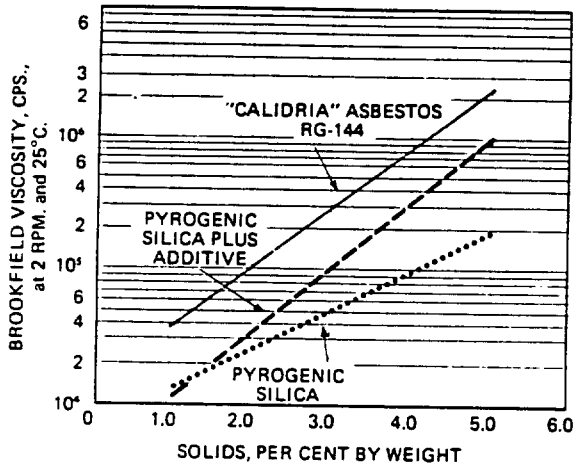
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Typical Performance Data in LIQUID EPOXY RESIN SYSTEMS

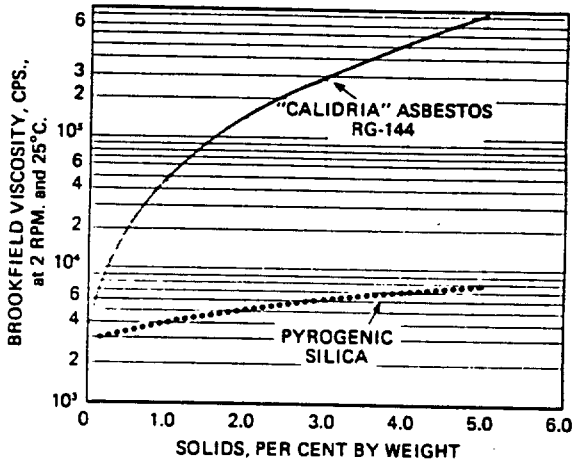
"Calidria" asbestos RG-144 is especially effective in improving the viscosity and thixotropy of liquid epoxy resin systems. The fiber improves these properties in both the resin and the hardener. In fact, RG-144 is so much more effective than competitive thickeners that up to 50% less material is needed to reach a particular viscosity or thixotropy level. Because "Calidria" asbestos RG-144 is also lower in price, its cost performance is outstanding.

The graphs below compare the viscosity and thixotropy increases provided by comparable additions of "Calidria" asbestos RG-144 and pyrogenic silica. RG-144 is shown to be more effective than silica in liquid epoxy resins and amine hardeners. In fact, RG-144 is so effective that additives usually recommended with pyrogenic silica are not needed.

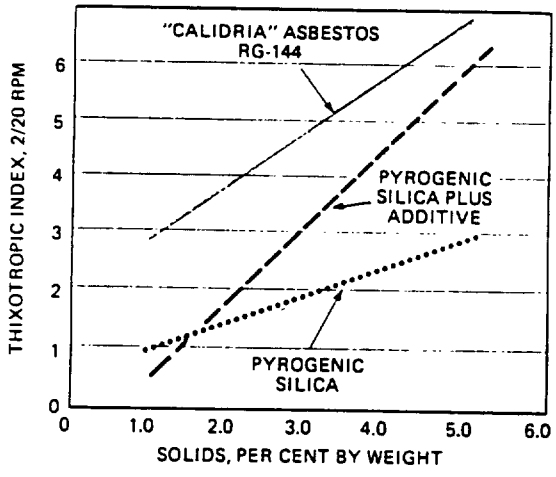
RESIN VISCOSITY – Typical Bisphenol A Liquid Epoxy Resin



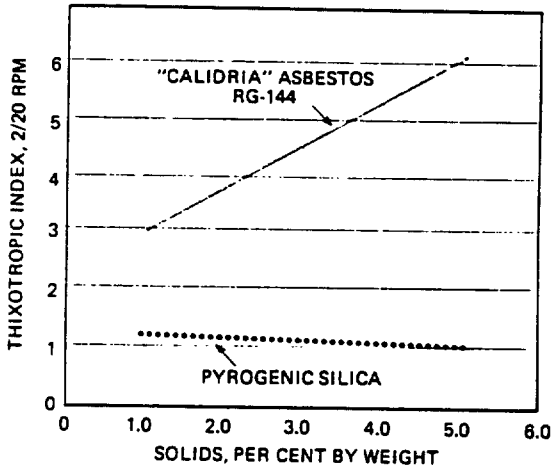
HARDENER VISCOSITY – Typical Minimum Irritation-Potential Amine Hardener



RESIN THIXOTROPY



HARDENER THIXOTROPY



PREPARATION – Thixotropes were added to the liquid resin or hardener at 25°C. and dispersed in a "Cowles" dissolver at 2400 rpm for 5 minutes.
MEASUREMENT – Viscosities were measured on a Brookfield model RVF viscometer at 2 and 20 rpm 24 hours after mixing.

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ACL Doc 16074 · Page 40 of 130 asbestosclaims.law/library/16074/40

The exceptional shelf life of epoxy systems containing RG-144 is shown in the chart below. A bisphenol A epoxy was stored for 6 months without any significant change in viscosity or thixotropy.

SHELF LIFE OF BISPHENOL A EPOXY CONTAINING 4 PARTS OF "CALIDRIA" ASBESTOS RG-144 PER 100 PARTS OF RESIN

	24 hours	7 days	30 days	45 days	6 months
Brookfield Viscosity, cps at room temperature					
2 rpm	464,000	430,000	480,000	480,000	450,000
20 rpm	86,800	76,000	97,200	98,000	100,000
Thixotropic Index, 2/20 rpm	5.3	5.7	5.1	4.9	4.5

Typical Performance Data in BUTYL RUBBER CAULK

"Calidria" asbestos RG-144 meets the heavy demands of a thixotrope used in caulks that are predominantly rubber and find many applications as sealants. The product disperses quickly with minimum dust. It can be added at any time and in small increments, and it is not sensitive to overmixing. This gives the formulator wide latitude for balancing operating errors, equipment problems, cost, and performance. Few thixotropes can offer this versatility.

"Calidria" asbestos RG-144 also minimizes the side effects of using a thixotrope, such as adhesion loss, package stability, and channel cracking. This is partly due to the fiber shape of the product and also the greater ease of balancing the compound.

When RG-144 is added to a caulk batch, the caulk takes on a "whipped cream" texture which does not affect the porosity of the compound. The asbestos effectively increases gunning ease and extrusion rates and does not cause clogging.

A typical starting formulation, as recommended by Rubber Research Elastomerics, Inc. of Minneapolis, is:

10 parts	Butyl Rubber (80% solids)
1 part	Titanium Dioxide
15 parts	Calcium Carbonate
1½ parts	"Calidria" Asbestos RG-144
2 parts	VMP Naphthas

A00108

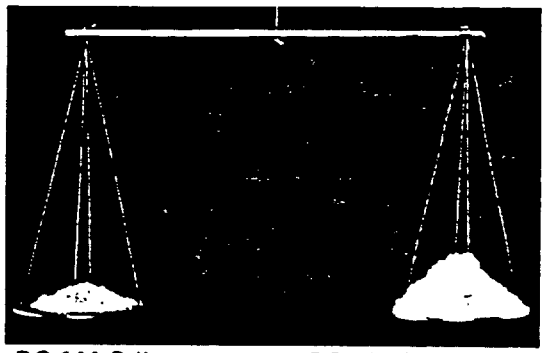
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ACL Doc 16074 · Page 41 of 130
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Available in Pellets Too ... for Reduced Dust and Lower Costs

"Calidria" asbestos RG-144 is available as high-density pellets that minimize dust generation and reduce storage and shipping costs.

These 3/8-in. by 1/8-in. diameter pellets are packaged in 50-lb. shrink-wrapped bags on 2000-lb. pallets or they can be shipped in bulk-hopper cars holding about 90 tons. The pellets can be handled by conventional bulk-handling equipment.

"Calidria" asbestos RG-144 pellets require greater shear energy for optimum mixing, although a Cowles-type mixer is usually adequate.



RG-144 Pellets RG-144 Open Fiber

Two Forms of "Calidria" Asbestos RG-144 . . . Both Weigh the Same

Calidria ASBESTOS

INFORMATION ON PROPERTIES, APPLICATIONS, AND PRICES

Northeast	P.O. Box 579, Niagara Falls, New York 14302	716-278-3371
South	17 Executive Park Drive, Atlanta, Georgia 30329	404-633-6161
Midwest	P.O. Box 579, Niagara Falls, New York 14302	716-278-3355
West	100 Oceangate, Long Beach, California 90802	213-435-3721

MARKETING AND TECHNICAL CENTER

P.O. Box 579, Niagara Falls, New York 14302 716-278-3369

PLANT

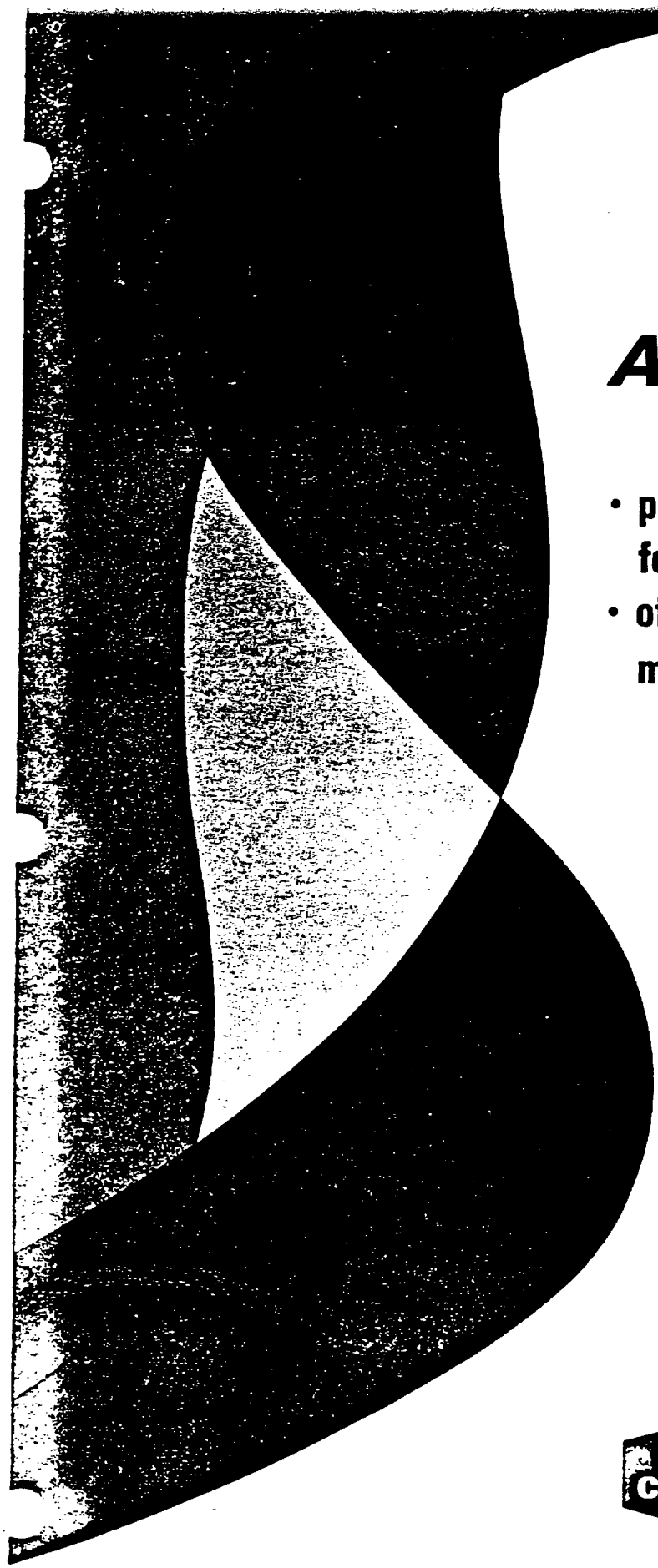
P.O. Box K, King City, California 93930 408-385-5961

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F-76-0059A
10/76—5M

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Calidria

ASBESTOS RG-600

- provides highly efficient reinforcement for thermoplastic resins
- offers unique new combinations of material properties

for... F.H. LARRISON

UNION CARBIDE

UNION CARBIDE CORPORATION
MINING AND METALS DIVISION
270 PARK AVENUE, NEW YORK, N.Y. 10017

MARKETING AND TECHNICAL CENTER: P.O. BOX 579, NIAGARA FALLS, N.Y. 14302
TELEPHONE: 716-278-3369

A06197

ADVANTAGES OF USING Calidria ASBESTOS RG-600 IN THERMOPLASTICS

"CALIDRIA" ASBESTOS RG-600 is a high-purity, highly liberated chrysotile fiber pretreated with a proprietary coupling agent. It gives unique combinations of properties to thermoplastics – specifically polyolefins, styrenics, and vinyls. It also has potential applications in aliphatic polyesters, polyamides, and acetals.

Property Benefits:

INCREASED MECHANICAL PROPERTIES – Surface-treated "Calidria" asbestos RG-600 gives significantly greater increases in stiffness and strength than conventional asbestos. In many cases, RG-600 gives properties comparable to those obtained from additions of chopped fiberglass. For example, high-density polyethylene containing RG-600 can be formulated so that overall properties are comparable to high-impact polystyrene.

HIGHER HEAT-DISTORTION TEMPERATURE – "Calidria" asbestos RG-600 also gives higher heat-distortion temperatures than conventional asbestos. In polypropylene, for example, 30% RG-600 increases the heat-distortion temperature from 58 to 123 deg. C.

SUPERIOR HOT-WATER RESISTANCE – Although strength properties of thermoplastics reinforced with fiberglass deteriorate in water, polyolefins reinforced with RG-600 actually show improved properties. Strength, stiffness, and heat-distortion temperature improve after extended immersion in boiling water.

IMPROVED THERMAL AND OXIDATIVE STABILITY – "Calidria" asbestos RG-600 can be formulated into polypropylene composites with excellent heat-aging characteristics. Also, the processing stability of polyvinyl chloride containing RG-600 is markedly superior to that of products made with conventional asbestos.

SMOOTH SURFACE – Extruded and molded products have an extremely smooth surface when reinforced with "Calidria" asbestos RG-600.

Processing Benefits:

FASTER, MORE UNIFORM DISPERSION – The highly liberated, pre-treated fibers of "Calidria" asbestos RG-600 disperse quickly and uniformly in thermoplastics with conventional mixing equipment. In fact, dispersion is faster and more complete than with any other asbestos, as shown on the top of the next page.

A06198

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DISPERSION OF ASBESTOS IN POLYSTYRENE



"Calidria" Asbestos RG-600



Untreated "Calidria" Asbestos

These electron micrographs show that surface-treated "Calidria" asbestos RG-600 disperses more readily in polystyrene resin than untreated "Calidria" asbestos.

EXTENDED MOLD, SCREW, AND DIE LIFE – "Calidria" asbestos RG-600 has a minimum of magnetite and rock particles that can wear processing equipment. The fibers themselves are also non-abrasive. As a result, RG-600 allows longer equipment life than fiberglass.

SCRAP REPROCESSING – In contrast to fiberglass, "Calidria" asbestos fibers do not fracture during compounding, extrusion, and molding. Thus, thermoplastic scrap containing this fiber can be reprocessed without sacrificing properties.

Handling Benefits:

PELLETS REDUCE DUST – The fibers of "Calidria" asbestos RG-600 are compacted and shipped as dust-free pellets. These pellets can be handled in bulk with minimum dust. This popular feature, available exclusively with "Calidria" asbestos, allows cleaner operations during materials handling and addition to thermoplastics.

FEED AUTOMATICALLY – The pellets of "Calidria" asbestos RG-600 are ideally suited for operations using automatic feed equipment. They flow quickly and smoothly through the equipment while generating a minimum of dust. Producers using Banbury mixers will find the high bulk density of the pellets permits optimum loadings.

EASIER HANDLING AND STORAGE – "Calidria" asbestos pellets are over twice as dense as open fibers. One ton of pellets occupies only 44 cu. ft. of space compared with up to 100 cu. ft. for typical open-fiber products. By using RG-600 pellets, handling is speeded and storage space is cut in half.

LOWER FREIGHT COSTS TOO – A box car can be loaded to its full 120,000 lb. capacity with "Calidria" RG-600 pellets. In comparison, much less open fiber can be loaded in the same car. Thus, pellets can save up to 20% on rail shipping costs by permitting use of lower tariffs. The high density of "Calidria" asbestos pellets also offers savings in truck freight costs in many parts of the country.

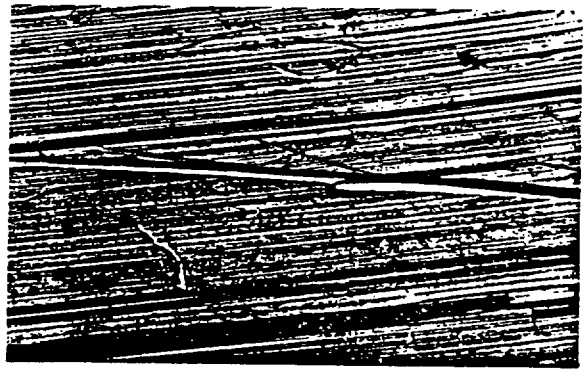
A0610

Why is "Calidria" asbestos different?

"Calidria" products are made from high-purity, short-fiber chrysotile asbestos obtained from a unique deposit about 150 miles south of San Francisco, California. Unlike conventional deposits that extend through the host rock, this deposit is essentially free of hard, consolidated rock masses. Further, the ore assays up to 60% asbestos fiber compared to conventional deposits which contain from 6 to 10% asbestos.

Special hydraulic beneficiation techniques developed by Union Carbide efficiently break down the fiber bundles and remove the rock and impurities from the asbestos fiber. As a result, all "Calidria" products are over 95% pure asbestos whose fibers are 98% liberated from fiber bundles.

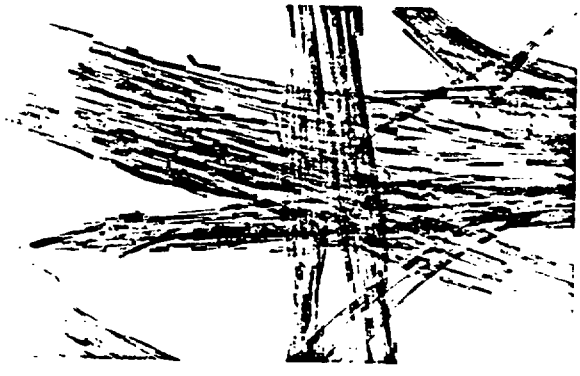
RG-600 is made by additional refining to achieve over 99% purity. The fibers are then pre-treated with a proprietary coupling agent to form this unique, highly efficient reinforcing agent for thermoplastic resins.



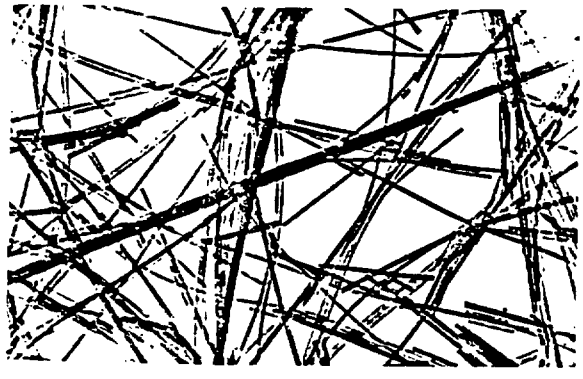
CANADIAN ASBESTOS – AS-MINED – Individual fiber bundles are straight and tightly bonded, surrounded by consolidated rock masses. In this form, the fibers defy separation from each other and from the host rock.



"CALIDRIA" ASBESTOS – AS-MINED – Here the fibers are randomly oriented and essentially free of hard rock masses. Further, the ore assays up to 60% asbestos, considerably more than the Canadian ore.



"CALIDRIA" ASBESTOS – IF DRY-PROCESSED – Even the most exacting dry processes do not completely break down the fiber bundles into individually liberated fibers. Union Carbide technology developed a special wet process to liberate the fibers.



"CALIDRIA" ASBESTOS – UNIQUELY WET-PROCESSED – Union Carbide's process separates 98% of the fiber bundles. RG-600 fibers are over 99% pure asbestos and then surface treated to provide efficient reinforcement.

A00207

TYPICAL PROPERTIES

USING

Calidria ASBESTOS RG-600

IN THERMOPLASTICS

HIGH-DENSITY POLYETHYLENE

PROPERTY	100% RESIN	30% RG-600, 70% RESIN	UNITS	TEST METHOD (ASTM)
THERMAL				
Heat Distortion Temperature	38	95	°C @ 264 psi	D 648-56
Coef. of Linear Expansion	12.0×10^{-5}	2.33×10^{-5}	–	D 696-44(61)
MECHANICAL				
Tensile Strength	2,770	6,550	psi	D 638-64T
Tensile Modulus	125,000	550,000	psi	D 638-64T
Elongation	8.7	2.5	%	D 638-64T
Flexure Strength	3,900	11,000	psi	D 790-66
Flexure Modulus	160,000	900,000	psi	D 790-66
Impact Strength Izod, Notched	1.20	0.45	ft. lb./in. of notch	D-256-56
GENERAL				
Specific Gravity	0.962	1.160	23/23°C.	D 792-64T
Water Absorption	0.05	≤0.10	%	D 570-63
Mold Shrinkage	2.93	0.72	%	–
(1/8 x 2.5 x 6 in.)	0.029	0.007	in./in.	–

TOTAL IMMERSION IN BOILING WATER FOR 2 DAYS

Resin containing 30% RG-600

PROPERTY	BEFORE TEST	AFTER TEST	UNITS	TEST METHOD (ASTM)
Tensile Strength	6,540	6,860	psi	D 638-64T
Tensile Modulus	536,000	500,000	psi	D 638-64T
Heat Distortion Temperature	96	110	°C @ 264 psi	D 648-56

Properties were measured on injection molded specimens

A06201

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TYPICAL PROPERTIES

USING

Calidria ASBESTOS RG-600

IN THERMOPLASTICS

POLYSTYRENE

PROPERTY	100% RESIN	30% RG-600, 70% RESIN	UNITS	TEST METHOD (ASTM)
THERMAL				
Heat Distortion Temperature	76	101	°C @ 264 psi	D 648-56
Coef. of Linear Expansion	7.25×10^{-5}	2.25×10^{-5}	–	D 696-44(61)
MECHANICAL				
Tensile Strength	6,070	7,700	psi	D 638-64T
Tensile Modulus	418,000	1,560,000	psi	D 638-64T
Elongation	1.69	0.53	%	D 638-64T
Flexure Strength	10,800	11,200	psi	D-790-66
Flexure Modulus	460,000	1,490,000	psi	D 790-66
Impact Strength Izod, Notched	0.25	0.24	ft. lb./in. of notch	D 256-56
GENERAL				
Specific Gravity	1.050	1.253	23/23°C.	D 792-64T
Water absorption	0.05	≤0.10	%	D 570-63
Mold Shrinkage	0.471	0.18	%	–
(1/8 x 2.5 x 6 in.)	0.004	0.001	in./in.	–

Properties were measured on injection molded specimens

A06202

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TYPICAL PROPERTIES
USING Calidria ASBESTOS RG-600
IN THERMOPLASTICS

POLYPROPYLENE

PROPERTY	100% RESIN	30% RG-600, 70% RESIN	UNITS	TEST METHOD (ASTM)
THERMAL				
Heat Distortion Temperature	58	123	°C @ 264 psi	D 648-56
Coef. of Linear Expansion	6.28×10^{-5}	1.97×10^{-5}	–	D 696-44(61)
MECHANICAL				
Tensile Strength	4,590	7,300	psi	D 638-64T
Tensile Modulus	196,000	580,000	psi	D 638-64T
Elongation	9.5	3.8	%	D 638-64T
Flexure Strength	6,780	12,900	psi	D 790-66
Flexure Modulus	239,000	992,000	psi	D 790-66
Impact Strength Izod, Notched	0.50	0.45	ft. lb./in. of notch	D 256-56
GENERAL				
Specific Gravity	0.916	1.095	23/23°C.	D 792-64T
Water absorption	0.03	≤0.06	%	D 570-63
Mold Shrinkage	1.95	0.48	%	–
(1/8 x 2.5 X 6 in.)	0.019	0.004	in./in.	–

TOTAL IMMERSION IN BOILING WATER FOR 7 DAYS
Resin containing 30% RG-600 and 0.7% antioxidant

PROPERTY	BEFORE TEST	AFTER TEST	UNITS	TEST METHOD (ASTM)
Tensile Strength	6,310	6,600	psi	D 638-64T
Tensile Modulus	507,000	545,000	psi	D 638-64T
Heat Distortion Temperature	95	106	°C @ 264 psi	D 648-56

Properties were measured on injection molded specimens

A06203

Calidria

ASBESTOS RG-600

- provides highly efficient reinforcement for thermoplastic resins

- offers unique new combinations of material properties

UNION CARBIDE

A06180

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ADVANTAGES OF USING Calidria ASBESTOS RG-600 IN THERMOPLASTICS

"CALIDRIA" ASBESTOS RG-600 is a high-purity, highly liberated chrysotile fiber pretreated with a proprietary coupling agent. It gives unique combinations of properties to thermoplastics – specifically polyolefins, styrenics, and vinyls. It also has potential applications in aliphatic polyesters, polyamides, and acetals.

Property Benefits:

INCREASED MECHANICAL PROPERTIES – Surface-treated "Calidria" asbestos RG-600 gives significantly greater increases in stiffness and strength than conventional asbestos. In many cases, RG-600 gives properties comparable to those obtained from additions of chopped fiberglass. For example, high-density polyethylene containing RG-600 can be formulated so that overall properties are comparable to high-impact polystyrene.

HIGHER HEAT-DISTORTION TEMPERATURE – "Calidria" asbestos RG-600 also gives higher heat-distortion temperatures than conventional asbestos. In polypropylene, for example, 30% RG-600 increases the heat-distortion temperature from 58 to 123 deg. C.

SUPERIOR HOT-WATER RESISTANCE – Although strength properties of thermoplastics reinforced with fiberglass deteriorate in water, polyolefins reinforced with RG-600 actually show improved properties. Strength, stiffness, and heat-distortion temperature improve after extended immersion in boiling water.

IMPROVED THERMAL AND OXIDATIVE STABILITY – "Calidria" asbestos RG-600 can be formulated into polypropylene composites with excellent heat-aging characteristics. Also, the processing stability of polyvinyl chloride containing RG-600 is markedly superior to that of products made with conventional asbestos.

SMOOTH SURFACE – Extruded and molded products have an extremely smooth surface when reinforced with "Calidria" asbestos RG-600.

Processing Benefits:

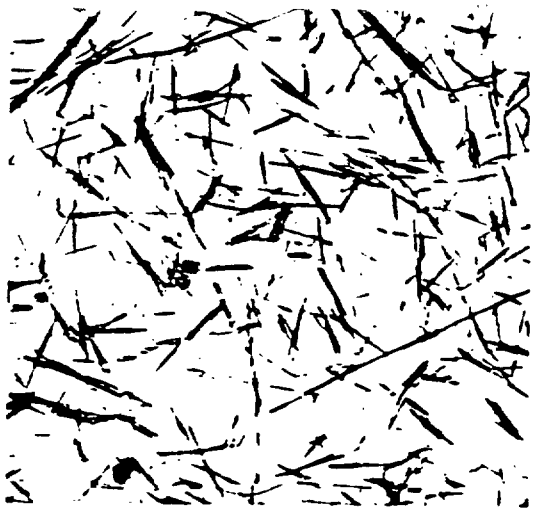
FASTER, MORE UNIFORM DISPERSION – The highly liberated, pre-treated fibers of "Calidria" asbestos RG-600 disperse quickly and uniformly in thermoplastics with conventional mixing equipment. In fact, dispersion is faster and more complete than with any other asbestos, as shown on the top of the next page.

A00190

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ACL Doc 16074 · Page 51 of 130 asbestosclaims.law/library/16074/51



"Calidria" Asbestos RG-600



Untreated "Calidria" Asbestos

DISPERSION OF ASBESTOS IN POLYSTYRENE

These electron micrographs show that surface-treated "Calidria" asbestos RG-600 disperses more readily in polystyrene resin than untreated "Calidria" asbestos.

EXTENDED MOLD, SCREW, AND DIE LIFE –"Calidria" asbestos RG-600 has a minimum of magnetite and rock particles that can wear processing equipment. The fibers themselves are also non-abrasive. As a result, RG-600 allows longer equipment life than fiberglass.

SCRAP REPROCESSING – In contrast to fiberglass, "Calidria" asbestos fibers do not fracture during compounding, extrusion, and molding. Thus, thermoplastic scrap containing this fiber can be reprocessed without sacrificing properties.

Handling Benefits:

PELLETS REDUCE DUST – The fibers of "Calidria" asbestos RG-600 are compacted and shipped as dust-free pellets. These pellets can be handled in bulk with minimum dust. This popular feature, available exclusively with "Calidria" asbestos, allows cleaner operations during materials handling and addition to thermoplastics.

FEED AUTOMATICALLY – The pellets of "Calidria" asbestos RG-600 are ideally suited for operations using automatic feed equipment. They flow quickly and smoothly through the equipment while generating a minimum of dust. Producers using Banbury mixers will find the high bulk density of the pellets permits optimum loadings.

EASIER HANDLING AND STORAGE – "Calidria" asbestos pellets are over twice as dense as open fibers. One ton of pellets occupies only 44 cu. ft. of space compared with up to 100 cu. ft. for typical open-fiber products. By using RG-600 pellets, handling is speeded and storage space is cut in half.

LOWER FREIGHT COSTS TOO – A box car can be loaded to its full 120,000 lb. capacity with "Calidria" RG-600 pellets. In comparison, much less open fiber can be loaded in the same car. Thus, pellets can save up to 20% on rail shipping costs by permitting use of lower tariffs. The high density of "Calidria" asbestos pellets also offers savings in truck freight costs in many parts of the country.

A00191

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TYPICAL PROPERTIES
USING Calidria ASBESTOS RG-600
IN THERMOPLASTICS

HIGH-DENSITY POLYETHYLENE

PROPERTY	100% RESIN	30% RG-600, 70% RESIN	UNITS	TEST METHOD (ASTM)
THERMAL				
Heat Distortion Temperature	38	95	°C @ 264 psi	D 648-56
Coef. of Linear Expansion	12.0×10^{-5}	2.33×10^{-5}	–	D 696-44(61)
MECHANICAL				
Tensile Strength	2,770	6,550	psi	D 638-64T
Tensile Modulus	125,000	550,000	psi	D 638-64T
Elongation	8.7	2.5	%	D 638-64T
Flexure Strength	3,900	11,000	psi	D 790-66
Flexure Modulus	160,000	900,000	psi	D 790-66
Impact Strength Izod, Notched	1.20	0.45	ft. lb./in. of notch	D-256-56
GENERAL				
Specific Gravity	0.962	1.160	23/23°C.	D 792-64T
Water Absorption	0.05	≤0.10	%	D 570-63
Mold Shrinkage	2.93	0.72	%	–
(1/8 x 2.5 x 6 in.)	0.029	0.007	in./in.	–

TOTAL IMMERSION IN BOILING WATER FOR 2 DAYS
Resin containing 30% RG-600

PROPERTY	BEFORE TEST	AFTER TEST	UNITS	TEST METHOD (ASTM)
Tensile Strength	6,540	6,860	psi	D 638-64T
Tensile Modulus	536,000	589,000	psi	D 638-64T
Heat Distortion Temperature	96	110	°C @ 264 psi	D 648-56

Properties were measured on injection molded specimens

A00192

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ACL Doc 16074 · Page 53 of 130
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asbestosclaims.law/library/16074/53

NYLON 6

PROPERTY	100% RESIN	15% FIBERGLASS, 85% RESIN	15% RG-600, 85% RESIN	UNITS	TEST METHOD (ASTM)
Flexure Strength	12,000	18,000	24,800	psi	D 790-66
Flexure Modulus	290,000	455,000	834,000	psi	D 790-66
Tensile Strength	8,400	11,800	14,000	psi	D 638-64T
Tensile Modulus	330,000	612,000	820,000	psi	D 638-64T
Heat Distortion Temperature	74	187	164	°C @ 264 psi	D 648-56
Impact Strength Izod, Notched	1.31	1.29	1.01	ft. lb./ in. of notch	D 256-56

Properties were measured on ram injection-molded bars.

POLYSTYRENE

PROPERTY	100% RESIN	30% RG-600, 70% RESIN	UNITS	TEST METHOD (ASTM)
THERMAL				
Heat Distortion Temperature	76	101	°C @ 264 psi	D 648-56
Coef. of Linear Expansion	7.25×10^{-5}	2.25×10^{-5}	–	D 696-44(61)
MECHANICAL				
Tensile Strength	6,070	7,700	psi	D 638-64T
Tensile Modulus	418,000	1,560,000	psi	D 638-64T
Elongation	1.69	0.53	%	D 638-64T
Flexure Strength	10,800	11,200	psi	D-790-66
Flexure Modulus	460,000	1,490,000	psi	D 790-66
Impact Strength Izod, Notched	0.25	0.24	ft. lb./in. of notch	D 256-56
GENERAL				
Specific Gravity	1.050	1.253	23/23°C.	D 792-64T
Water absorption	0.05	≤0.10	%	D 570-63
Mold Shrinkage	0.471	0.18	%	–
(1/8 x 2.5 x 6 in.)	0.004	0.001	in./in.	–

Properties were measured on injection molded specimens

A00103

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TYPICAL PROPERTIES
USING Calidria ASBESTOS RG-600
IN THERMOPLASTICS

POLYPROPYLENE

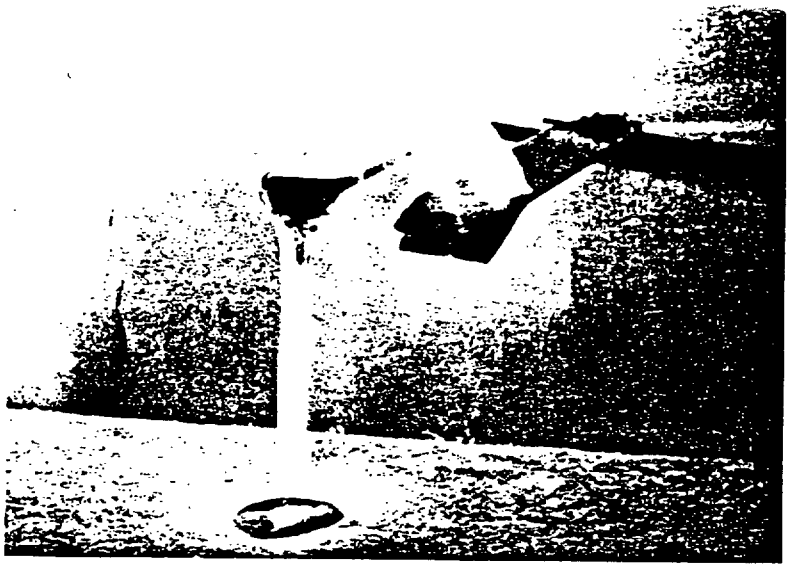
PROPERTY	100% RESIN	30% RG-600, 70% RESIN	UNITS	TEST METHOD (ASTM)
THERMAL				
Heat Distortion Temperature	58	123	°C @ 264 psi	D 648-56
Coef. of Linear Expansion	6.28×10^{-5}	1.97×10^{-5}	–	D 696-44(61)
MECHANICAL				
Tensile Strength	4,590	7,300	psi	D 638-64T
Tensile Modulus	196,000	580,000	psi	D 638-64T
Elongation	9.5	3.8	%	D 638-64T
Flexure Strength	6,780	12,900	psi	D 790-66
Flexure Modulus	239,000	992,000	psi	D 790-66
Impact Strength Izod, Notched	0.50	0.45	ft. lb./in. of notch	D 256-56
GENERAL				
Specific Gravity	0.916	1.095	23/23°C.	D 792-64T
Water absorption	0.03	≤0.06	%	D 570-63
Mold Shrinkage	1.95	0.48	%	–
(1/8 x 2.5 X 6 in.)	0.019.	0.004	in./in.	–

TOTAL IMMERSION IN BOILING WATER FOR 7 DAYS
Resin containing 30% RG-600 and 0.7% antioxidant

PROPERTY	BEFORE TEST	AFTER TEST	UNITS	TEST METHOD (ASTM)
Tensile Strength	6,310	6,600	psi	D 638-64T
Tensile Modulus	507,000	545,000	psi	D 638-64T
Heat Distortion Temperature	95	106	°C @ 264 psi	D 648-56

Properties were measured on injection molded specimens

A00104



High-density polyethylene containing as little as 5% "Calidria" asbestos RG-600 (right) has a slower burning rate without burning drops. Polyethylene on the left contains no RG-600.

AIRBORNE FIBER COUNTS
OF COMPOSITES CONTAINING *Calidria* ASBESTOS RG-600

Airborne asbestos-fiber concentrations have been measured in a series of tests to illustrate the levels which might be expected during the three basic operations involved in producing RG-600 – resin composites. Data collected to date are summarized below. These data have not been reduced to time-weighted averages and should more reasonably be compared to ceiling-concentration limits. Such a comparison shows that the expected concentrations during normal processing are below both current and proposed OSHA limits.

SUMMARY OF "CALIDRIA" ASBESTOS RG-600 AIRBORNE ASBESTOS FIBER COUNTS

OPERATION	NO. OF SAMPLES	AIRBORNE ASBESTOS CONCENTRATIONS (FIBERS/cc > 5μ) RANGE	AVERAGE
Handling RG-600 Resin Dry Blend	7 Personal	< 0.1 - 0.5	0.3
	8 Area (in or close to equipment)	< 0.1 - 2.2	1.2
Compounded Resin Operations	1 Personal	< 0.1 - 0.1	< 0.1
	4 Area	< 0.1 - 0.1	< 0.1
Cutting, Chopping & Grinding Operations	4 Personal	0.2 - 0.4	0.3
	11 Area	< 0.1 - 0.3	0.1

A00105

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ACL Doc 16074 · Page 56 of 130 asbestosclaims.law/library/16074/56

Calidria ASBESTOS

INFORMATION ON PROPERTIES, APPLICATIONS, AND PRICES

Northwest	P.O. Box 579, Niagara Falls, New York 14302	716-278-3371
South	17 Executive Park Drive, Atlanta, Georgia 30329	404-633-6161
Midwest	P.O. Box 579, Niagara Falls, New York 14302	716-278-3355
West	100 Oceangate, Long Beach, California 90802	213-435-3721

MARKETING AND TECHNICAL CENTER

P.O. Box 579, Niagara Falls, New York 14302 — 716-278-3369

PLANT

P.O. Box K, King City, California 93930 — 408-385-5961

UNION CARBIDE

UNION CARBIDE CORPORATION • METALS DIVISION

270 PARK AVENUE, NEW YORK, N.Y. 10017

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THE DISCOVERY COMPANY

Union Carbide

Calidria ASBESTOS

"CALIDRIA" ASBESTOS SG-130 AND SG-210
For Tape Joint Compounds

Lowers Costs Two Ways

CALIDRIA Asbestos acts as a bodying and secondary thickening agent permitting formulation of lower density, more economical tape joint compounds without the sacrifice of performance. CALIDRIA Asbestos is produced by a proprietary manufacturing process that yields unusually high fiber content and more complete fiber liberation from the natural bundles. As a result, CALIDRIA Asbestos goes up to twice as far, pound for pound, as commercial grades of asbestos containing large amounts of other filler materials that have no specific desirable effects on tape joint compound properties.

Reduces Cracking

The fibers of CALIDRIA Asbestos behave as an active lyophobic colloid in aqueous dispersion; by this mechanism CALIDRIA Asbestos increases tape joint compound liquid cohesive strength during drying. Increased liquid cohesive strength greatly reduces the tendency for cracks over nail holes, in thick sections at the center of the joint, and along the feathered edges.

Enhances Sandability

CALIDRIA Asbestos contains mainly chrysotile fiber and is essentially free from abrasive contaminants, such as magnetite and serpentine rock dust. This composition results in a low density product, free from contaminants that interfere with sanding.

Improves Uniformity

Narrow and well-controlled particle size distribution, low alkalinity and high brightness are characteristic of CALIDRIA Asbestos. These properties are consistent from batch to batch and improve the uniformity of tape joint compounds using CALIDRIA Asbestos.

Suggestions for Use of CALIDRIA Asbestos

CALIDRIA Asbestos can be readily used in your present tape joint compound formulation. Add approximately one-half the proportion of asbestos you now use. Increase the proportion of calcium carbonate or other inert filler to make up for the lower quantity of asbestos. You may also be able to use slightly more water in your ready-mix and maintain your present viscosity level. No other changes in your

October, 1968
F-42258

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Suggestions for Use of CALIDRIA Asbestos (Continued)

formulation or manufacturing procedure are required.

CALIDRIA Asbestos SG-130 has the coarser particle size; it finds use for bedding compounds or perhaps spackling compound. The SG-210 has the finer particle size and is favored for topping compounds, all-purpose compositions, texture paints, and similar formulas.

A Suggested Ready-Mix Tape Joint Compound For Use With CALIDRIA Asbestos

	Parts by Weight Dry Basis
Fillers:	
Calcium Carbonate, No. 1 White (Thompson Weinman)	61.42
Mica, P80F (Western Mica)	21.00
Clay, ASP-400 (Minerals and Chemicals Philipp Corp.)	4.00
CALIDRIA Asbestos, SG-210 (Union Carbide)	4.58
Binder:	
UCAR Latex 131 (Union Carbide)	6.60*
Workability Control Agent:	
CELLOSIZE Thickener, TJC Grade (Union Carbide)	0.50
Drying Control:	
Ethylene Glycol (Union Carbide)	1.00
Defoamer:	
"Nopco" PD-1 (Nopco Chemical Company)	0.10
Dispersant:	
"Daxad" 30 (Dewey & Almy Chemical Div.)	0.60*
Bacteriostat:	
"Dowicide" A (Dow Chemical Co.)	0.20
	100.00

Total Water: about 56 parts by weight per 100 parts dry solids

*Contained solids basis

A05674

Typical Product Characteristics

	CALIDRIA Asbestos	
	SG-130	SG-210
Reflectance (G.E. Photovolt)	68%	
Contained magnetite	2% max.	
Alkalinity (as % of Na_2O)	0.05 to 0.06	
pH (5% aqueous slurry)	8.5 to 9.5	
Surface area (BET)	50 to 60 $m^2/g.$	
Oil Adsorption (DOP #/100# asbestos)	90 to 100	110 to 120
Wet Bulk, settled vol. (ml.) 10g/250 ml./1 hr.	200	220
Dry Bulk (#/ft.^{3})	7 to 8	5 to 6
Water absorption (wt. % in filter cake)	55 to 60	62 to 65
Size distribution (cumulative % retained)		
Wet Screen mesh size		
100	5	Trace
200	17	3
325	28 to 32	10 to 15

Packaging and Shipping Information

Product Form – Opened (finely ground) chrysotile asbestos fiber.

Packaging –

	CALIDRIA Asbestos	
	SG-130	SG-210
One Package	40 lb.	30 lb.
Pallet Weight		
Carload	1,600 lb.	1,050 lb.
Truckload	2,000 lb.	1,500 lb.

Shipping –
Classification – asbestos shorts
Rail point of origin – Welby, California (King City, California)

TOXICOLOGICAL PROPERTIES

It has been known for many years that some persons working in asbestos production were prone to develop a disabling lung disease. In time, this condition became known as asbestosis and was related to exposure to high concentrations of asbestos dust. With further experience, it was found that men could work with asbestos without development of lung disease if dust concentrations were kept below a certain level. It is now generally accepted that a man can work a 40-hour week for a lifetime without developing asbestosis if the asbestos dust particle count is kept at or below 5 million particles per cubic foot of air. This dust concentration of 5 million particles per cubic foot of air is the Threshold Limit Value for asbestos, and no cases

A05375

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ACL Doc 16074 · Page 60 of 130
asbestosclaims.law/library/16074/60

TOXICOLOGICAL PROPERTIES (Continued)

of asbestosis are believed to have occurred when exposures have been maintained at or below this level, despite large-scale utilization (now approaching one million tons per year in the U.S.A.). This concentration of dust is generally not visible in the average work area unless a beam of light causing a Tyndall effect is present. Usually the dust concentration must be from 8-10 million particles per cubic foot before its presence is visible in average lighting conditions.

Several years ago, it was reported that there was an increase in the incidence of cancerous tumors, especially of the lung, associated with asbestosis. Recently there have been reports of some cancers occurring in individuals exposed to asbestos dust, but who have not developed clinical asbestosis. It is believed by most authorities that these cases have been associated with exposures significantly exceeding the Threshold Limit Value. A major manufacturer of asbestos products who also mines asbestos has not been able to show an increase in cancerous growths in men working where dust concentrations were maintained at the Threshold Limit Value.

Control of asbestos dust exposure is therefore necessary. The control methods are the standard ones applicable to a variety of dusty operations. They include closed flow systems, wet processes where possible, and adequate exhaust ventilation where openings in the system are necessary. Pelletizing is sometimes used to improve the handling characteristics of otherwise dusty materials. Where satisfactory containment to stay within the Threshold Limit Value is impractical or impossible, efficient and reliable respirators are available for the protection of the employee. A program of environmental monitoring in manufacturing operations is highly desirable to determine that Threshold Limit Values are not being exceeded. Employees should wear respirators where dusting occurs in finishing products such as sanding taped joints.

Pre-employment and periodic physical examinations of workers are desirable. These should include chest X-rays to insure that the worker has no chest condition prior to work with asbestos and to determine that no lung changes are resulting from work with asbestos.

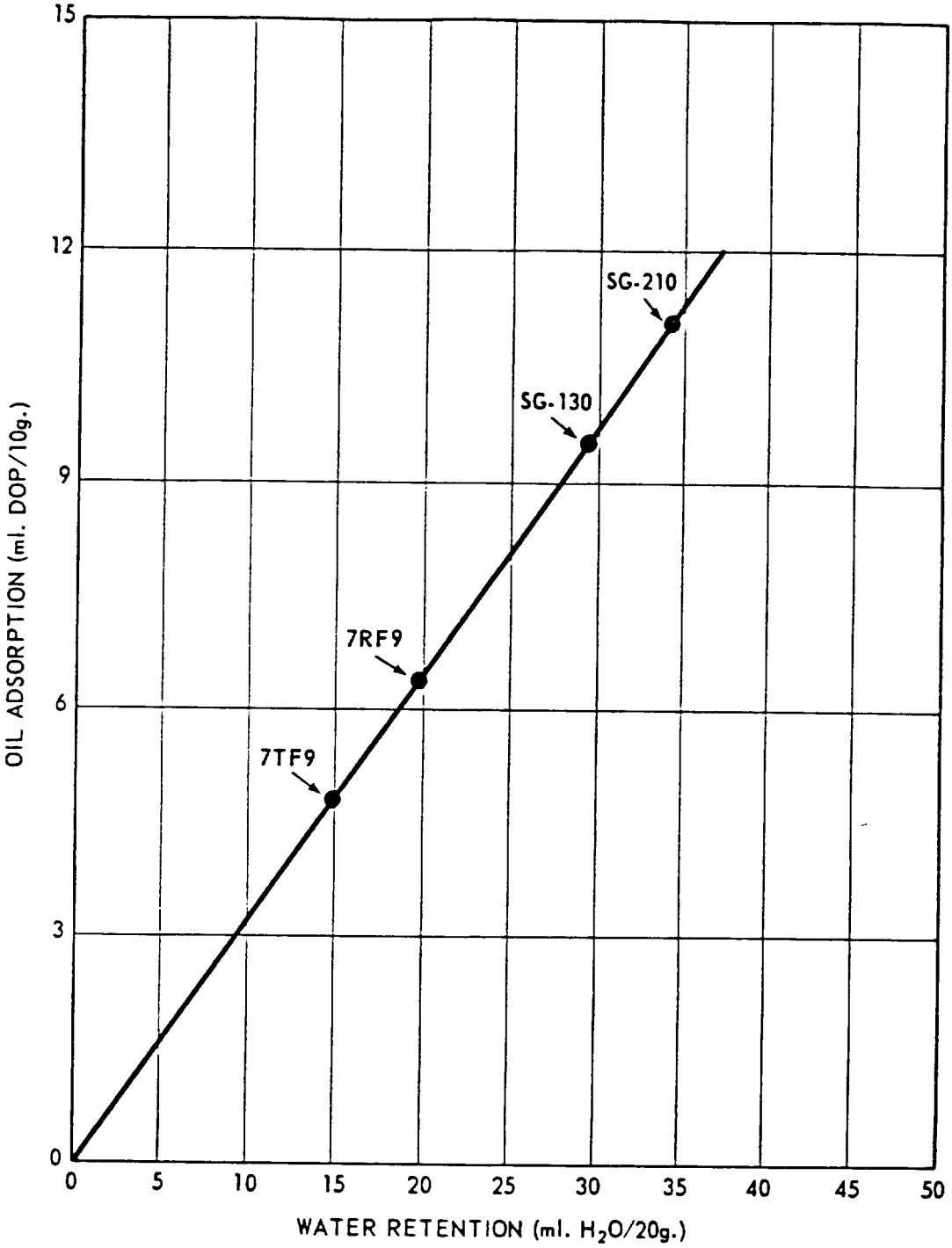
In conclusion, while asbestos dust in excess of the Threshold Limit Value is potentially harmful, as are many other dusts encountered in industry, it is as readily controlled as other such dusts and it can be used safely with appropriate precautions.

A05870

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"CALIDRIA" ASBESTOS SG-130 AND SG-210

For Tape Joint Compounds



RELATIONSHIP BETWEEN WATER & OIL ADSORPTION CAPACITY OF SOME ASBESTOS PRODUCTS FOR TAPE JOINT ADHESIVE FORMULATIONS

A05377

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THE DISCOVERY COMPANY

UNION CARBIDE CORPORATION
CHEMICALS AND PLASTICS
270 PARK AVENUE, NEW YORK, N.Y. 10017

Sales Offices

United States

ATLANTA, GEORGIA 30309	1371 Peachtree St., N. E.	404-892-7500
BALTIMORE, MARYLAND 21207	Beltway Bldg., 6707 Whitestone Rd.	301-944-8211
BOSTON, MASSACHUSETTS 02194	300 First Ave., Needham Hgts.	617-444-5400
BUFFALO, NEW YORK 14225	3343 Harlem Rd.	716-837-6450
CHARLOTTE, NORTH CAROLINA 28210	6230 Fairview Rd.	704-364-1400
CHICAGO, ILLINOIS 60606	120 South Riverside Plaza	312-822-7000
CINCINNATI, OHIO 45227	West Street and Madisonville Rd.	513-272-0206
CLEVELAND, OHIO 44114	1300 Lakeside Ave., N.E.	216-621-4202
CLIFTON, NEW JERSEY 07012	935 Allwood Rd.	201-778-2900
DALLAS, TEXAS 75207	2710 Stemmons Freeway	214-631-0010
DETROIT, MICHIGAN 48221	10421 West Seven Mile Rd.	313-341-3131
HARTFORD, CONNECTICUT 06103	410 Asylum St.	203-525-9345
HOUSTON, TEXAS 77027	3839 West Alabama Ave.	713-621-1000
INDIANAPOLIS, INDIANA 46220	720 Broad Ripple Ave.	317-255-3181
KANSAS CITY, MISSOURI 64141	910 Baltimore Ave.	816-221-2400
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NEW YORK, NEW YORK 10017	270 Park Ave.	212-551-4641
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SAN FRANCISCO, CALIFORNIA 94106	22 Battery St.	415-982-1360
SEATTLE, WASHINGTON 98118	4726 Rainier Ave., South	206-723-8660
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Calidria ASBESTOS RG-244

...a chemically modified, highly refined fiber with a mineral coating that gives:

HIGHER VISCOSITY AT LOW LOADINGS—"Calidria" asbestos RG-244 builds more viscosity at a given concentration than pyrogenic silica or other thickeners. Part of this viscosity increase comes from hydrogen bonding between the mineral coating and the resin system—the same way that pyrogenic silica builds viscosity. What makes RG-244 more efficient is that the fibers enhance flow resistance. On a lb.-for-lb. basis, RG-244 builds over twice as much viscosity as pyrogenic silica.

BETTER FLOW AT HIGH SHEAR RATES—"Calidria" RG-244 also improves flow at high shear rates because of its inherent thixotropic characteristics. This property is especially desirable in spray-up applications where less resistance to flow is desired during pumping and spraying.

SAVINGS FROM BETTER PERFORMANCE—By increasing viscosity and thixotropy more efficiently than other materials, "Calidria" asbestos RG-244 allows users to obtain their desired properties with less mineral additive. This reduction lowers costs and reduces any detrimental effect of thickeners on other resin properties.

LOW COSTS TOO—"Calidria" asbestos RG-244 costs less per lb. than similar thickeners. Thus, users save two ways—on unit cost *and* cost performance.

FAST WETTING, EASY DISPERSION—Conventional mixing equipment can be used to disperse "Calidria" RG-244 quickly and easily. In fact, this unique product wets out and disperses considerably faster than most other thixotropes.

BETTER SHELF LIFE, LESS SETTLING—Systems containing "Calidria" asbestos RG-244 can be stored for long periods without any significant change in viscosity or thixotropy. Settling during storage is minimized, and systems containing RG-244 can be remixed easily. In all these respects, RG-244 surpasses most other thickeners.

NO COLOR OR OPACITY—"Calidria" asbestos RG-244 is a highly refined fiber with a clear mineral coating that does not add color to most systems. At the same time, RG-244 has a refractive index that matches many systems, so that it does not add opacity. These features make RG-244 especially well suited for use in clear polyester gel coats.

REDUCED DUSTING—"Calidria" RG-244 is a fibrous material containing a minimum of dust. It therefore reduces dusting during materials handling and additions to resin systems.

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TYPICAL PHYSICAL PROPERTIES

Specific Gravity	2.45	—
Moisture Content	2.0	% max. by weight
Nature of Surface Charge	Neutral	—
Magnetite Content	0.3	% max. by weight
Refractive Index	1.54 to 1.56	n_D 25° C.
Oil (DOP) Absorption	300 to 350	lb. per 100 lb.
Surface Area	>60	sq. m. per g.
Fiber Diameter	0.025	microns
Length/Diameter (Aspect Ratio)	200 avg.	—
Bulking Value	4.9	gal. per 100 lb.
Dry Bulk Density (aerated)	1.0	lb. per cu. ft.

PACKAGING AND AVAILABILITY

Single Package—Weight (3-ply paper bag sealed in polyethylene)	10 lb.
Single Pallet—Weight —Dimensions (full pallets covered by waxed cardboard)	350 lb. approx. 53 in. x 44 in. x 61 in. high
Full Carload (available from King City plant)	52 pallets 18,200 lb.
Full 40-ft. Truckload (available nationwide)	17 pallets 5,950 lb.

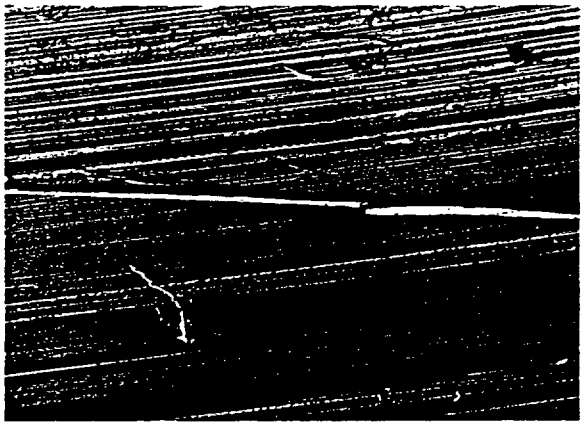
"Calidria" asbestos RG-244 is stocked at Union Carbide's shipping locations throughout the United States and is available from several distributors.

Why is "Calidria" asbestos different?

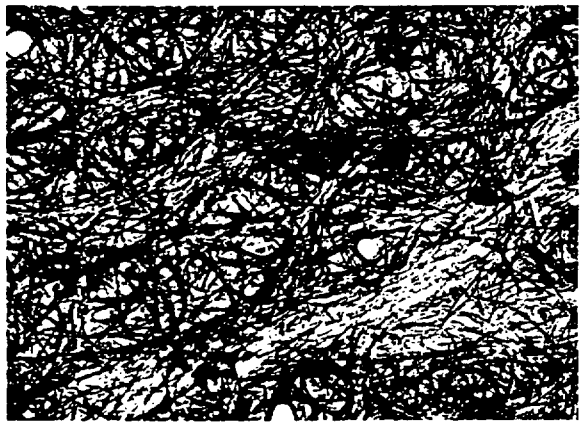
"Calidria" products are made from high-purity, short-fiber chrysotile asbestos obtained from a unique deposit about 160 miles south of San Francisco, California. Unlike conventional deposits that extend through the host rock, this deposit is essentially free of hard, consolidated rock masses. Further, the ore assays up to 60% asbestos fiber compared to conventional deposits which contain from 6 to 10% asbestos.

Special hydraulic beneficiation techniques developed by Union Carbide efficiently break down the fiber bundles and remove the rock and impurities from the asbestos fiber. As a result, all "Calidria" products are over 95% pure asbestos whose fibers are 98% liberated from fiber bundles.

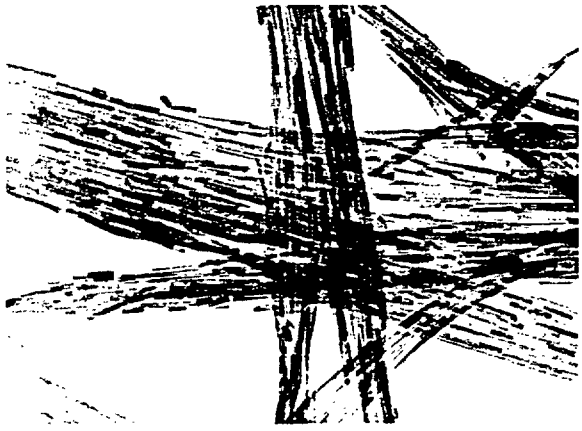
RG-244 is made by additional refining to achieve over 99% purity. The fibers are then chemically coated by a patented process to form this unique, highly efficient thickener and thixotrope.



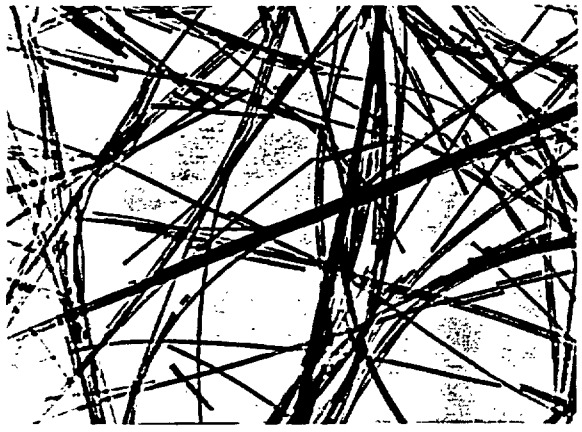
CANADIAN ASBESTOS—AS-MINED—Individual fiber bundles are straight and tightly bonded, surrounded by consolidated rock masses. In this form, the fibers defy separation from each other and from the host rock.



"CALIDRIA" ASBESTOS—AS-MINED—Here the fibers are randomly oriented and essentially free of hard rock masses. Further, the ore assays up to 60% asbestos, considerably more than the Canadian ore.



"CALIDRIA" ASBESTOS—IF DRY-PROCESSED—Even the most exacting dry processes do not completely break down the fiber bundles into individually liberated fibers. Union Carbide technology developed a special wet process to liberate the fibers.

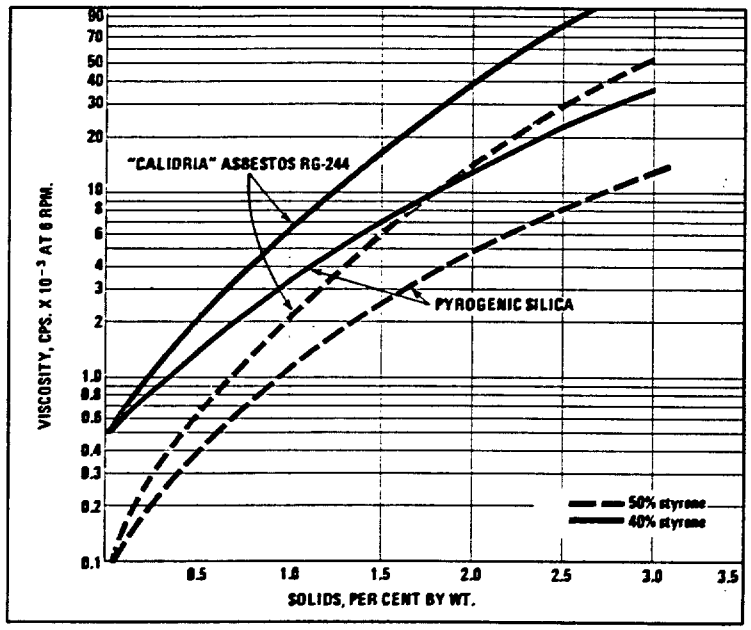


"CALIDRIA" ASBESTOS—UNIQUELY WET-PROCESSED — Union Carbide's process separates 98% of the fibers from the fiber bundles. RG-244 fibers are over 99% pure asbestos and chemically coated to provide an efficient thickener and thixotrope.

Typical Performance Data/General Purpose UNPROMOTED Polyester Resins

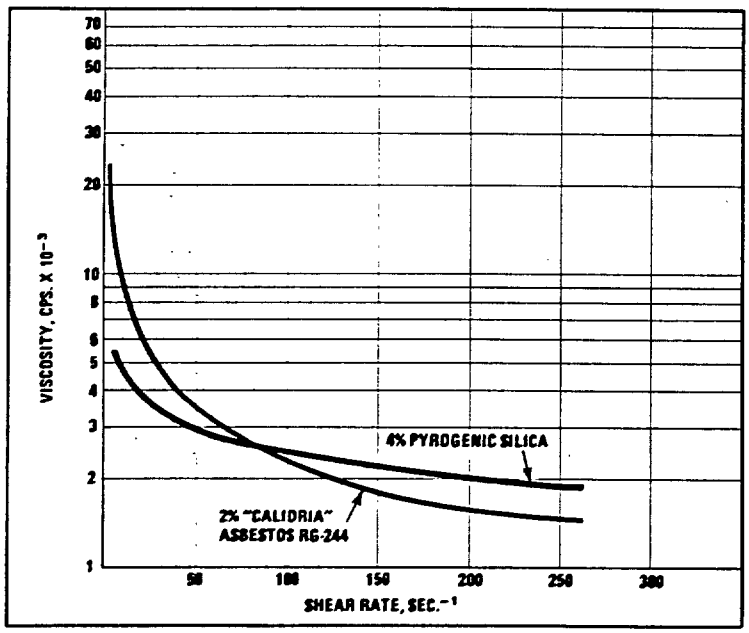
HIGHER VISCOSITY AT GIVEN CONCENTRATION

On a lb.-for-lb. basis, "Calidria" asbestos RG-244 builds substantially more viscosity in these 2 polyester systems than pyrogenic silica. RG-244 builds twice as much viscosity at a 1% concentration and 4 times as much viscosity at 3% concentration. Thus, users can use less RG-244 to obtain their desired viscosity.



HIGHER VISCOSITY AT LOW SHEAR RATES · BETTER FLOW AT HIGH SHEAR RATES

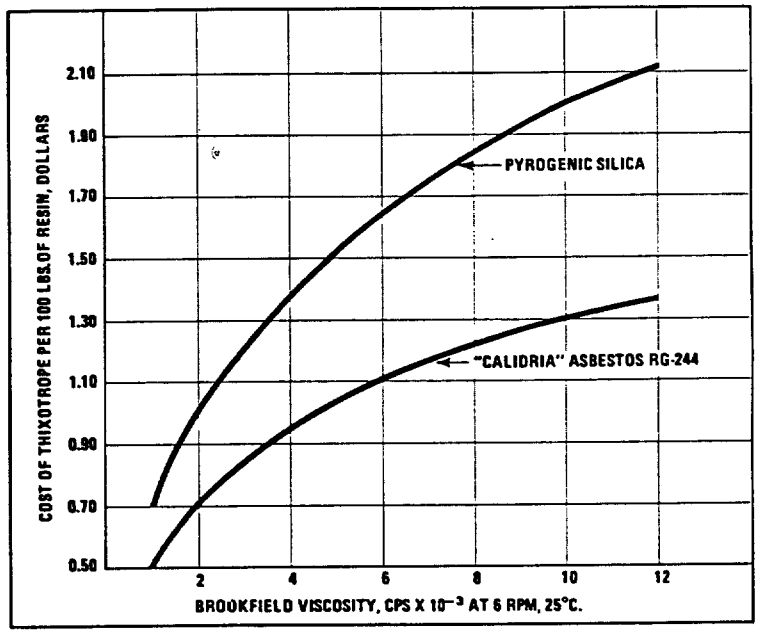
2% "Calidria" asbestos RG-244 gives better thixotropic properties than 4% pyrogenic silica in this unpromoted polyester resin containing about 50% styrene. The RG-244 system has better flow at high shear rates, allowing easier pumping and spray-up. As the shear rate is reduced, the RG-244 resin has better viscosity and sag resistance.



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SAVINGS USING "CALIDRIA" ASBESTOS RG-244 · UNPROMOTED Polyester Resins

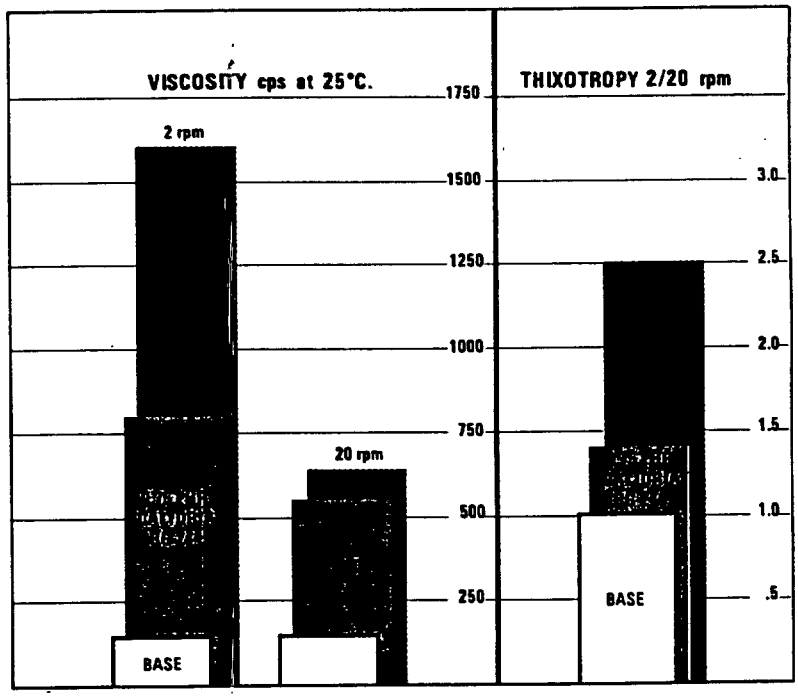
The better performance and lower cost of "Calidria" asbestos RG-244 allow substantial savings. In the typical unpromoted polyester resin system shown at the right, "Calidria" RG-244 builds a given viscosity for about one-half the cost of pyrogenic silica.



Typical Performance Data / General Purpose PROMOTED Polyester Resins

IMPROVES BOTH VISCOSITY AND THIXOTROPY

"Calidria" asbestos RG-244 also effectively improves the viscosity and thixotropy of promoted polyester resins. In many cases, the improved viscosity and thixotropy provided by RG-244 will be sufficient to meet user needs. Should higher values be required, a small addition of ethylene glycol or a similar additive will improve the viscosity, thixotropy, and stability of the RG-244 dispersion. At the right is an example of these improvements in a typical polyester resin containing a cobalt-type accelerator.



Typical Performance Data/Heat-Curable VINYL PLASTISOL Sealants

"Calidria" asbestos RG-244 improves the viscosity of heat-curable vinyl plastisols without reducing their inherently good adhesion properties. In fact, RG-244 provides excellent anti-sag properties at both low (275 to 375 deg. F.) and high (above 350 deg. F.) fusion temperatures. An example of how RG-244 improves the viscosity of a high-fusion temperature structural sealant without detracting from adhesion is shown below:

FORMULATION FOR HIGH-FUSION TEMPERATURE STRUCTURAL SEALANT

INGREDIENT	PARTS BY WEIGHT
BAKELITE QYOH-2 Resin	100
FLEXOL Plasticizer 10-10	60
FLEXOL Plasticizer 10A	40
EX-1 Extender Plasticizer	10
Barium-Cadmium Stabilizer	2
UNION CARBIDE Silane Y-5162 Adhesion Promoter	0.25
Calcium Carbonate	130
CALIDRIA Asbestos RG-244	5

TEST DATA

Butt tensile adhesion to cold-rolled steel after 45 minutes cure at 350° F.	440 psi
Severs type flow properties Binks orifice (1/8 inch) Time of test: 150 seconds	
Aged 24 hr. at room temperature	63 g. at 40 psi
Aged 72 hr. at 130° F	76 g. at 40 psi
Aged 45 days at room temperature	73 g. at 40 psi
Shore hardness, A scale after 24 hr. at room temperature	76

Dispersion of "Calidria" Asbestos RG-244

ULTRASONIC

Good dispersion of "Calidria" asbestos RG-244 in polyester laminating resins can be obtained with an "Econosonic" disperser operating at 300 psi pressure. Pressures above 300 psi tend to reduce viscosities. In general, "Calidria" asbestos RG-244 requires less energy for adequate dispersion than comparable concentrations of pyrogenic silica.

"COWLES" DISSOLVER

A "Cowles" dissolver can disperse "Calidria" asbestos RG-244 in 5 to 10 minutes at 3500 rpm, using a 3-in. impeller in a 3-quart container. Under these conditions a 1% loading can be mixed for 1 hour while a 2% loading can be stirred for 30 minutes without degrading. Large volumes of RG-244 can be dispersed easily by scaling up the equipment.

Union Carbide trial exhibit UC-863: Union Carbide Calidria Asbestos Product Brochures for Rubber, Resins, Thixot... Published by AsbestosClaims.Law
ACL Doc 16074 · Page 70 of 130 asbestosclaims.law/library/16074/70

Calidria® ASBESTOS

PRICE LIST

Effective: Jan. 4, 1982

RG-144 and RG-100

. . . a highly refined fiber used as a low-cost, efficient thixotrope and viscosity control agent in epoxy, phenolic, and similar resin compounds used in mastics, adhesives, sealants, caulks, and coatings. RG-144 is an open fiber, while RG-100 is pelletized for minimum dusting and improved handling. Pellets require high-shear mixing for adequate dispersion.

NET PRICES — CENTS PER LB. — F.O.B. SHIPPING POINT — SOLD ONLY IN FULL-PALLET MULTIPLES

SHIPPING POINTS	Carload	Truckload	6 to 16 pallets	1 to 5 pallets
King City, Calif. *(plant)*	40.0	41.0	48.0	55.0
Atlanta, Ga. Finderne, N.J. Hammond, Ind. *(warehouses)*	—	51.0	58.0	65.0

All prices subject to change without notice.
RG-100 is available only from King City plant.

PACKAGING INFORMATION

GRADE	Package Weight	Pallet Weight	Carload Weight	Carload Pallets	Truckload Weight	Truckload Pallets
RG-144	35 lb	1,400 lb.	72,800 lb.	52	23,800 lb.	17
RG-100	50 lb.	2,000 lb.	120,000 lb.	60	40,000 lb.	20

- Packages are shrink-wrapped at no extra charge.

TO ORDER . . . OR ASK A TECHNICAL QUESTION — call or write your nearest "Calidria" asbestos office below:
Northeast: P.O. Box 579, Niagara Falls, N.Y. 14302 — Tel.: 716-278-3371
South: 17 Executive Park Drive, Atlanta, Ga. 30329 — Tel.: 404-320-3595
Midwest: P.O. Box 579, Niagara Falls, N.Y. 14302 — Tel.: 716-278-3365
West: 100 Oceangate, Long Beach, Calif. 90802 — Tel.: 213-435-3721
Plant: P.O. Box K, King City, Calif. 93930 — Tel.: 408-385-5961

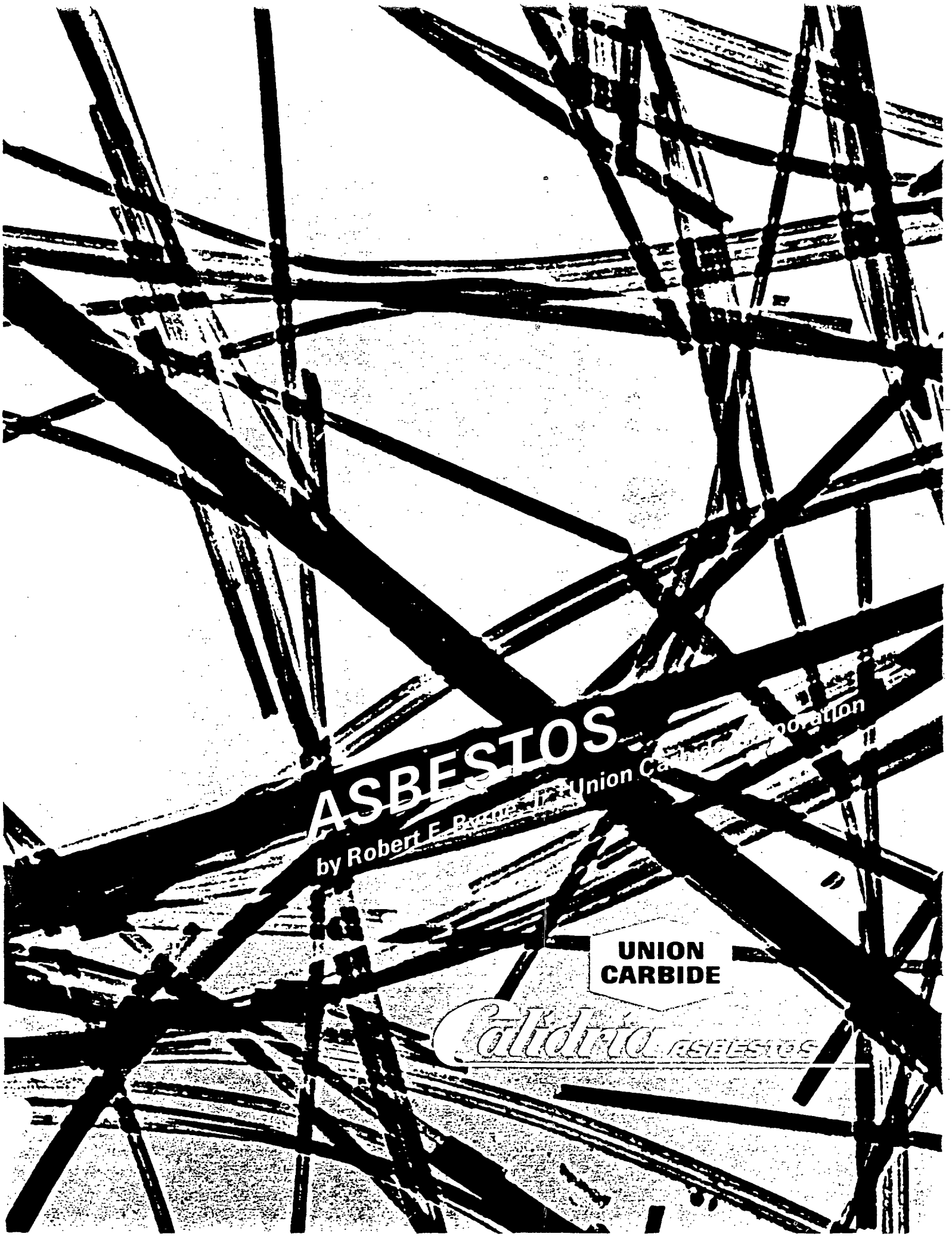
TRUCKLOAD PRICING is based on minimum quantities shown above. However, to facilitate compliance with DOT regulations, Union Carbide reserves the right to load trucks to full volume or weight capacity and to adjust customer orders accordingly.

COMBINED SHIPMENTS — Shipments of one or more pallets of any "Calidria" asbestos product may be combined with one or more pallets of any other "Calidria" product for total quantity price, based on the total number of pallets ordered.

IMPORTANT — Terms are net cash 30 days from invoice date. Prices apply within continental U.S.A. Union Carbide reserves the right to adjust customer's orders to comply with the ordering quantities shown above.

UNION CARBIDE CORPORATION • METALS DIVISION • OLD RIDGEBURY ROAD, DANBURY, CT 06817

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By Robert E. Byrne, Jr.*

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Asbestos is a commercial term used for six naturally occurring "asbestiform" minerals that are fibrous, hydrated metal silicates. They include the fibrous form of serpentine, known as chrysotile, and five minerals of the amphibole group: anthophyllite, crocidolite, actinolite, tremolite and amosite.

Chrysotile is the most plentiful and useful form of asbestos. Of the more than 2 billion lb. of asbestos used each year by the plastics industry, about 93% is chrysotile. Its positive surface charge, softness and flexibility, and its low refractive index set it apart from other asbestos. Chrysotile's fiber diameters, less than 0.03 micron, are the smallest among commonly known fibers, and the material has exceptional mechanical strength.

Commercial products based on chrysotile have been introduced which, by chemical modifications of the normal chrysotile fiber, have novel surface properties. These materials are used mainly for viscosity control in antisag and thixotropic applications.

Compared to chrysotile, amphibole fibers are larger in cross-section, harsh, and hard. The amphibole asbestos minerals are anionic in surface charge, and are more resistant to acids than is chrysotile.

Anthophyllite fibers usually occur as fibrous masses containing randomly oriented cubic blocks of fiber up to an inch in length. They are generally used in insulating materials, as filtering media, and as fillers in plastics, paints, and asbestos-cement products.

Crocidolite, or blue asbestos, is found principally in South Africa. Needle-like in structure and possessed of exceptionally high mechanical strength, it is used in plastics, where its pronounced color is not detrimental.

Tremolite and *actinolite* are very similar, except for the higher iron content of the latter. Both are in relatively short supply, and are used mainly as filter media or fillers. *Amosite* is a long yellowish-brown fiber that is harsh and brittle, and is used mainly in thermal insulation.

Low cost, exceptional mechanical strength, and heat resistance account for much of the increasing usage of asbestos in plastic products. It has recently been recognized that the unit chrysotile fibril is a naturally occurring reinforcing whisker. Because of its high strength, stiffness, and aspect ratio, it provides excellent whisker reinforcement. Maximum utilization of these reinforcing potentials, however, requires a high degree of fibril liberation and the absence of extraneous gangue material. Some caution is necessary in selecting a product providing the optimum in these characteristics.

Asbestos is usually graded on the basis of fiber lengths separated by dry screening. While the different grades cannot be precisely characterized by a specific length, grades 2 and 3 are the

*Area Manager, "Calidria" Asbestos, Marketing and Technology, Mining and Metals Div., Union Carbide Corp., P.O. Box 579, Niagara Falls, N.Y. 14302

Table I. Comparative properties of asbestos minerals

	Crysotile	Amosite	Crocidolite	Actinolite	Tremolite	Anthophyllite
Composition	$Mg_3Si_2O_5(OH)_4$	$Mg_7Si_8O_{22}(OH)_2$	$Na_2Fe_3Fe_2Si_8O_{22}(OH)_2$	$Ca_2Fe_5Si_8O_{22}(OH)_2$	$Mg_5Ca_2Si_8O_{22}(OH)_2$	$(Fe,Mg)_7Si_8O_{22}(OH)_2$
Crystal habit	Fine, easily separable fibers	Prismatic crystals and fibers	Long brittle fibers	Prismatic crystals and fibers	Prismatic crystals and fibers	Prismatic crystals and fibers
Color	White, gray, greenish	Gray-white	Blue	Green	White, gray-white, greenish	Ash gray or brown
Texture	Soft to harsh, also silky	Harsh	Soft to harsh	Harsh	Harsh	Harsh
Flexibility	Very good	Poor	Good	Poor	Poor	Good
Hardness, Mohs	2.5–4	5.5–6	4	6	5.5	5.5–6
Fiber dia., Å	180–300	600–900	600–900	600–900	600–900	600–900
Tensile strength, p.s.i.	300,000–800,000	<4,000	400,000–600,000	<1,000	1,000–8,000	100,000–200,000
Modulus of elasticity, p.s.i.	23.2×10^6	—	27.1×10^6	—	—	23.6×10^6
Fusion pt., ° F.	2770	2675	2180	2540	2400	2550
Specific heat, Btu/lb./° F.	0.266	0.210	0.201	0.217	0.212	0.193
Surface area BET, $m^2/g.$	10–60	7	10	—	—	9
Specific gravity	2.4–2.6	2.8–3.1	3.2–3.3	3.0–3.2	2.9–3.2	3.1–3.3
Refractive index (mean)	1.51–1.55	1.61	1.7	1.63	1.61	1.64
pH	9.5–10.3	9.4	9.1	9.5	9.5	9.1
Electric charge in aqueous slurry	Positive	Negative	Negative	Negative	Negative	Negative
Resistance to acids	Poor	Very good	Good	Fair	Good	Good
Resistance to alkalis	Good	Good	Good	Good	Good	Fair

Table II. Typical changes in resin properties with asbestos reinforcement

Material	% change				
	Flexural modulus	Flexural strength	Tensile strength	Impact notched Izod	Mold. sh.
ABS	+130	−20	−5	−60	+16
Nylon 6	+170	+100	+85	+20	+200
Phenolic	+120	+50	—	+5	—
Polyethylene	+320	+30	+20	0	+72
Polyphenylene sulfide	+60	+100	+10	+100	+35
Polypropylene	+360	—	−4	+125	+25
Polystyrene	+110	+50	+20	−40	+18

*Optimum reinforcement usually requires 20-40% short fiber asbestos.

longest fibers and grade 7 is the shortest. In general, the longer fibers are more expensive.

One of the few important nonmetallic minerals imported into the U.S. from foreign sources is asbestos. About 10% of our annual usage is produced from domestic sources with a value of over $10 million. The remainder comes mainly from Canada.

Asbestos selection

Asbestos short fiber is normally used for reinforcement, heat resistance, and flow control of plastics, while the longer grades are used for reinforcement and heat resistance in the form of fibers, yarns, or textiles. Chrysotile, as noted previously, is normally chosen for most applications because of its plentiful supply and product uniformity unless the special advantages of another mineral are required. For example, anthophyllite has been employed for reinforcing polypropylene because it allows easier heat stabilization. Recent reports, however, show that this disadvantage of chrysotile can be overcome. One of the amphiboles may be selected also where the poor resistance of chrysotile to acids presents a problem.

The use of short fiber asbestos in plastics products requires adequate dispersion to achieve optimum results. Melt processing is most satisfactorily accomplished in high-intensity mixers such as the Banbury. Dispersion in liquid resin systems also requires high shear devices and maximum viscosity to allow the resin/asbestos mix to absorb maximum energy. The masterbatch technique should be employed wherever practical.

Asbestos use

The largest uses for asbestos in plastics are vinyl/asbestos floor tile and in phenolic compounds. It is also used in myriad other areas including polypropylene, polyesters, nylons, melamines, epoxies, silicones, and vinyls. It is used in product types, including friction materials, heat resistant and electrical components, sealants, and mastics. The applications for asbestos are a balance of some combination of these effects. For example, short fiber chrysotile is used in vinyl asbestos floor tile to improve heat strength and dimensional stability, but requires that particular attention be given to heat stabilization of the resultant product mix during processing.

Since 1965, the consumption of asbestos-reinforced polypropylene by the automotive industry has increased rapidly. This trend toward the use of short fiber products for reinforcement is dependent on the inherent strength and fibril geometry of asbestos.

The volume of short fiber chrysotile used in mastics, sealants, and adhesives of various types is increasing. From 5 to 60% asbestos is used in adhesives to reduce crazing, shrinkage, and embrittlement. Asbestos also reduces cost, increases bulk, and provides controlled penetration and resistance to heat in such adhesives as phenolics, urea, resorcinol, epoxy, nitrile and reclaimed rubber, and silicones. In mastics and sealants, asbestos provides toughness, flow, and penetration control, as well as reduced cost. The colloidal grades of chrysotile are reported to contribute additional performance and handling improvements.

Polyester premixes used to fabricate automotive parts, tractor and marine engine housing, and materials-handling bins and containers often contain short fiber chrysotile to provide flow control, improve surface appearances, reduce shrinkage, and lower cost. The new low-profile systems utilize asbestos for controlled shrinkage, improved mechanical strength, and heat resistance.

The amount of asbestos needed varies with the particular resin system and the fiber length, and degree of openness of the asbestos. Each system has an optimum level for maximum mechanical strength. For example, in phenolics about 25% is typical for asbestos floats, or as low as 5% colloidal chrysotile. Asbestos content may vary up to 60%, however, depending on the levels of chemical, thermal and impact resistance, and the electrical properties desired. Asbestos-filled phenolic and urea formaldehyde resins find use in many electrical applications where heat resistance is required. Asbestos-filled polyester and diallyl phthalate compounds are also used in electrical applications. The asbestos-containing compounds enable molding with exceptional accuracy, molding-in metal inserts easily, and mass producing intricate shapes difficult to fabricate from other dielectric materials.

Phenolic/asbestos laminates used for rocket flame tubes are one example of the increased demand for asbestos-reinforced systems brought about by space age requirements for heat, chemical, and shock resistance.

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Calidria

ASBESTOS products for plastics

- Economical
- High Purity
- High Brightness
- Low Moisture
- Less Dust

CALIDRIA Asbestos [illegible]

a chemically [illegible] high-purity [illegible] mineral coating

- for maxmum thickening efficiency and thixotropy in polyester spray-up and hand lay-up laminating resins and gel coats.
- effective thickener for plastisol and organosol adhesives, coatings, mastics, and sealants as well as epoxy and phenolic adhesives.

Advantages:

- Permits high viscosity at low loadings, reducing costs.
- Wets out quickly and disperses easily.
- Improves shelf life, reduces settling.
- Does not add color or opacity at normal loadings.
- Reduces dusting from material-handling operations.

CALIDRIA Asbestos RG-144

[illegible] asbestos fiber without coating

- efficient, low-cost thickener and thixotrope for epoxy, vinyl, and phenolic resins; butyl, polysulfide, and other sealants; and casein adhesives.
- excellent reinforcer for rigid vinyl, nylon, polysulfone, and similar compounds.

Advantages:

- Thickens both epoxy resins and amine hardeners at 1/6 the cost of pyrogenic silica.
- Wets out quickly and disperses easily.
- Has no shear sensitivity.
- Improves shelf life, reduces settling.
- Reduces dusting from material-handling operations.
- Eliminates need for viscosity build-up or thixotropic stabilization additives (except for low viscosity, cycloaliphatic epoxides).

For further information on this "new approach" to thickening and thixotropy, contact your nearest Union Carbide sales office, listed on the back cover.

UNION CARBIDE

THE DISCOVERY COMPANY

Any of our offices below will be glad to give you complete information on properties, applications, and prices of "Calidria" asbestos.

Marketing

Niagara Falls, New York 14302	P. O. Box 579	716-285-3311

Plant

King City, California 93930	P. O. Box K	408-385-5961

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THE DISCOVERY COMPANY

UNION CARBIDE CORPORATION
MINING AND METALS DIVISION
270 PARK AVENUE, NEW YORK, N. Y. 10017

F-72-0061
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UNION CARBIDE THE DISCOVERY COMPANY

Calidria ASBESTOS

"CALIDRIA" ASBESTOS SG-130 AND SG-210
For Tape Joint Compounds

Lowers Costs Two Ways

CALIDRIA Asbestos acts as a bodying and secondary thickening agent permitting formulation of lower density, more economical tape joint compounds without the sacrifice of performance. CALIDRIA Asbestos is produced by a proprietary manufacturing process that yields unusually high fiber content and more complete fiber liberation from the natural bundles. As a result, CALIDRIA Asbestos goes up to twice as far, pound for pound, as commercial grades of asbestos containing large amounts of other filler materials that have no specific desirable effects on tape joint compound properties.

Reduces Cracking

The fibers of CALIDRIA Asbestos behave as an active lyophobic colloid in aqueous dispersion; by this mechanism CALIDRIA Asbestos increases tape joint compound liquid cohesive strength during drying. Increased liquid cohesive strength greatly reduces the tendency for cracks over nail holes, in thick sections at the center of the joint, and along the feathered edges.

Enhances Sandability

CALIDRIA Asbestos contains mainly chrysotile fiber and is essentially free from abrasive contaminants, such as magnetite and serpentine rock dust. This composition results in a low density product, free from contaminants that interfere with sanding.

Improves Uniformity

Narrow and well-controlled particle size distribution, low alkalinity and high brightness are characteristic of CALIDRIA Asbestos. These properties are consistent from batch to batch and improve the uniformity of tape joint compounds using CALIDRIA Asbestos.

Suggestions for Use of CALIDRIA Asbestos

CALIDRIA Asbestos can be readily used in your present tape joint compound formulation. Add approximately one-half the proportion of asbestos you now use. Increase the proportion of calcium carbonate or other inert filler to make up for the lower quantity of asbestos. You may also be able to use slightly more water in your ready-mix and maintain your present viscosity level. No other changes in your

October, 1968
F-42258

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Suggestions for Use of CALIDRIA Asbestos (Continued)

formulation or manufacturing procedure are required.

CALIDRIA Asbestos SG-130 has the coarser particle size; it finds use for bedding compounds or perhaps spackling compound. The SG-210 has the finer particle size and is favored for topping compounds, all-purpose compositions, texture paints, and similar formulas.

A Suggested Ready-Mix Tape Joint Compound For Use With CALIDRIA Asbestos

	Parts by Weight Dry Basis
Fillers:	
Calcium Carbonate, No. 1 White (Thompson Weinman)	61.42
Mica, P80F (Western Mica)	21.00
Clay, ASP-400 (Minerals and Chemicals Philipp Corp.)	4.00
CALIDRIA Asbestos, SG-210 (Union Carbide)	4.58
Binder:	
UCAR Latex 131 (Union Carbide)	6.60*
Workability Control Agent:	
CELLOSIZE Thickener, TJC Grade (Union Carbide)	0.50
Drying Control:	
Ethylene Glycol (Union Carbide)	1.00
Defoamer:	
"Nopco" PD-1 (Nopco Chemical Company)	0.10
Dispersant:	
"Daxad" 30 (Dewey & Almy Chemical Div.)	0.60*
Bacteriastat:	
"Dowicide" A (Dow Chemical Co.)	0.20
	100.00

Total Water: about 56 parts by weight per 100 parts dry solids

*Contained solids basis

Union Carbide trial exhibit UC-863: Union Carbide Calidria Asbestos Product Brochures for Rubber, Resins, Thixot... Published by AsbestosClaims.Law
ACL Doc 16074 · Page 79 of 130 asbestosclaims.law/library/16074/79

Typical Product Characteristics

	CALIDRIA Asbestos	
	SG-130	SG-210
Reflectance (G.E. Photovolt)	68%	
Contained magnetite	2% max.	
Alkalinity (as % of Na_2O)	0.05 to 0.06	
pH (5% aqueous slurry)	8.5 to 9.5	
Surface area (BET)	50 to 60 m^2/g.	
Oil Adsorption (DOP #/100# asbestos)	90 to 100	110 to 120
Wet Bulk, settled vol. (ml.) 10g/250 ml./1 hr.	200	220
Dry Bulk (#/$ft.^3$)	7 to 8	5 to 6
Water absorption (wt. % in filter cake)	55 to 60	62 to 65
Size distribution (cumulative % retained)		
Wet Screen mesh size		
100	5	Trace
200	17	3
325	28 to 32	10 to 15

Packaging and Shipping Information

Product Form – Opened (finely ground) chrysotile asbestos fiber.

Packaging –

	CALIDRIA Asbestos	
	SG-130	SG-210
One Package	40 lb.	30 lb.
Pallet Weight		
Carload	1,600 lb.	1,050 lb.
Truckload	2,000 lb.	1,500 lb.

Shipping –
Classification – asbestos shorts
Rail point of origin – Welby, California (King City, California)

TOXICOLOGICAL PROPERTIES

It has been known for many years that some persons working in asbestos production were prone to develop a disabling lung disease. In time, this condition became known as asbestosis and was related to exposure to high concentrations of asbestos dust. With further experience, it was found that men could work with asbestos without development of lung disease if dust concentrations were kept below a certain level. It is now generally accepted that a man can work a 40-hour week for a lifetime without developing asbestosis if the asbestos dust particle count is kept at or below 5 million particles per cubic foot of air. This dust concentration of 5 million particles per cubic foot of air is the Threshold Limit Value for asbestos, and no cases

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ACL Doc 16074 · Page 80 of 130 asbestosclaims.law/library/16074/80

TOXICOLOGICAL PROPERTIES (Continued)

of asbestosis are believed to have occurred when exposures have been maintained at or below this level, despite large-scale utilization (now approaching one million tons per year in the U.S.A.). This concentration of dust is generally not visible in the average work area unless a beam of light causing a Tyndall effect is present. Usually the dust concentration must be from 8 - 10 million particles per cubic foot before its presence is visible in average lighting conditions.

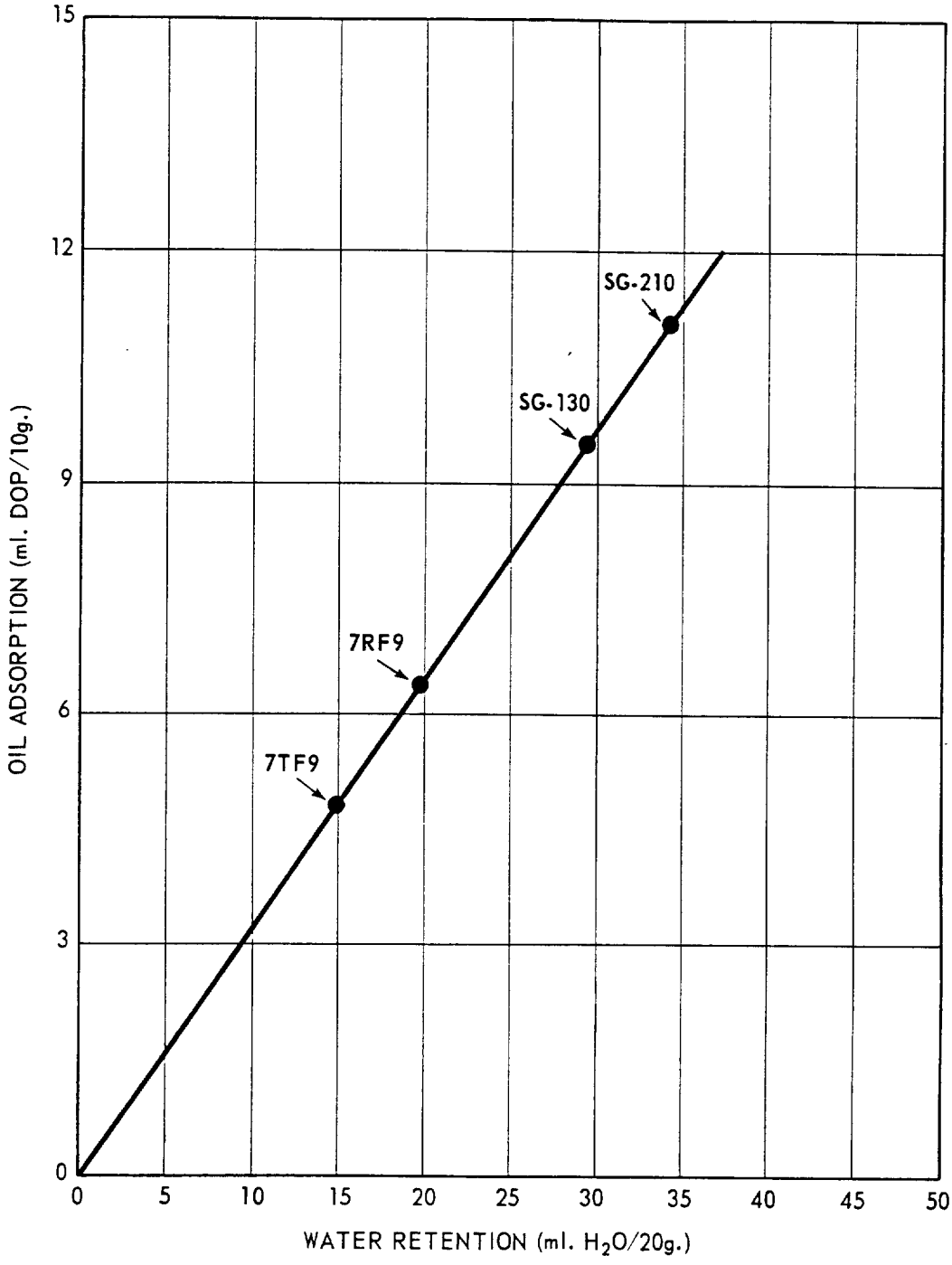
Several years ago, it was reported that there was an increase in the incidence of cancerous tumors, especially of the lung, associated with asbestosis. Recently there have been reports of some cancers occurring in individuals exposed to asbestos dust, but who have not developed clinical asbestosis. It is believed by most authorities that these cases have been associated with exposures significantly exceeding the Threshold Limit Value. A major manufacturer of asbestos products who also mines asbestos has not been able to show an increase in cancerous growths in men working where dust concentrations were maintained at the Threshold Limit Value.

Control of asbestos dust exposure is therefore necessary. The control methods are the standard ones applicable to a variety of dusty operations. They include closed flow systems, wet processes where possible, and adequate exhaust ventilation where openings in the system are necessary. Pelletizing is sometimes used to improve the handling characteristics of otherwise dusty materials. Where satisfactory containment to stay within the Threshold Limit Value is impractical or impossible, efficient and reliable respirators are available for the protection of the employee. A program of environmental monitoring in manufacturing operations is highly desirable to determine that Threshold Limit Values are not being exceeded. Employees should wear respirators where dusting occurs in finishing products such as sanding taped joints.

Pre-employment and periodic physical examinations of workers are desirable. These should include chest X-rays to insure that the worker has no chest condition prior to work with asbestos and to determine that no lung changes are resulting from work with asbestos.

In conclusion, while asbestos dust in excess of the Threshold Limit Value is potentially harmful, as are many other dusts encountered in industry, it is as readily controlled as other such dusts and it can be used safely with appropriate precautions.

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RELATIONSHIP BETWEEN WATER & OIL ADSORPTION CAPACITY OF SOME ASBESTOS PRODUCTS FOR TAPE JOINT ADHESIVE FORMULATIONS

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ACL Doc 16074 · Page 82 of 130 asbestosclaims.law/library/16074/82

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	TULSA, OKLAHOMA 74114	2901 South Harvard	918-742-5524

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Calidria

ASBESTOS products for plastics

* Economical
* High Purity
* High Brightness
* Low Moisture
* Less Dust

CALIDRIA Asbestos RG-244

a chemically modified, high-purity fiber with a mineral coating

- for maxmum thickening efficiency and thixotropy in polyester spray-up and hand lay-up laminating resins and gel coats.
- effective thickener for plastisol and organosol adhesives, coatings, mastics, and sealants as well as epoxy and phenolic adhesives.

Advantages:

- Permits high viscosity at low loadings, reducing costs.
- Wets out quickly and disperses easily.
- Improves shelf life, reduces settling.
- Does not add color or opacity at normal loadings.
- Reduces dusting from material-handling operations.

CALIDRIA Asbestos RG-144

a high-purity asbestos fiber without coating

- efficient, low-cost thickener and thixotrope for epoxy, vinyl, and phenolic resins; butyl, polysulfide, and other sealants; and casein adhesives.
- excellent reinforcer for rigid vinyl, nylon, polysulfone, and similar compounds.

Advantages:

- Thickens both epoxy resins and amine hardeners at 1/6 the cost of pyrogenic silica.
- Wets out quickly and disperses easily.
- Has no shear sensitivity.
- Improves shelf life, reduces settling.
- Reduces dusting from material-handling operations.
- Eliminates need for viscosity build-up or thixotropic stabilization additives (except for low viscosity, cycloaliphatic epoxides).

For further information on this "new approach" to thickening and thixotropy, contact your nearest Union Carbide sales office, listed on the back cover.

UNION CARBIDE

THE DISCOVERY COMPANY

AU3607

Asbestos beefs up plastics and adhesives to extend their use



Highway markers are bonded with inexpensive, asbestos-modified adhesives. Two components are mixed and dispensed from cart before applying reflectant.

The first single-crystal whiskers to be used by man were asbestos. Since the whiskers' high strength was first measured in a laboratory, scientists have been trying to find ways to harness the potential of asbestos in structural materials.

The tensile strength of single crystals of asbestos has been measured at more than 800,000 psi—as strong as the strongest glass filaments. But so far, strengths achieved in composites do not go beyond those achieved with glass-mat reinforcements.

The thorn to date. One of the chief drawbacks of asbestos has been the inability of researchers to incorporate homogeneously more than 10% to 20% asbestos with structural resins. With only 4% or 5%, resin mixtures become unmanageably viscous.

But this very deficiency is being turned to advantage by Union Carbide chemists, who have developed a number of thixotropic uses for their new resin-grade of chrysotile asbestos. The Union Carbide material, because of its high purity and fine particle size, is easier to incorporate in resinous compounds. Union Carbide's filler is cheaper than other thixotropic agents.

Opening new fields. Union Carbide mines an area in California. Asbestos was discovered there just a few years ago, and it is believed to be the largest source of high-purity asbestos ore in the world. The extra-high purity of this grade has opened up a whole new range of uses for asbestos.

An important difference in the California grade of asbestos is its random orientation, which permits the wet-processing system. Wet-processing breaks up individual fibers into easy-to-handle dust-free pellets. The separation of fibers yields a more efficient reinforcing effect in resin-based products.

Another application for asbestos is as a reinforcement for thermoplastics. Adding 20% asbestos to Nylon 6 doubles both the flexural and tensile strength of the unreinforced material. The increase matches the strength improvement obtained with chopped-glass fibers.

Saving money. Most other applications for the new grade of asbestos have been in viscosity-control uses such as with epoxy and polyester compounds. Of course, some reinforcing effect also results.

For example, traffic-marker adhesives based on epoxy resins have been made 60¢ to 70¢/lb. cheaper by using the asbestos thickener.

About 30 gm of adhesive are used by the State of California's Highway Dept. in putting down round-button pavement markers. About 3 million of these markers will be applied by the end of this year: The use of asbestos has added up to some important savings for the California tax payer. **(2.127)**

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AU3603

Reprinted from

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PAINT and VARNISH PRODUCTION

FEBRUARY 1971

Resin-Grade Asbestos Boosts Thixotropic Qualities of Epoxies

Based on the results of a year-long series of laboratory and in-the-field tests, Sta-Crete, Inc., San Francisco, Calif., is now using a resin-grade asbestos instead of pyrogenic silica as the standard thixotrope in most of its epoxy coatings.

Jane A. Black, president of Sta-Crete, reports that the company has found that the asbestos, manufactured by Union Carbide Corp., New York, N.Y., offers many important processing advantages. "It is simpler to handle," she said, "and dispersion is easier, using either high or low speed mixing equipment. In addition, a dusting problem that prevailed with silica was eliminated. We are no longer concerned with particles floating in the immediate area when the thixotrope is dumped into the mixing tank.

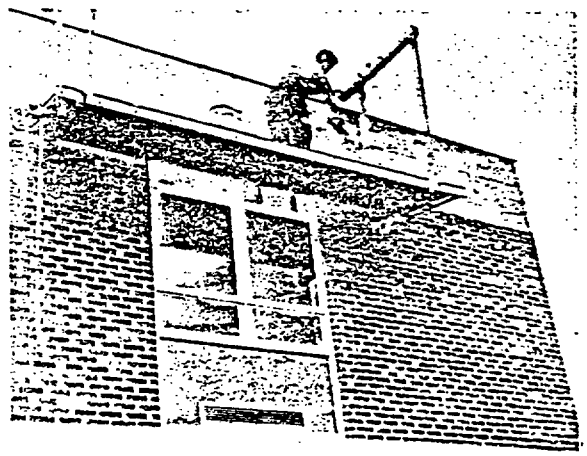
"Another benefit gained," Miss Black continued, "is improved economy. The asbestos costs about 75 per cent less than the silica."

In actual use, coatings with the asbestos additive reportedly have better consistency and improved thixotropic properties. As a result, the coatings can have lower viscosity but still offer good sag resistance for vertical surface applications.

The effectiveness of Sta-Crete's coatings in this type of application was shown in the use of a new epoxy coating as an exterior facing on a new high school building in Summerville, S.C. The coating was specifically formulated around a particular form of resin-grade asbestos, Union Carbide's Calidria Asbestos, Resin-Grade 144.

The contractor, Ed Scarpa, of Charleston Tile & Marble Co., Charleston, S.C., pointed out that the coating was not gritty or sandy and did not contain any lumps or other undesirable aggregates that could hinder mixing or application of the two-part material. Installation involved troweling the coating onto the masonry surface. Because of its high thixotropy, the facing had sufficient flow to permit easy, uniform application with no run-off.

Sta-Crete found that the coating offered a number of other advantages. The material is applied in place rather than being installed as a prefabricated panel. As a result, the contractor did not have to be concerned with joint alignment or masonry plumb errors, two conditions that would have required costly, time-consuming corrections or adjustments. Use of the coating, Mr. Scarpa estimated, lowered material and installation costs for the 12,000-square-foot epoxy facing to about 50 per cent less than what would have been incurred with other facings.



A workman trowels the epoxy coating onto the masonry surface of the new Summerville High School in Summerville, S.C. Because of its high thixotropic qualities, the material had sufficient flow to permit easy, uniform application.

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A03609

Resin-Grade Asbestos Improves Thixotropic Properties of Highway Marker Adhesive

Reprinted from ADHESIVES AGE, March 1969

By specifying resin-grade asbestos as the viscosity control agent for epoxy-based adhesives used to affix button lane markers on California highways, the state's Division of Highways eliminated an adhesive storage stability problem that had prevailed with previous thixotropes.

In California, pavement markers are installed on most state highways in accordance with a state law enacted a number of years ago. Designed to replace striping, the raised markers are used to delineate traffic lanes, especially at night and during wet weather. Since every ninth marker is reflectorized, lane differentiation is accomplished primarily by visual means. The raised markers also give an audible sound as a vehicle rides over them.

An average of 30 grams of adhesive is used per button, but the amount varies depending upon marker shape — round or square — and on the type and condition of the pavement. Although about three million button markers were applied in 1968, the program will continue for several more years before all California roads will be equipped as prescribed.

All adhesives used are pre-tested by the highway division's test laboratory, placed in specific inventory, and released to contractors by state inspectors at the time of application. In many instances, storage time is quite extensive, sometimes under temperatures that reach 115° F. or higher. Under these circumstances, the viscosity and thixotropy achieved by the use of colloidal silica in the "A" or epoxy resin component is unstable and loss is excessive and quite rapid. When this instability occurred it resulted in adhesive rejects or in critical runoff during application that left insufficient resin to assure a proper bond.

To improve these characteristics, the state highway division sought a thixotrope that would extend shelf life without any effect on adhesive performance or structural strength.

After testing several different materials, the laboratory found that a resin-grade asbestos, such as Union Carbide Corporation's Calidria Asbestos, Type R-G 144, best met the storage stability requirements stipulated in state specifications covering pavement markers and their adhesives. Under these regulations, the adhesive could not change in viscosity and shear index by more than plus or minus 15 per cent when stored for two weeks in closed containers at 115° F., ± 3° F.

Resin-grade asbestos proved acceptable in all oven-aged stability tests and in all viscosity and thixotropy measurement tests. The results showed little or no drop in viscosity, resulting in a highly stable adhesive that had an excellent shelf life.

Significant processing advantages also are offered. For example, the asbestos is less costly than other thixotropes, with an average reduction of about 60 to 70 cents per pound. Processing costs also are lower because comparatively smaller amounts of asbestos are required. In addition, resin-grade asbestos is easier to store, handle and disperse. Its excellent shear strength eliminated the need for polar additives. Because of these improvements, processors are now assured of producing adhesives with consistent viscosities that do not drop even after prolonged storage under high heat.



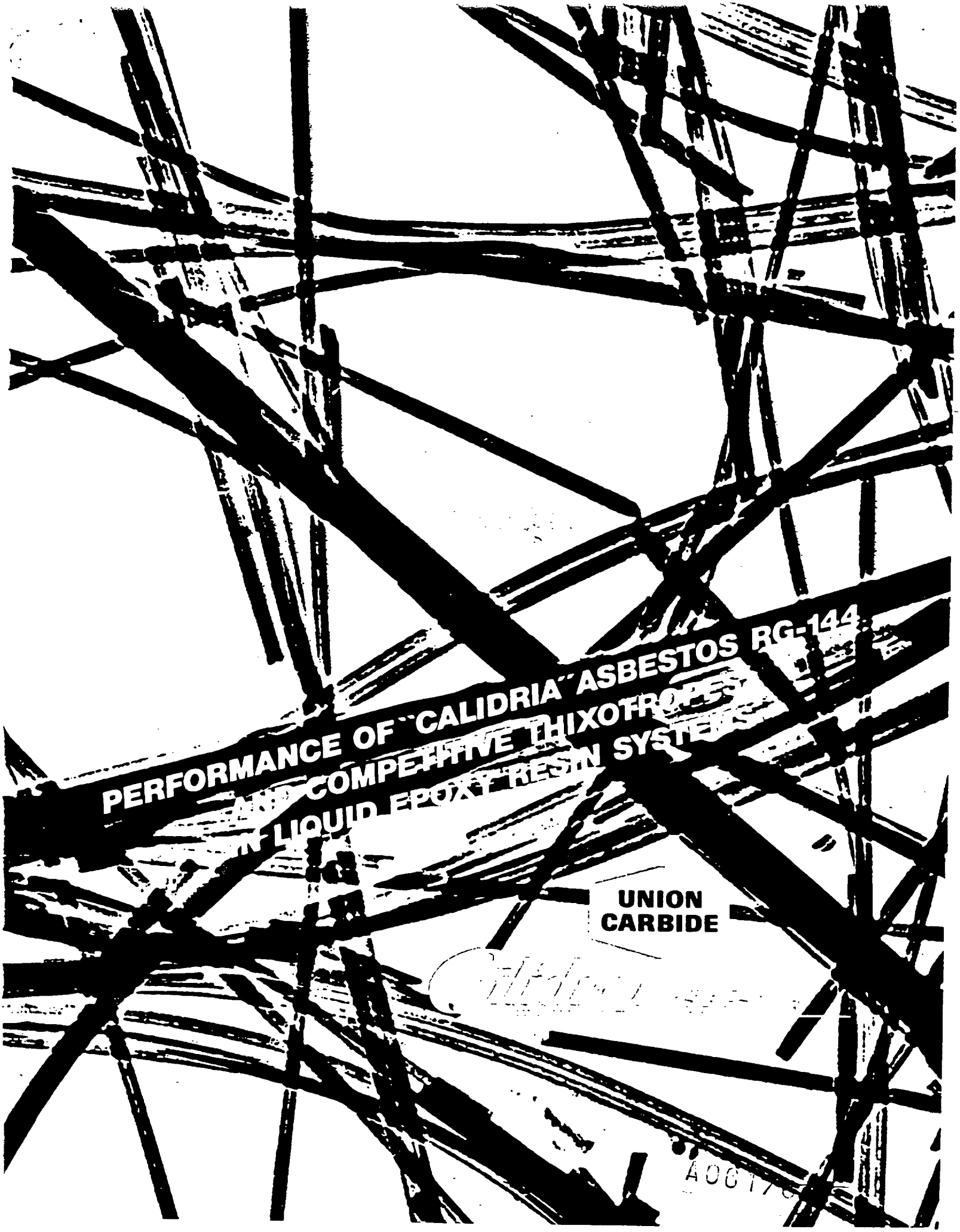
On the left a predetermined amount of adhesive is applied to specific locations on road surface with truck-mounted meter-mix and dispense equipment. On the right a button marker is hand applied on the prepared spot. The thixotropic properties of resin-grade asbestos keep adhesive viscosity constant, assuring no runoff during application.

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PERFORMANCE OF *CALIDRIA* R-G 144 AND COMPETITIVE THIXOTROPES

in Liquid Epoxy Resin Systems

CALIDRIA R-G 144 Asbestos is a highly purified fiber product that is an effective, low-cost thickening agent and thixotrope for epoxy resin systems. Produced by UNION CARBIDE's proprietary process, an unusually high fiber content is obtained, that is both grit-free and non-abrasive.

Comparative evaluations have shown that up to 50 per cent less CALIDRIA R-G 144 Asbestos is required than other commonly used thickeners, to provide equivalent viscosity and thixotropic properties, in liquid epoxy resin systems. Because CALIDRIA Asbestos is much lower in price, its cost-performance is outstanding.

Figures 1 and 2 compare the relative differences in viscosity and thixotropy of BAKELITE Epoxy Resin ERL-2774 solutions containing equivalent concentrations of CALIDRIA R-G 144 Asbestos, micro-crystalline silicate, and pyrogenic silica.

The superiority of CALIDRIA R-G 144 is again indicated, as shown in Figures 1 and 2, in that its use does not require amine-type additives usually recommended with the use of pyrogenic silicas.

Figures 3 and 4 show the superior performance of CALIDRIA R-G 144 Asbestos in BAKELITE Resin Hardener ZZL-0814, in comparison with equivalent mixtures of micro-crystalline silicate and pyrogenic silica.

RESIN AND AMINE HARDENER EVALUATION

In preparing test samples used in determining data for the following graphs, the thixotropes were 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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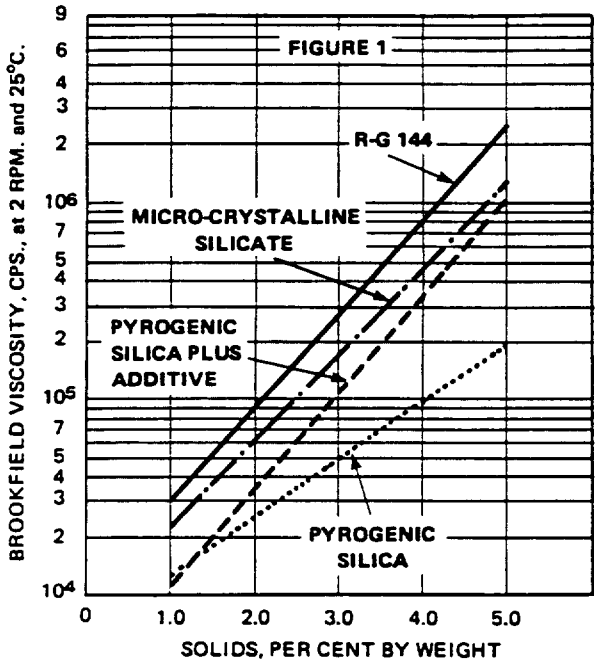
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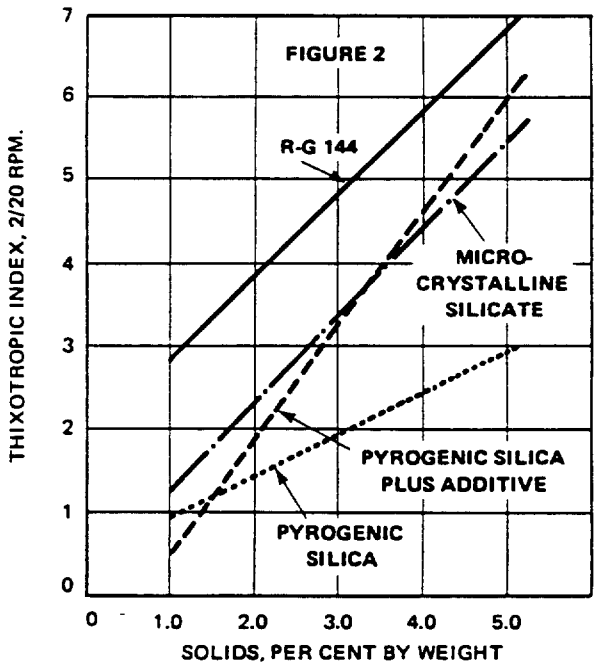
PERFORMANCE OF *CALIDRIA* R-G 144 AND COMPETITIVE THIXOTROPES

in Liquid Epoxy Resin Systems

FIGURES 1 AND 2

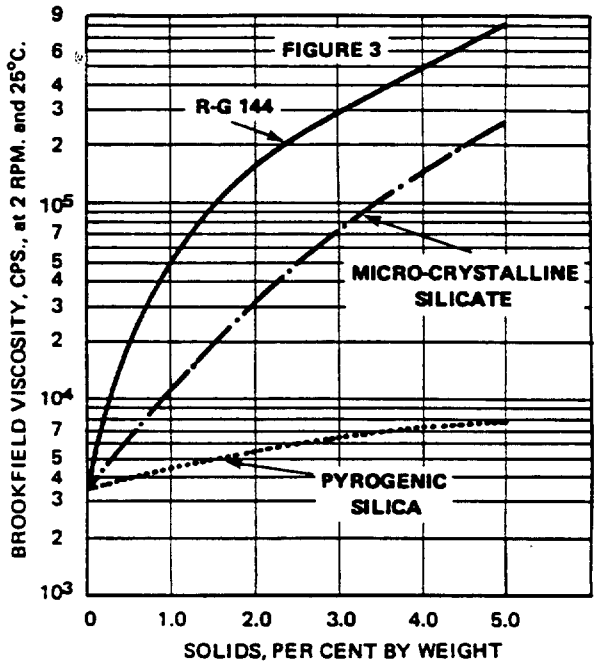
COMPARISON OF VISCOSITY AND THIXOTROPY OF BAKELITE® EPOXY RESIN ERL-2774 SOLUTIONS CONTAINING EQUIVALENT CONCENTRATIONS OF *CALIDRIA* R-G 144 ASBESTOS, MICRO-CRYSTALLINE SILICATE, AND PYROGENIC SILICA

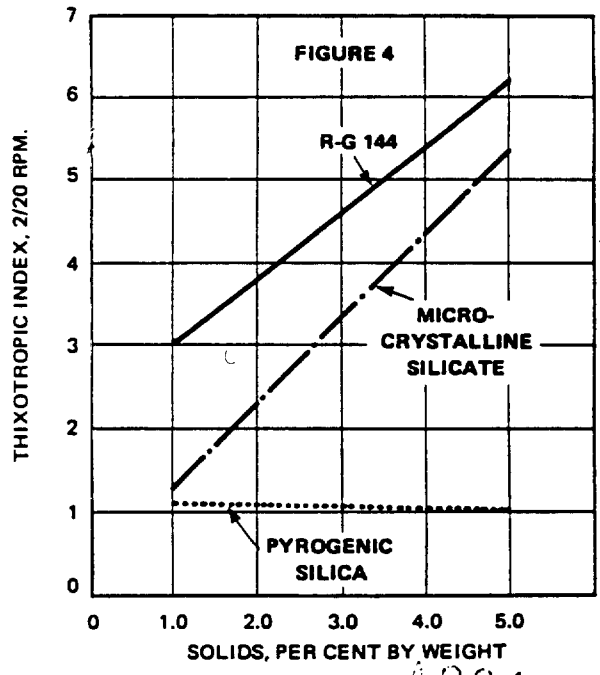




FIGURES 3 AND 4

PERFORMANCE OF *CALIDRIA* R-G 144 ASBESTOS IN BAKELITE® RESIN HARDENER ZZL-0814 COMPARED WITH EQUIVALENT MIXTURES OF MICRO-CRYSTALLINE SILICATE AND PYROGENIC SILICA





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Calidria ASBESTOS

CALIDRIA RESIN-GRADE ASBESTOS FOR VINYL PLASTISOL SEALANT APPLICATIONS

F-42804

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CALIDRIA RESIN-GRADE ASBESTOS FOR VINYL PLASTISOL SEALANT APPLICATIONS

GENERAL

CALIDRIA Asbestos Resin-Grade products, R-G 144 and R-G 244 are effective, economic viscosity control agents for vinyl plastisol sealants.

- R-G 144 is an economical highly purified fiber product which is grit-free and non-abrasive.
- R-G 244, a modified fiber, was developed for maximum thixotropy in various resin systems.

TYPICAL PHYSICAL PROPERTIES

Property	*CALIDRIA* ASBESTOS	
	R-G 144	R-G 244
Specific Gravity	2.45	2.45
Moisture Content, % by wt.	2.0, max.	2.0, max.
Surface Area, sq. meters per gram	60, appr.	60, appr.
Reflectance, G. E. Brightness	72-76	80-84
Nature of Surface Charge in Water Slurry	Cationic	Neutral
Oil Absorption (DOP), lb. per 100 lb.	120-140	300-350
Refractive Index, n_D 25°C.	1.54-1.56	1.54-1.56
Dry Bulk Density (Aerated), lb./cu. ft.	4	1
Packaged Bulk Density, lb./cu. ft.	17	5
Standard Package Weight, lb.	35	10
% Magnetite, maximum	0.6	0.3
Fiber Diameter, microns	0.025	0.025
Length/Diameter	200, avg. (1000, max.)	200, avg. (1000, max.)

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SEALANT EVALUATION

CALIDRIA R-G 144 and R-G 244 provide excellent anti-sag resistance in both low (approx. 275-375°F.) and high (greater than 350°F.) fusion temperature plastisol sealants. Since CALIDRIA R-G products do not detract from inherent plastisol adhesion, formulations shown provide excellent adhesion as well as desired viscosity control. Typical formulations together with performance data on each are shown in the following tables:

TABLE 1

HIGH FUSION TEMPERATURE STRUCTURAL SEALANT (with CALIDRIA R-G 244)

Formulation	Parts by Weight
BAKELITE QYOH-2 Resin	100
FLEXOL Plasticizer 10-10	60
FLEXOL Plasticizer 10A	40
EX-1 Extender Plasticizer	10
Barium-Cadmium Stabilizer	2
UNION CARBIDE Silane Y-5162 Adhesion Promoter	0.25
Calcium Carbonate	130
CALIDRIA R-G 244 Asbestos	5
Test Data	
Butt tensile adhesion to cold-rolled steel after 45 minutes cure at 350°F.	440 psi.
Severs Type Flow Properties Binks orifice (1/8 inch) Time of test, 150 seconds	Grams at 40 psi., Aged 24 hr. at Room Temperature . . . 63 72 hr. at 130°F. . . . . 76 45 days at Room Temperature . . 73
Shore Hardness, A scale after 24 hr. at Room Temperature	76

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ACL Doc 16074 · Page 94 of 130 asbestosclaims.law/library/16074/94

SEALANT EVALUATION

CALIDRIA R-G 144 and R-G 244 provide excellent anti-sag resistance in both low (approx. 275-375°F.) and high (greater than 350°F.) fusion temperature plastisol sealants. Since CALIDRIA R-G products do not detract from inherent plastisol adhesion, formulations shown provide excellent adhesion as well as desired viscosity control. Typical formulations together with performance data on each are shown in the following tables:

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EX-1 Extender Plasticizer	10
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UNION CARBIDE Silane Y-5162 Adhesion Promoter	0.25
Calcium Carbonate	130
CALIDRIA R-G 244 Asbestos	5
Test Data	
Butt tensile adhesion to cold-rolled steel after 45 minutes cure at 350°F.	440 psi.
Severs Type Flow Properties Binks orifice (1/8 inch) Time of test, 150 seconds	Grams at 40 psi., Aged 24 hr. at Room Temperature . . . 63 72 hr. at 130°F. . . . . 76 45 days at Room Temperature . . 73
Shore Hardness, A scale after 24 hr. at Room Temperature	76

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ACL Doc 16074 · Page 95 of 130 asbestosclaims.law/library/16074/95

TABLE 2
HIGH FUSION TEMPERATURE STRUCTURAL SEALANT
(with CALIDRIA R-G 144)

Formulation	Parts by Weight
BAKELITE QYOH-2 Resin	90
BAKELITE QYPM Resin	10
FLEXOL Plasticizer 10-10	60
FLEXOL Plasticizer 10-A	40
EX-1 Plasticizer Extender	10
"Duramite" Filler[a]	120
"Mark" LL Stabilizer[b]	2
UNION CARBIDE Y-5162 Silane Adhesion Promoter	0.5
CALIDRIA R-G 144 Asbestos	10

[a] Thompson, Weinman & Co.
[b] Argus Chemical Co.

Test Data		
Bead seal on cold-roll steel after aging 24 hours, cured 15 minutes at 350°F.	Excellent Adhesion	Cohesive Failure
Bead seal on cold-roll steel adhesion after aging 43 days at room temperature plus 3 days at 130°F., cured 15 minutes at 350°F.	Excellent Adhesion	Cohesive Failure
Severs Type Flow Properties Binks orifice (1/8 inch) Time of test, 150 seconds	Grams at 40 psi., Aged 24 hr. at Room Temperature . . . 21 72 hr. at 130°F. 21	
Shore Hardness, A Scale after 24 hr. at Room Temperature 86		

In Table 3, a typical appliance-type sealant is shown. This formula is similar to the structural sealant outlined in Table 2. The appliance compound does not require the high strength of the structural sealant; however, sag resistance over a wide temperature range and excellent adhesion are extremely important in the appliance-type system. The added filler content of the appliance compound creates an added viscosity problem that is easily adjusted by the addition of more BAKELITE QYPM Plastisol Blending Resin. Table 3, also lists some performance characteristics of the appliance sealant. In addition to those properties shown in Table 3, the appliance type sealant has passed two mandrel

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ACL Doc 16074 · Page 96 of 130 asbestosclaims.law/library/16074/96

bend tests. A 1/4-inch high by 3/8-inch wide bead seal was drawn down on a "Bonderite" 1000 steel panel. The bead was baked 45 minutes at 350°F. After a 24-hour room temperature aging, the panel was bent around a 1-inch mandrel. A knife cut was made through the bead at the point of highest stress. After seven days, the sealant had not pulled loose from the panel. The same sealant bead size panel type and bake cycle were used to bend over a 3-inch mandrel after the panel had been aged one hour at -20°F. No cut was made in this test. After the -20°F. bend was made, no pulling away or cracking of the sealant was evident.

TABLE 3
APPLIANCE SEALANT

Formulation	Parts by Weight
BAKELITE QYOH-2 Resin	75
BAKELITE QYPM Resin	25
FLEXOL Plasticizer 10-10	110
"Duramite" Filler[a]	200
"Mark" LL Stabilizer[b]	2
UNION CARBIDE Y-5162 Silane Adhesion Promoter	0.5
CALIDRIA R-G 144 Asbestos	2

[a] Thompson, Weinman & Co.
[b] Argus Chemical Co.

Test Data	Adhesion	Type of Failure	Degree of Sag
3/16-inch bead seal on cold-roll steel, cured 10 minutes at 350°F.	Excellent	Cohesive	None
1/2-inch rectangular bead seal, baked vertically at:[c]			
270°F. for 20 minutes	Poor	Adhesive	None
350°F. for 45 minutes	Excellent	Cohesive	None
400°F. for 30 minutes	Excellent	Cohesive	None
Severs Type Flow Properties Binks orifice (0.051 thousandth) Time of test, 30 seconds	Aged 24 hr. at Room Temperature Grams at 20 psi. 2.5 Grams at 40 psi. 7.0 Grams at 60 psi. 12.6		

[c] Adhesion and sag tests run on cold roll. "Bonderite" 100 and "Bonderite" 1000.

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ACL Doc 16074 · Page 97 of 130 asbestosclaims.law/library/16074/97

Table 4 includes a typical formulation for a low fusion temperature plastisol sealant containing CALIDRIA R-G 144. This formulation, which exhibits excellent sag resistance, can be used in automotive drip rail sealer applications or in other areas where waterproofing and adhesion are required.

TABLE 4
LOW FUSION TEMPERATURE PLASTISOL SEALANT

Formulation	Parts by Weight
BAKELITE VLFV Resin	90
BAKELITE QYPM Resin	10
FLEXOL Plasticizer 10-10	60
FLEXOL Plasticizer 13-13	10
FLEXOL Plasticizer Z-88	40
EX-1 Extender Plasticizer	15
"Mark" LL[a] Stabilizer	2
"Duramite" Filler [b]	120
UNION CARBIDE Y-5162 Silane Adhesion promoter	0.5
CALIDRIA R-G 144 Asbestos	10

[a] Argus Chemical
[b] Thompson, Weinman & Co.

Test Data		
Severs Type Flow Properties Binks orifice (1/8 inch) Time of test, 150 seconds	Grams at 40 psi., Aged 24 hr. at room Temperature . . . 275 3 days at 130°F. 110	
Bead seal on cold-rolled steel, 20 minutes at 300°F.	Excellent Adhesion	Cohesive Failure

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FIGURE 1 — ILLUSTRATION OF SAG RESISTANCE



**COLD ROLL STEEL
FUSED - 15 MINUTES
AT 350° F.**

**COLD ROLL STEEL
FUSED - 20 MINUTES
AT 350° F.**

Figure 1 shows sag resistance and, although it is difficult to see, the coating of sealant left on the panel after attempts to remove the bead with a razor blade. In both the high fusion temperature plastisol sealant shown in Table 1 and the low fusion temperature system in Table 4, the adhesion failures are cohesive.

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REINFORCED POLYOLEFINS FOR LARGE STRUCTURAL-FOAM PARTS

by
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Paper presented at the 1977 Reinforced Plastics/Composites Institute Meeting of the Society of the Plastics Industry, Inc. Washington, D.C., February 8-11, 1977

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Reinforced Polyolefins for Large Structural-Foam Parts

by M. J. MICHNO, JR., M. S. LEUNG, and A. W. HAWKINS
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Abstract – Underground structural parts such as utility boxes, manholes, septic tanks, etc. represent attractive new large volume applications for reinforced plastic structural foam. Replacing the heavy and cumbersome traditional concrete and cast iron parts, the plastic structural foam parts appeal to the end user by enabling important savings in storage, transportation, and installation.

In this paper, the dimensioning and economics of manufacturing an underground utility box (15 x 30 inch on a side) from reinforced concrete and unreinforced and reinforced high density polyethylene (HDPE) structural foam (SF) are compared. First, the prediction of structural foam properties from solid plastic properties is discussed. Second, the dimensioning of an underground box to achieve maximum cost effectiveness is analyzed in terms of wall deflection allowables and the properties of unreinforced and reinforced HDPE structural foam. Third, the economics to an SF molder is compared by Return on Investment (ROI) analysis of several cases representing variations in selling price, raw materials, and molding operations.

The analysis shows that the economics of molding large HDPE structural foam parts is highly sensitive to raw material costs. "Calidria" asbestos RG-600 is the most cost-effective reinforcement available for polyolefin resins. Utilizing this reinforcement in large SF molded parts can dramatically increase the ROI of an SF molding business.

INTRODUCTION

Structural foam polyolefin parts (see Figure 1) are replacing a variety of cement and metal underground utility parts; for example, transformer and switch enclosures, cable junction boxes, water meter and valve boxes [1,2].(1) The combination of high rigidity, good strength, light weight, ease of design, and favorable economics of manufacture, shipping, handling, and installation are important factors in this trend. A primary performance requirement for large underground structures is adequate rigidity to resist deflection imposed by lateral and axial pressure loadings. Polyolefin structural foam parts can achieve adequate rigidity for most applications through local rib stiffening and/or other inherently stiff structural shapes. However, for the more demanding applications, high stiffness materials must be employed, e.g., Impact Polystyrene, ABS, or glass-reinforced polyolefins. Unfortunately, these higher stiffness materials are also higher in cost and may introduce problems such as poor environmental resistance and inability to reprocess scrap without degrading material properties.

Polyolefins reinforced with "Calidria" chrysotile asbestos RG-600 are known to be attractive, highly cost-effective materials when used for solid injection

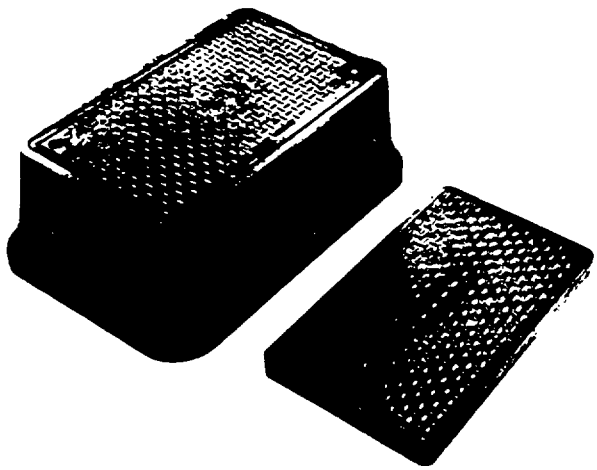


FIGURE 1 – Structural foam underground utility box.

(1)Numbers in brackets refer to the list of references.

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ACL Doc 16074 · Page 103 of 130
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molded parts [3]. When compared with the high cost engineering plastics, HDPE/RG-600 composites often possess the best material property profiles (for example: flexural modulus, flexural strength, heat distortion temperature (HDT), and impact strength combinations) at the lowest volume cost (¢/cu. in). Furthermore, RG-600 reinforced polyolefins have good environmental resistance and scrap can be reprocessed without loss of mechanical properties.

Herein we illustrate the advantages of using HDPE/RG-600 composites in large structural foam parts. For demonstration purposes, we will consider the design and fabrication economics of an open utility box 15 x 30 inches per side. Economic comparisons in the form of molder Return on Investment statements will be drawn between structural foam parts fabricated with neat HDPE and with HDPE/RG-600 composites. In both cases, the selling price (F.O.B.) of the parts is the same and fixed to be competitive with a pre-cast concrete utility box. Possible end-user oriented economic advantages of structural foam parts are also examined.

DIMENSIONING AN UNDERGROUND STRUCTURAL FOAM UTILITY BOX

To effectively dimension structural foam parts, one must know: the material's properties, the imposed loading, and the performance (or failure) criterion. In the case of underground utility boxes, the imposed loading is very complex and is governed by extreme cases, such as lateral pressures imposed when vehicles compact the backfill adjacent to the buried box (Figure 2). Emerging specifications [4] are setting performance criteria for utility boxes in terms of allowable maximum sidewall deflections under uniform lateral pressure loadings. For the purposes of this paper, the critical performance specification shall be taken as: the maximum allowable deflection of a sidewall is 1/4 inch per foot of length under a uniform pressure loading of 720 lbs/sq ft (=5 lbs/sq in) when the sidewall is simply supported all around. Knowledge of HDPE/RG-600 composite structural foam material properties is needed to continue the utility box design.

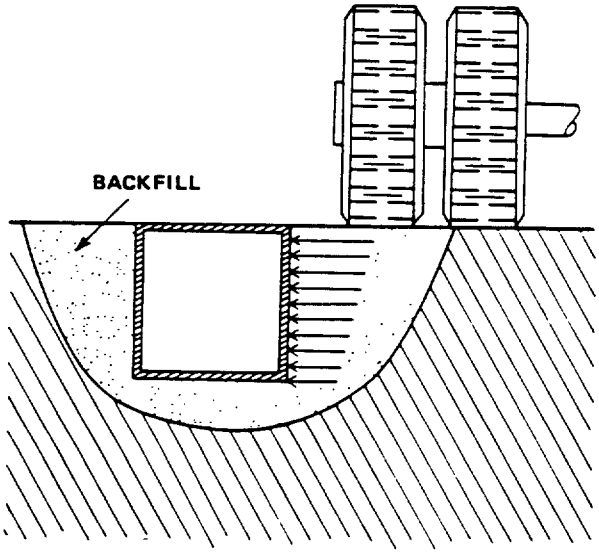


FIGURE 2 – Pressure loading on buried utility box.

RG-600/HDPE SF PROPERTIES AND COSTS

RG-600 is a high purity, high aspect ratio colloidal chrysotile asbestos which is pretreated with a proprietary coupling agent specifically developed for polyolefin composites [5,6]. It is manufactured as 1/8" pellets which enables convenient handling on conventional equipment used for thermoplastic resin pellets. In contrast to conventional open asbestos, the pellets are essentially non-dusting, keeping air-borne fibers readily below both current and proposed OSHA limits [7]. Furthermore, due to the similarity between RG-600 and resin pellets, completely enclosed handling is practical.

Intensive mixing conditions similar to those used in compounding other high surface area fillers such as carbon black are required for compounding RG-600/resin concentrates. This is in contrast to fiberglass where low shear blending must be used to minimize fiber breakage which causes loss of reinforcement. In fact, colloidal chrysotile such as RG-600 is unique among high modulus inorganic fibers in that no attrition occurs during compounding and molding and scrap can thus be reground and remolded with no loss in mechanical properties. Resin concentrates containing up to 50 wt % RG-600 can be prepared using W & P twin screw extruders (ZSK), Farrel continuous mixers (FMC) or ordinary Banburys. The concentrate pellets are readily let down to the desired RG-600 loading by blending with neat resin pellets prior to extrusion and molding.

Table I presents selected mechanical properties and costs for HDPE/RG-600 composites for both solid injection molded and structural foam molded parts. The starting material employed was a masterbatched concentrate of 50 wt % RG-600 in HDPE, DMDJ-5140. This concentrate was let down to the indicated wt % RG-600 with either DMDJ-5140 or DMDJ-7902. DMDJ-5140 is an HDPE impact grade homopolymer with a density of 0.962 (gr/cc) and a melt index of 0.72. DMDJ-7902 is an HDPE copolymer of 0.953 (gr/cc) density and a 2.0 melt index.

It is apparent from the data presented in Table I that the inherently good property profiles of solid HDPE/RG-600 composites carry over to structural foam. At the 30 wt % RG-600 reinforcement level, 5140 structural foam exhibits a threefold increase in flexural modulus, a twofold increase in flexural strength, a threefold increase in HDT, and a threefold decrease in coefficient of linear expansion while maintaining reasonable impact strength. Most importantly, the improved mechanical property profile is achieved with only a modest increase in material cost which includes compounding costs (see Appendix C). Note, in particular, that the molded density for the RG-600/-7902/-5140 resin blend system is approximately 0.66 gr/cc. The 40% density reduction achieved

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TABLE I – SELECTED MECHANICAL PROPERTIES AND COSTS FOR HDPE

Material	RG-600 Loading, wt. %	Flexural Modulus, psi	Flexural Strength, psi	Heat Distortion Temperature, °C @ 264 psi	Izod[2] Impact, ft.-lbs./in.	Coefficient of Linear Expansion, in./in./°C x 10^{-4}	Molded Density, gm/cc	Cost, ¢/lb.	Volume Cost, ¢/cu. in.
Injection Molded HDPE DMDJ-5140	0	160,000	3,900	43	13.56	1.20	0.962	29	1.008
	10	300,000	6,100	55	4.22	–	1.027	30.8	1.143
	20	500,000	7,900	65	2.00	–	1.101	32.6	1.297
	30	740,000	10,000	85	1.30	0.233	1.186	34.4	1.474
Structural Foam HDPE DMDJ-5140	0	110,000	3,400	R.T.	13.57	1.24	0.70	29	0.733
	10	280,000	4,800	52	6.04	0.681	0.73	30.8	0.812
	20	370,000	5,800	62	2.29	0.533	0.76	32.6	0.895
	30	480,000	7,000	82	1.50	0.40	0.78	34.4	0.969
Structural Foam DMDJ-7902[1]	0	80,000	1,760	R.T.	7.86	1.30	0.66	29	0.692
	10	185,000	2,650	R.T.	2.33	1.05	0.65	30.8	0.723
	20	310,000	4,900	68	2.18	0.924	0.67	32.6	0.789
	30	420,000	5,500	81	1.45	0.850	0.68	34.4	0.845

[1]DMDJ-7902/RG-600 composite material is prepared by letting down a 50 wt. % DMDJ-5140/RG-600 masterbatch to the indicated RG-600 wt. %, e.g., 10 wt. % DMDJ-7902 = 10 wt. % RG-600, 10 wt. % -5140, 80 wt. % -7902.

[2]Izod values based on notched test for IM; unnotched test for SF.

obviously helps to improve the economics of using RG-600/HDPE composites.

An additional advantage of RG-600 reinforced HDPE structural foam is a more uniform cell structure. Figure 3 shows that the RG-600/HDPE composite exhibits a more uniform cell structure with no large air pockets directly beneath the solid surface skin. Absence of large air pockets ensures improved reproducibility in structural foam properties, hence high reliability in part performance.

PREDICTION OF RG-600/HDPE SF PROPERTIES FROM SOLID DATA

Data in the literature [3] present properties of several RG-600/polyolefin composites based on solid injection molded samples. Data are generally not available for RG-600/polyolefin structural foam composites. Hence, we wish to see how well a key property like flexural modulus can be predicted for structural foam given solid data. Consider the DMDJ-5140/RG-600 system for which both solid and structural foam data are given in

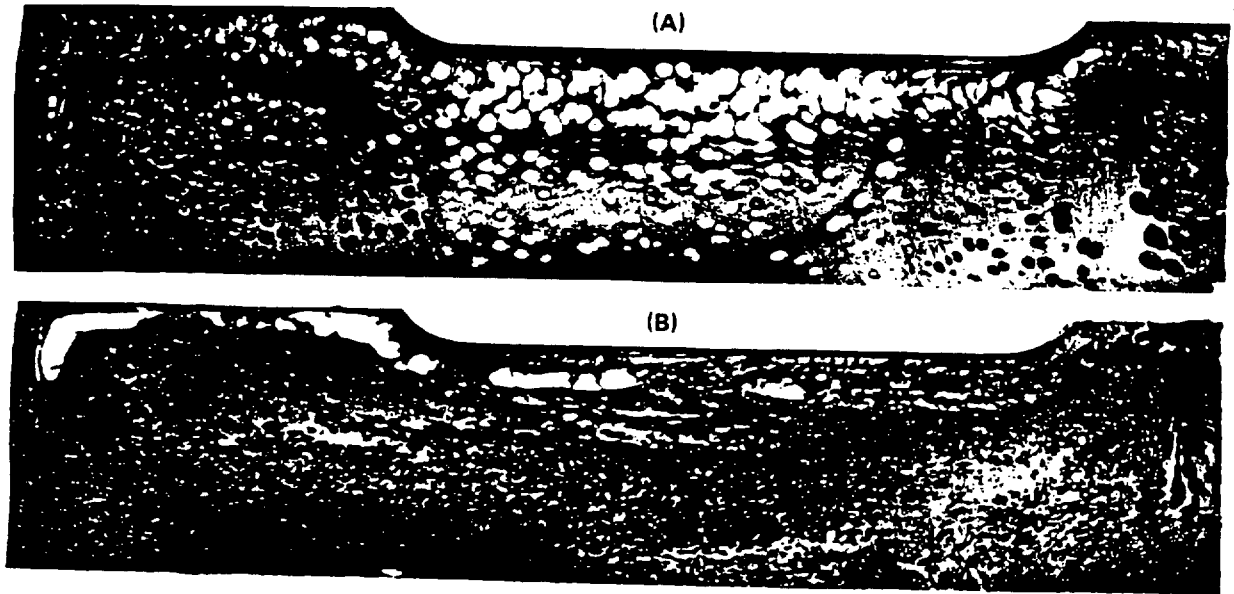


FIGURE 3 – Cell structure comparison between large SF parts. HDPE SF reinforced with 13 wt. % RG-600 has uniform cell structure (A). Neat HDPE SF shows large air pockets directly beneath solid surface skin (B).

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TABLE II – STRUCTURAL FOAM FLEXURAL MODULUS PREDICTED FROM SOLID DATA

Wt. % RG-600	Flexural Modulus Solid, psi	$\Delta = \frac{\text{Density Solid}}{\text{Density Foam}}$	$E_f = \frac{E_s}{\Delta}$ psi	% Voids 1-1/Δ	C	$E_f = \left(\frac{t_c}{h}\right)^3 E_s K$ psi
0	160,000	1.37	117,000	27	0.57	120,000
10	300,000	1.41	212,750	29	0.54	220,000
20	500,000	1.45	344,800	31	0.52	362,000
30	740,000	1.52	486,800	34	0.48	518,000

Table I.

The simplest empirical equation for predicting structural foam moduli is [11]:

$$E_f = \frac{E_s}{\Delta^n} \quad (1)$$

where E_f = Flexural modulus of structural foam

E_s = Flexural modulus of the solid

Δ = Expansion ratio = $\frac{\text{Density Solid}}{\text{Density Foam}}$

n = An exponent $1 < n < 2.5$

It has been found that the exponent, n, depends upon the quality of the foam cell structure. For well-formed, uniform foam typical of RG-600/HDPE systems, n = 1. The predicted values of structural foam moduli based on Equation 1 are listed in Table II and compared to the measured values in Figure 4.

One can also predict structural foam moduli by accounting for the characteristic sandwich structure.

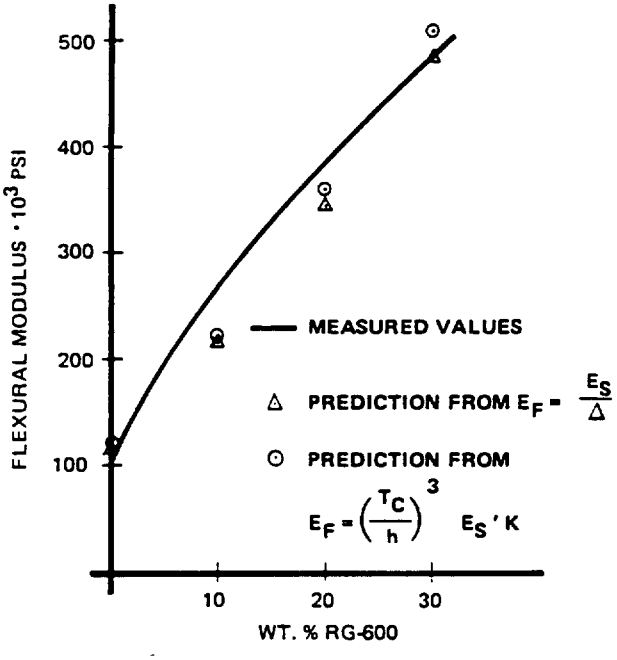


FIGURE 4 – SF Modulus prediction from solid data for DMDJ-5140/RG-600.

Specifically, the cross section of a structural foam beam, b, wide and, h, high consists of a foam core, t_c, thick and two integral solid skin surfaces each, t_s, thick, Figure 5. The effective structural foam modulus E_f and the effective moment of inertia of the cross section I can be expressed in terms of the modulus E_i and moment of inertia, I_i, of each constituuent sandwich member, i.e.,

$$\bar{E}_f \bar{I} = \Sigma E_i I_i \quad (2)$$

For our particular case

$$\bar{E}_f \frac{1}{12} bh^3 = \frac{b}{12}\left\{t_c^3 E_c + 2E_s[t_s^3 + 3t_s(t_c + t_s)^2]\right\} \quad (3)$$

Several structural foam panels with h = 0.375 inch were examined and it was found that: $t_s = \frac{1}{10} t_c$ with $t_s = \frac{1}{32}$ inch, $t_c = \frac{5}{16}$ inch. Thus, we can simplify Equation (3) to read:

$$E_f = \left(\frac{t_c}{h}\right)^3 (E_c + 0.728\, E_s) \quad (4)$$

E_c, the flexural modulus of the foam core, can be predicted from E_s via the modified Kerner Equation [8] and is given by $C \cdot E_s$ where C depends upon the % voids in the foam. The % voids is given by 1-1/Δ. Thus, Equation (4) may be written as

$$E_f = \left(\frac{t_c}{h}\right)^3 E_s K \quad (5)$$

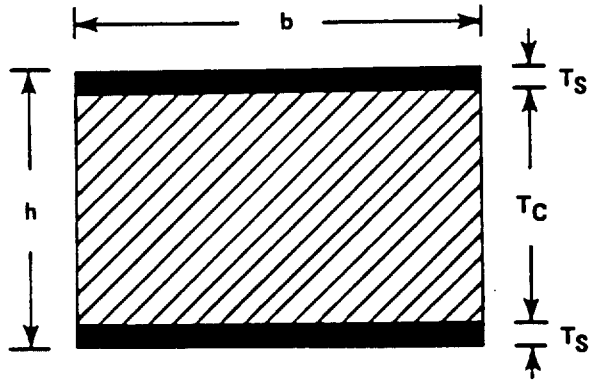


FIGURE 5 – Sandwich structure of structural foam.

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ACL Doc 16074 · Page 106 of 130 asbestosclaims.law/library/16074/106

where, for our particular case, $\left(\frac{t_c}{h}\right)^3 = 0.58$ and K = C + 0.728. The predicted foam moduli based upon Equation (5) are listed in Table II and compared to measured values in Figure 4.

One concludes that structural foam moduli predicted from solid data are in fair agreement with measured values. In general, Equation (1) is easier to use, but its predictive capability is highly dependent upon the value of exponent, n. Equation (5) is more general and thus more versatile. For preliminary design purposes, moduli predicted from solid data would suffice. We now proceed with the structural foam utility box design.

DESIGN PRINCIPLES

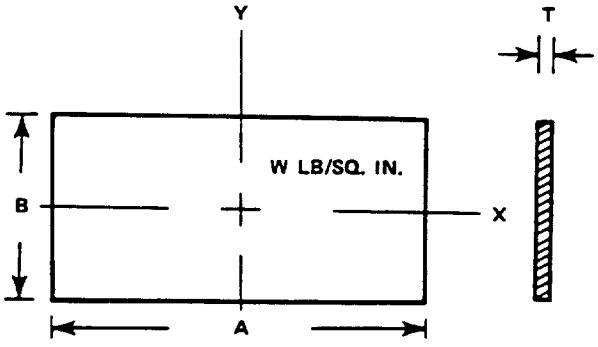
We model the utility box sidewall as a simply supported rectangular plate under uniform pressure loading of intensity w lb/sq ft, Figure 6. The maximum deflection of such a plate occurs at the center and is given by [9,10]:

$$\delta_{max} = \frac{0.142\ wb^4}{Et^3}\left[\frac{1}{2.21(b/a)^3+1}\right] \qquad (6)$$

Clearly, the deflection depends upon the plate width, b, the radio of plate width to plate length, b/a, the plate thickness, t, the material flexural modulus, E, and the intensity of loading, w. For the utility box design we fix: a = 30 inch, b = 15 inch, b/a = 0.5, and w = 720 lb/sq ft = 5 lb/sq in. Therefore, Equation (6) reduces to:

$$\delta_{max} = \frac{28{,}160}{Et^3} \qquad (7)$$

where δ_{max} in inches results if E (psi) and t (inches) are substituted. Fixing "a" at 30 inch (2.5 feet) fixes the



UNIFORM PRESSURE LOADING W LB/SQ. IN.
SIMPLE SUPPORT ALL EDGES.

$$\sigma_{MAX} = \sigma_{Y\ (CENTER)} = \frac{3_{WB}{}^2}{4_T{}^2}\left[\frac{1}{1.61\ (B/A)^3 + 1}\right]$$

$$\delta_{MAX} = \delta_O = \frac{0.142_{WB}{}^4}{E_T{}^3}\left[\frac{1}{2.21\ (B/A)^3 + 1}\right]$$

FIGURE 6 — Uniformly loaded rectangular plate.

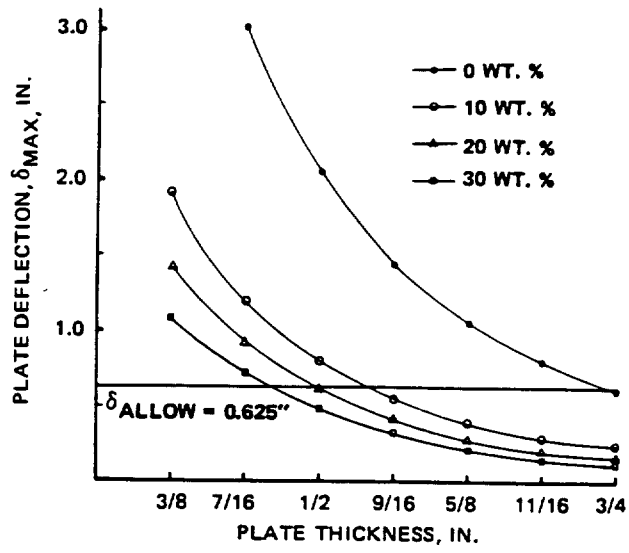


FIGURE 7 — Plate deflection vs. thickness for RG-600/DMDJ-5140.

maximum allowable deflection at δ_{allow} = 1/4 inch/ft x 2.5 ft = 0.625 inch.

Figures 7 and 8 show the calculated maximum plate deflections as a function of plate thickness. The individual curve in each figure characterizes the plate deflection behavior for a single material. By imposing the maximum allowable plate deflection on these curves, we can estimate, for each material under

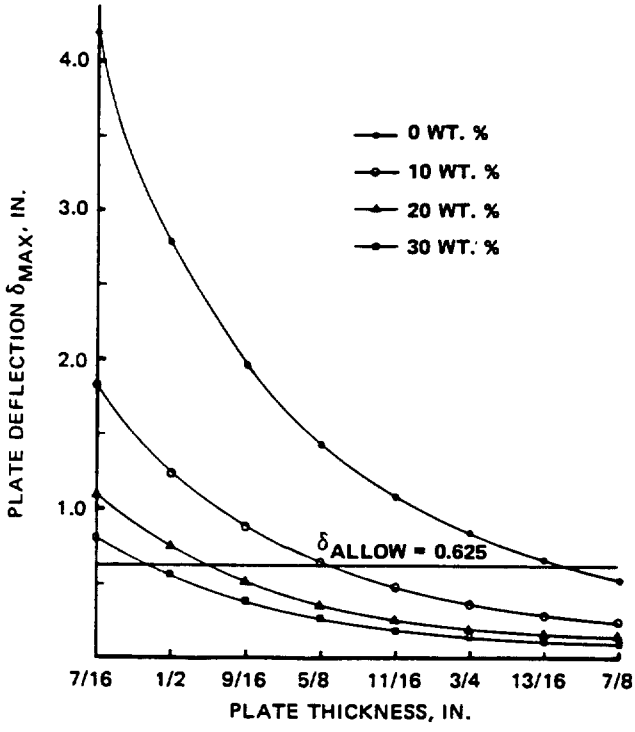


FIGURE 8 — Plate deflection vs. thickness for RG-600/DMDJ-7902.

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TABLE III – MATERIAL COSTS TO ACHIEVE PLATE DEFLECTION $\delta MAX. < \delta ALLOW.$

Material	Wt. % RG-600	Plate Thick-ness, t inch	Plate Volume, cu. in.	Material Cost, ¢
DMDJ-5140	0	3/4	337.5	247.4
	10	9/16	281.3	228.4
	20	9/16	253.0	226.0
	30	1/2	225	218
DMDJ-7902	0	7/8	393.8	272.5
	10	5/8	281.3	203.3
	20	9/16	253.1	199.7
	30	1/2	225	190.1

consideration, the plate thickness required to satisfy the design requirement. Specifically, Figure 7 considers RG-600/DMDJ-5140 composites while Figure 8 considers RG-600/DMDJ-7902 composites.

Clearly, the higher the modulus of the structural foam plate the thinner the plate can be without deflecting more than the allowable 0.625 inch limit. The thinnest plate will have the smallest volume and the material with the lowest volume cost (¢/cu in) will be the most cost-effective material to employ. Table 3 summarizes the results. The most cost-effective neat resin to use is DMDJ-5140 at a thickness of 3/4 inch and a cost of 247.4¢. The most cost-effective composite material is 30 wt % RG-600/DMDJ-7902 at a thickness of 1/2 inch and a cost of 190.1¢. Hence, the use of 7902 reinforced with 30 wt % RG-600 instead of neat 5140 reduces raw material cost by 23%.

Although the plate thicknesses have been fixed to meet the deflection allowable, calculation of the plate stresses at the prescribed thickness discloses that the maximum stress is only 50% or less of the material strength (Figure 6). Thus, we find that even with reduced sidewall thickness, RG-600/HDPE composites are stiff and strong enough for this type of underground application. Furthermore, a reduction of thickness also decreases mold cycle time and hence increases productivity and cost-effectiveness. The true gains to be realized in structural foam molding with RG-600/Polyolefin composites require examination of *R*eturn *O*n *I*nvestment (ROI) statements.

ECONOMIC ADVANTAGE TO MOLDER

The quality of a structural foam utility box molding business will be judged through two basic criteria: (1) Is the product unit price competitive?, (2) Is the return on investment after taxes adequate?

Appendix A presents the economics of manufacture for a reinforced pre-cast concrete utility box (15 x 30 inch on a side). A selling price of $13.10/unit allows for

TABLE AI – R.O.I. STATEMENT FOR PRE-CAST CONCRETE

INCOME	
Units Produced	32,000
Unit Selling Price	$13.10
Net Income from Sales	$419,000
Unit Plant Costs (Direct)	$7.20
Plant Costs (Direct)	$230,400
Direct Gross Margin	$188,600
Gross Margin, %	45
Supporting Labor	$10,000
Contributory Income	$178,600
Allocated Plant Costs	$20,000
Operating Income	$158,600
Utilized New Investment	$150,000
Depreciation	$28,000
Net Income before Tax	$130,600
Net Income after Tax	$67,900
INVESTMENTS	
New Utilized	$150,000
Acct's Receivable	$52,000
Inventory	$58,000
Total Utilized Investment	$260,000
R.O.I. before Tax	50%
R.O.I. after Tax	26%

a gross margin of 45% and an ROI After Tax of 26%. The pre-cast concrete part price is taken as the 'competition' which structural foam parts must meet.

Appendix B presents detailed ROI statements for seven assumed cases in structural foam molding of a utility box (15 x 30 inch on a side). Case I considers molding one part/cycle from neat 5140 resin. The selling price required for a 45% gross margin is $20.22/unit and the After Tax ROI is 30%. The selling price is too high to compete head-on with concrete units.

In Case II, and all other cases, the selling price is adjusted to be competitive with concrete, i.e., $14.00/unit. The 90¢ differential in FOB selling price between concrete and structural foam can be readily absorbed through lower shipping and installation costs associated with plastics. However, if we continue to use neat 5140 material and mold one part/cycle, the After Tax ROI of only 4% indicates that the selling price is much too low.

Examine Cases III and IV in which RG-600/DMDJ-7902 composite material replaces the neat 5140. We hold unit selling price at $14.00 and mold one part/cycle. However, since the RG-600 reinforced parts are thinner and have higher heat distortion temperatures, the cycle time is lower and we can mold more parts per unit production time. In addition, the overall material costs are lower when RG-600 reinforced HDPE is used, refer to Table 3. Note that the ROI After Tax increases to 21% and 18% for 30 wt % and 20 wt % RG-600/7902, respectively.

We next consider molding two parts/cycle. Case V considers molding neat 5140 and the associated ROI After Tax is only 10%. Case VI employs 30 wt %

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TABLE BI – R.O.I. STATEMENTS FOR STRUCTURAL FOAM UTILITY BOXES

Case No.	I	II	III	IV	V	VI	VII
INCOME							
Units Produced, No.	26,000	26,000	34,000	34,000	52,000	68,000	68,000
Unit Selling Price, $	20.22	14.00	14.00	14.00	14.00	14.00	14.00
Net Income from Sales, $	525,700	364,000	476,000	476,000	728,000	952,000	952,000
Unit Plant Costs (Direct), $	11.12	11.12	8.81	9.20	10.65	8.35	8.73
Plant Costs (Direct), $	289,000	289,100	299,800	313,000	553,800	567,600	593,400
Direct Gross Margin, $	236,600	74,800	176,200	163,000	174,200	384,400	358,600
Gross Margin, %	45	20	37	34	24	40	38
Supporting Labor, $	11,600	11,600	12,000	12,500	22,100	22,700	23,700
Contributory Income, $	225,000	63,200	164,200	150,500	152,100	361,700	334,900
Allocated Plant Costs, $	21,000	18,200	19,000	20,000	29,100	38,100	38,100
Operating Income, $	204,000	45,000	145,200	130,500	123,000	323,600	296,800
Utilized New Investment, $	175,000	175,000	175,000	175,000	250,000	250,000	250,000
Depreciation, $	22,000	22,000	22,000	22,000	31,300	31,300	31,300
Net Income Before Tax, $	182,000	23,000	123,200	108,500	91,600	292,300	238,500
Net Income After Tax, $	94,600	12,000	64,000	56,400	47,700	152,000	124,000
INVESTMENTS							
New Utilized, $	175,000	175,000	175,000	175,000	250,000	250,000	250,000
Acct's Receivable, $	65,700	45,500	59,500	59,500	91,000	119,000	119,000
Inventory, $	72,300	72,300	75,000	78,300	138,300	141,900	148,400
Total Utilized Investment, $	313,000	292,800	309,500	312,000	479,300	510,900	517,400
R.O.I. Before Tax, %	58	8	40	35	19	57	46
R.O.I. After Tax, %	30	4	21	18	10	30	24

RG-600/7902 material and the ROI After Tax is dramatically increased to 30%. In case VII 20 wt % RG-600/7902 material is employed with a resulting ROI After Tax of 24%.

One concludes that structural foam molding is extremely sensitive to raw material costs. The use of highly cost-effective RG-600/HDPE composites results in two to three hundred percent increases in ROI After Tax. In some cases a very marginal business becomes quite attractive through the use of RG-600/HDPE composites. In addition to economic advantages to the molder, RG-600/HDPE composite parts also offer advantages to the end-user.

ECONOMIC ADVANTAGES TO USER

The preceding ROI analysis for structural foam utility boxes was based on an FOB selling price of $14.00/unit. This selling price represents a $.90/unit premium above the FOB selling price of a pre-cast concrete unit. However, the lighter weight structural foam unit allows savings in handling, shipping, and installation costs.

Consider shipping charges for the concrete units. At 312 lb/unit, 128 units will reach capacity of a 40,000 lb truck. Typical freight rates for 250 miles at full truck weight is $1.12/100 lb. The shipping charges per unit are ~$3.50.

The structural foam boxes weigh only 32 lb/unit (one tenth the weight of a concrete part), occupy 4 cu ft, and 30% nesting is possible. A truck contains 2560 cu ft which will be fully occupied by 832 units at a total weight of 26,000 lb. Shipment of a cubed out load vs. a weighed out load costs more and we must pay $4.30/100 lb for 250 miles. The total shipping charge for the structure foam boxes is $1.38/unit. Hence, savings in freight charges are $2.10/unit.

One furthermore expects that the lighter weight structural foam units would allow for additional savings in handling and installation costs. Specifically, installation would require less manpower and eliminate the need for complex heavy equipment necessary for handling the concrete units.

CONCLUSIONS

RG-600/HDPE composites are highly cost effective materials when used for large structural foam molded parts. This conclusion is supported by ROI statements for several typical molding cases. The reader should apply his own judgment factors and experience in evaluating the conclusions.

In addition to economic advantages for the molder, structural foam parts afford savings in distribution, handling, and installation costs because of lighter weight vs. competitively priced pre-cast concrete parts.

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APPENDIX A

ECONOMICS FOR A PRE-CAST CONCRETE UTILITY BOX

Calculations show that a rectangular concrete plate (15 x 30 inch) subjected to a uniform pressure loading of 720 lb./sq. ft. must be 1.75 inches thick to ensure against tensile failure. Four steel rods (0.4 inch diameter, 3 inches apart) must reinforce the 30-inch plate dimension. A utility box consisting of four such plates weighs 312 lbs. with associated raw materials costs of $3.25.(1) Further appreciation for the economics of manufacture for pre-cast concrete utility boxes can be gained from examination of an elementary *r*eturn *o*n *i*nvestment (R.O.I.) statement.

We consider a manufacturer who is already in the pre-cast concrete business. An investment of $150,000 will allow expansion to accommodate the utility box business. The new investment required relates primarily to molds and handling equipment.

Assume the following for the R.O.I. calculations:

1. Yearly production (2,000 hours) of 32,000 units.
2. Direct plant costs per unit is assumed as $7.20 consisting of raw material at $3.25 and labor, supervision, and indirect labor as $3.95.
3. Other costs assigned to the project are: $10,000/year supporting labor and $20,000/year allocated plant costs.
4. Depreciation is assumed to be straight line at 12 1/2%/year.
5. The ratio of direct plant costs (F.O.B.) to selling price is 55%.

A detailed R.O.I. statement is shown in Table AI. The essential results are:

Net Income from sales	= $419,000
Selling price per unit	= $13.10
Net Income before tax	= $130,600
Net Income after tax	= $67,900
Total utilized investment	= $260,000
R.O.I. before taxes	= 50%
R.O.I. after taxes	= 26%

Generally one would conclude that the assumed business structure is satisfactory.

APPENDIX B

R.O.I. STATEMENTS FOR THE MANUFACTURE OF STRUCTURAL FOAM UTILITY BOXES

Presented below are seven R.O.I. statements for the manufacture of structural foam utility boxes. In all cases an established molder is assumed to have fully amortized supporting equipment, e.g., material handling systems, resin storage, resin conveying, building space, etc. A new investment of $175,000(1) is required to cover the cost of equipment directly related to the manufacture of utility boxes.

The following cases are assumed:

CASE I – Use neat DMDJ-5140; set gross margin at 45%

CASE II – Use neat DMDJ-5140; set unit selling price at $14.00.

CASE III – Use 30 wt. % RG-600 composite(2); set unit selling price at $14.00.

CASE IV – Use 20 wt. % RG-600 composite; set unit selling price at $14.00.

CASE V – Same as II except mold two parts per cycle.

CASE VI – Same as III except mold two parts per cycle.

CASE VII – Same as IV except mold two parts per cycle.

(1) Assumes: 58.4 lb. steel x $0.30/lb. = $1.75
254.2 lb. concrete x $0.0059/lb. = $1.50

(1) $175,000 covers one part/cycle; $250,000 needed to cover two parts/cycle.

(2) Start with 50 wt. % RG-600/DMDJ-5140 concentrate let down with DMDJ-7902 copolymer to desired wt. %.

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APPENDIX C

COMPOUNDED RAW MATERIAL COSTS OF RG-600/HDPE COMPOSITES

Raw material costs utilized in this paper are based on a 50 wt % RG-600/HDPE concentrate. Tnis concentrate has a weight cost (c_w ¢/lb) of 38 ¢/lb derived as follows:

50 wt % RG-600	@ 30 ¢/lb =	15	¢/lb
50 wt % HDPE	@ 29 ¢/lb =	14.5	¢/lb
Compounding	@ 8.5 ¢/lb =	8.5	¢/lb
		38.0	¢/lb

A particular RG-600/HDPE composite of L wt % is achieved by letting down the 50 wt % concentrate to the desired level with 29 ¢/lb HDPE. For example, to achieve a 20 wt % composite requires:

100 lb, 50 wt % Concentration	@ 38 ¢/lb =	3800
+ 150 lb, HDPE	@ 29 ¢/lb =	4350
250 lb		8150

$$\text{or } C_w = \frac{8150\ ¢}{250\ lb} = 32.6\ ¢/lb$$

In general, the weight cost is given by:

$$C_w = 29\ ¢/lb + 0.18 \cdot L\ ¢/lb$$

where L = the RG-600 loading in weight percent.

The volume cost (C_v ¢/in) of a material is calculated from its weight cost (C_w ¢/lb) and the density (d g/cm) by the relation: $C_v = 0.03613 \cdot C_w \cdot d$ (¢/in).

The following shows the calculation of the density of a particular RG-600/HDPE composite, with L wt % RG-600 loading. Consider the case where L = 20 wt % and 100 gr of compound. Then 20 gr (RG-600) + 80 gr (HDPE) = 100 gr composite. The volume is given by:

$$\underset{\text{composite}}{\frac{20\ gr}{2.6\ gr/cc}\ (RG\text{-}600)} + \frac{80\ gr}{0.962\ gr/cc}\ (HDPE) = 90.85cc$$

where we know $d_{RG\text{-}600} = 2.6$ gr/cc and in our case $d_{HDPE} = 0.962$ gr/cc

$$\text{The composite density} = \frac{100\ gr}{90.85\ cc} = 1.101\ gr/cc.$$

In general:

$$\text{Density of Composite} = \frac{100}{L/2.6 + 100 - L/d_{HDPE}}$$

The density of structural foam is determined by multiplying the solid composite density by the ratio of the SF part weight to the solid part weight for the same volume.

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ACL Doc 16074 · Page 111 of 130 asbestosclaims.law/library/16074/111

Calidria ASBESTOS

INFORMATION ON PROPERTIES, APPLICATIONS, AND PRICES

Northeast	P.O. Box 579, Niagara Falls, New York 14302	716-278-3371
South	17 Executive Park Drive, Atlanta, Georgia 30329	404-633-6161
Midwest	P.O. Box 579, Niagara Falls, New York 14302	716-278-3355
West	100 Oceangate, Long Beach, California 90802	213-435-3721

MARKETING AND TECHNICAL CENTER

P.O. Box 579, Niagara Falls, New York 14302 716-278-3369

PLANT

P.O. Box K, King City, California 93930 408-385-5961

UNION CARBIDE

UNION CARBIDE CORPORATION • METALS DIVISION
270 PARK AVENUE, NEW YORK, N.Y. 10017

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ACL Doc 16074 · Page 113 of 130



A unique and versatile fiber with proven applications as an

- Extender
- Thickener
- Reinforcer
- Opacifier

An unlimited source of new ideas for utilizing asbestos

UNION CARBIDE

The Discovery Company

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ACL Doc 16074 · Page 114 of 130

What is Calidria ASBESTOS

CALIDRIA Asbestos, a product of Union Carbide, is a chrysotile asbestos obtained from a unique, short-fiber deposit located in the New Idria area of the Diablo Mountain Range in central California, approximately 150 miles south of San Francisco.

New Idria ore is essentially free of hard, consolidated rock masses typical of asbestos ores from the Quebec region—generally conceded to be the center of the established free world industry. Further, this ore assays up to 60 per cent asbestos fiber compared to Canadian ore which ranges from 7 to 15 per cent.

Through special mining methods and processing techniques developed by Union Carbide, New Idria ore is converted into CALIDRIA Asbestos products with many superior advantages. Their unusual properties have been instrumental in the introduction of unique, economical products of high purity which have found application in an entirely new spectrum of industrial uses.

Union Carbide's California deposit is one of the world's largest sources of high-grade asbestos ore, assuring continued supply for development and expansion of CALIDRIA Asbestos materials.

Where is it being used today?

Listed are the primary, conventional, and specialized application areas where the high purity, non-abrasiveness, high brightness and end use efficiency of CALIDRIA Asbestos are contributing to better products and lower costs:

- Viscosity Control Additive
- Thixotrope
- Extender
- Reinforcing Agent
- Pollution Control Agent
- Thickener
- Co-Flocculant
- Opacifier
- Softener
- Bulking Agent

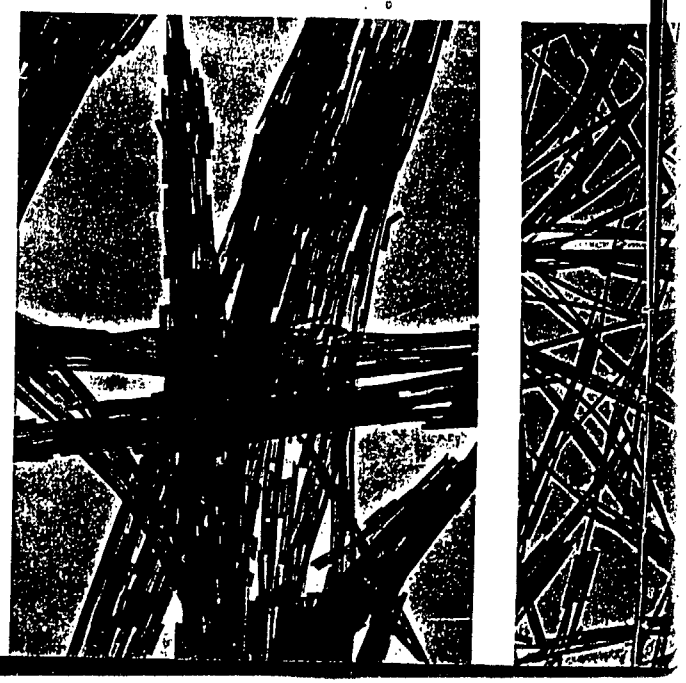


1. **CANADIAN CHRYSOTILE**
Individual fiber bundles are straight and tightly bonded. Deviation from the parallel configuration is minimal.

2.

3. **DRY-PROCESSING—California Chrysotile**
Fiber bundles in California asbestos are still evident even with the most exacting dry processes.

4.



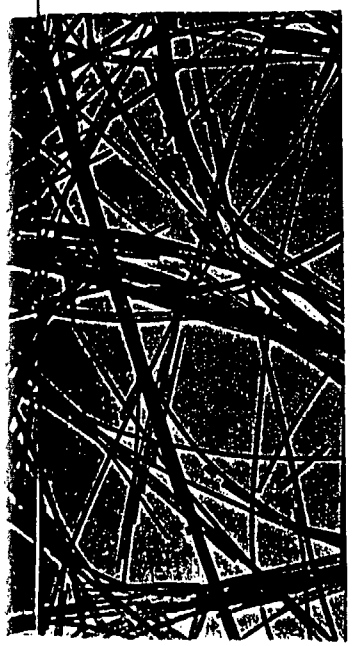
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ACL Doc 16074 · Page 115 of 130



2. CALIFORNIA CHRYSOTILE
Random orientation, point contact and high fiber content set CALIDRIA Asbestos ore apart from other asbestos sources.

4. WET-PROCESSING—CALIDRIA Asbestos
Unique process used to produce CALIDRIA Asbestos provides 98 per cent liberated, efficient fibrils.



High purity and proprietary processing make **CALIDRIA** ASBESTOS superior to any other asbestos

The four electron micrographs on the left graphically illustrate the wide difference between the random orientation of fibrils of CALIDRIA Asbestos and typical close-packed Canadian fiber structure.

Figure 1 shows the structure of a Canadian fiber bundle. Individual fibers, or fibrils, are all in linear contact and basically straight. There is little or no deviation from the parallel configuration. The texture of chrysotile from the New Idria deposit is the direct opposite.

Figure 2 shows the random orientation of CALIDRIA Asbestos fibrils where each fiber is in only point contact with its neighbor. The high fiber content of Union Carbide's California deposit is one of the several factors that make New Idria ore unique as a raw material for the production of high purity CALIDRIA Asbestos products.

Purity through wet-processing

Union Carbide established that the major factor enhancing the differences between California and Canadian fiber products was in the purity of the beneficiated product.

Of the processing techniques investigated, hydraulic beneficiation proved to be the most logical approach to the manufacture of highly purified chrysotile products.

The wet process is used to produce all CALIDRIA Asbestos products. Although details are proprietary, the process may be described as a treatment which breaks down the fiber bundles and removes the rock and other foreign contaminants of the ore body, leaving essentially pure asbestos.

Figure 3 shows the results of dry-processing New Idria—California chrysotile. Fiber bundles are evident even with the most exacting dry beneficiation methods. Figure 4 shows the results of hydraulic beneficiation, which provides 98 per cent liberated, efficient fibrils of consistently uniform quality.

Major "firsts" in the industry

A distinct result of the Union Carbide wet process is the ability for the first time in the industry to offer an economic pelletized asbestos product. Advantages of this form are: ease-of-handling, reduced dusting, lower shipping rates, and less troublesome and costly storage.

CALIDRIA Asbestos pellets, ⅜ in. diameter by ¾ in. long, can be handled by conventional dry bulk handling systems, representing a major achievement in the asbestos industry.

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ACL Doc 16074 · Page 116 of 130

CALIDRIA ASBESTOS

sets new standards of performance!

Typical Applications in

VISCOSITY CONTROL

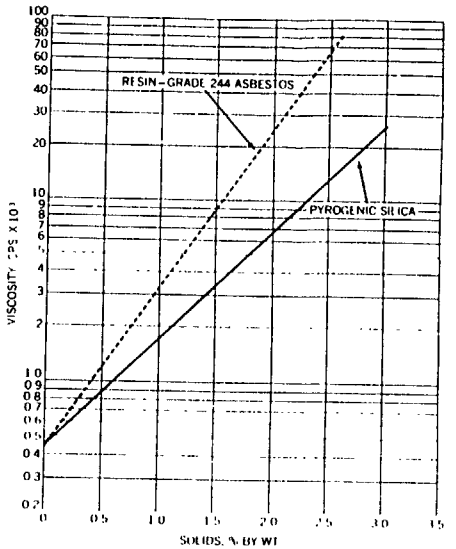
Resin Systems:

Coatings · Adhesives · Sealants · Caulks · Mastics

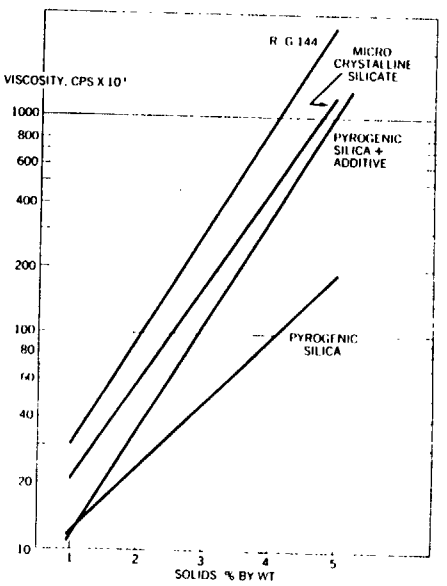
Aqueous Systems:

Water Thickening · Drilling Muds · Joint Cements

The distinctive properties of CALIDRIA Asbestos offer thickening efficiency quite unlike anything available!



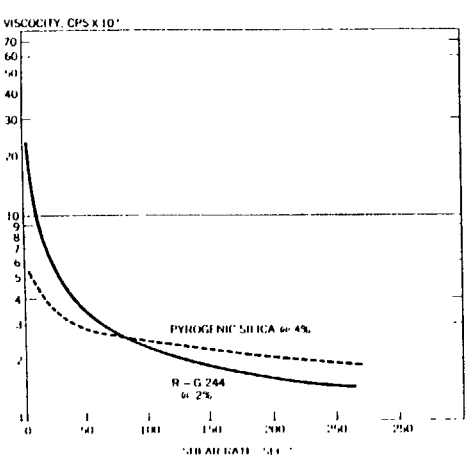
A. Thickening Efficiency in Polyester Resins



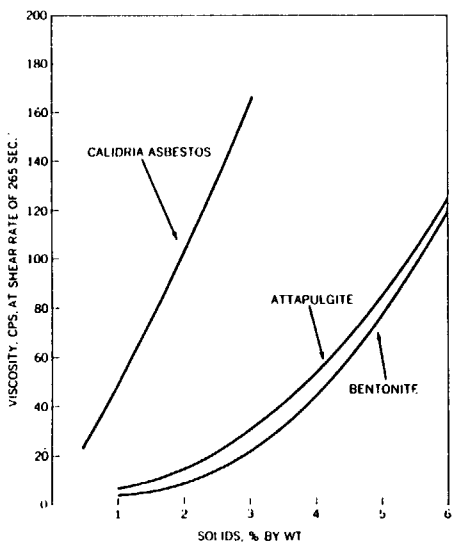
B. Thickening Efficiency in Liquid Epoxy Resins

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ACL Doc 16074 · Page 117 of 130



C. Thixotropic Characteristics in Polyester Resins



D. Viscosity of CALIDRIA Asbestos Water Slurries

High concentration of liberated fibrils, purity, and low abrasiveness provide quality compounds at improved costs.

Typical Applications in REINFORCEMENT

(High mechanical strength makes CALIDRIA Asbestos fibers effective reinforcing whiskers.)

Nylon 6/6 – CALIDRIA R-G144 Molding Compounds

Reinforcement of Nylon 6/6 with CALIDRIA R-G144 asbestos results in compounds with greatly improved tensile and flexural properties and heat distortion temperature. Tensile strength, for example, is more than doubled by the addition of R-G144 at twenty per cent by weight in the molding compound.

Reinforced Nylon 6/6

Test	"Typical" Nylon 6/6	Nylon 6/6 with 20% (wt.) R-G144
Tensile strength @ 73°F psi	10,000	21,300
% Elongation @ 73°F	50	2.4
Modulus of Elasticity @ 73°F psi x 10^{-5}	3	13.2
Flexural strength @ 73°F psi	13,000	32,200
Flexural modulus @ 73°F psi x 10^{-5}	–	15.4
Izod Impact (notched) @ 73°F ft.lb./in.	1.0	0.9
Heat Distortion Temperature 264 psi–°C	66	241

OTHER PROVEN APPLICATIONS:

Cellulose Paper Additive: for pitch control, pigment retention, softening, extending, opacifying (T-135) and improved save-all efficiency.

Water and Waste Treatment: clarifier, aerobic digestion promoter, reducer of BOD and COD, filtration aid and waste oil controller.

Vinyl and Asphalt Flooring: adds to dimensional stability and improves hot strength reinforcement.

Oil Well Drilling Fluids: designed as a viscosity modifier and used to increase carrying capacity and suspending ability of drilling muds.

Tape Joint Cements: fine, consistent, uniform particle size and high bulking factor make for more efficient joint cements for gypsum board applications.

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ACL Doc 16074 · Page 118 of 130

REPRESENTING VARIED PRODUCTS THAT POSSESS THEIR OWN

1. FIBER PRODUCTS

Standard Grade 100 Series

Vinyl Asbestos Floor Tile

Standard Grade 100 series products are obtained primarily by straight-line beneficiation of asbestos ore. They provide high fiber content and high brightness at low applied cost.

Standard Grade 200 Series

Drilling Fluids, Joint Cements

Standard Grade 200 series products are further treated so that the fibers are more open and uniform in size. They are designed for use where fine grind and high bulk are desired.

2. COLLOIDAL PRODUCTS

High Purity Asbestos

Cellulose Paper Additive

A uniform, highly purified non-abrasive fiber product for pitch control, pigment retention, softening, extending and improving save-all efficiency. Excellent performance in water and waste treatment.

Resin-Grade 100 Series

Viscosity Control, Reinforcement

The Resin-Grade 100 Series are specially produced and refined for the plastics industry. They exhibit unique capabilities because of fibrous geometry, fiber liberation, high purity and low iron.

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ACL Doc 16074 · Page 119 of 130

produced in 3 grades—

DISTINCTIVE CHARACTERISTICS!

3. MODIFIED PRODUCTS

Resin-Grade 244

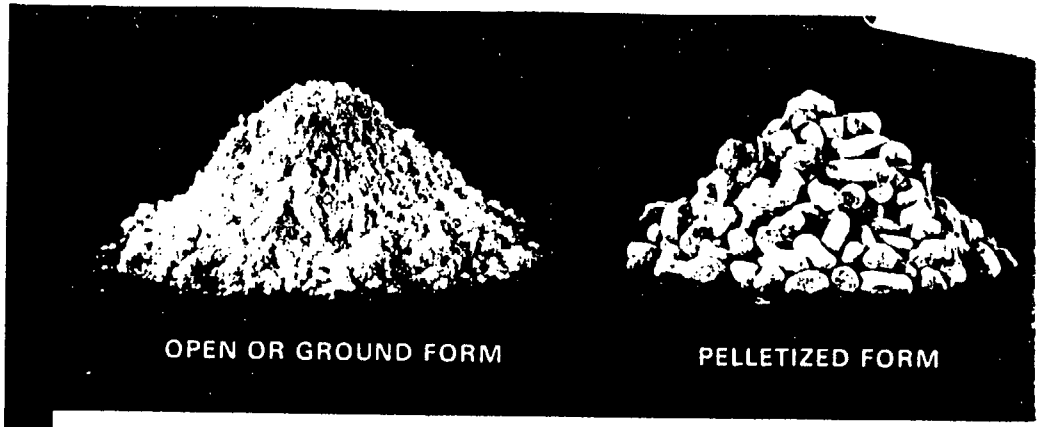
Viscosity Control for Polyester Resin Systems

Resin-Grade 244 was developed for maximum thickening efficiency in a wide range of applications. It offers ease of dispersion with non-settling, stable viscosity, long shelf life and true thixotropy.

Asbestos T-135

Opacifying Agent for Cellulosic Paper

Asbestos T-135 is a titanated High Purity Asbestos. The titania portion of the product does not agglomerate when added to a paper pulp. The result is greatly enhanced opacifying power.



Typical Physical Properties of CALIDRIA ASBESTOS PRODUCTS

General Properties

Specific Gravity	2.45
Surface Charge	Electropositive (Cationic)
Surface Area	60 sq. meters per gram
Refractive Index	1.54—1.56
Fiber Diameter	0.025 microns
Length/Diameter	200 avg. (1000 max.)

PROPERTY	Fiber Products		Colloidal Products		Modified Products	
	SG-100 Series	SG-200 Series	High Purity Open	Resin-Grade 144	Resin-Grade 244	T-135 Open
% Magnetite	2.0	2.0	0.75	0.6	0.3	0.6
Reflectance	66-68	68-70	72-76	–	–	85-88
Oil Absorption #DOP/(100 # Asb.)	90-100	110-120	–	120-140	300-350	–
Dry Bulk, lbs/ft³	8-10	5-6	5	4	1-5	8
Screen Size, Typical % + 325 Mesh	32	15	NIL	NIL	NIL	NIL
Water Absorption Wt % in Filter Cake	55-60	62-65	–	–	–	–

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ACL Doc 16074 · Page 120 of 130

For complete information on properties, applications and prices, or technical assistance in utilizing

Calidria ASBESTOS

contact the nearest Union Carbide sales office or CALIDRIA Asbestos representative

Atlanta, Ga. 404-892-7500 · Baltimore, Md. 301-944-8211 · Boston, Mass. 617-444-5400 · Buffalo, N.Y. 716-837-6450 · Charlotte, N.C. 704-377-6991 · Chicago, Ill. 312-822-7000 · Cincinnati, Ohio 513-272-0206 · Cleveland, Ohio 216-621-4202 · Clifton, N.J. 201-778-2900 · Dallas, Texas 214-631-0010 · Detroit, Mich. 313-341-3131 · Hartford, Conn. 203-525-9345 · Houston, Texas 713-621-1000 · Indianapolis, Ind. 317-255-3181 · Kansas City, Mo. 816-221-2400 · Los Angeles, Calif. 213-583-3061 · Memphis, Tenn. 901-396-5375 · Minneapolis, Minn. 612-927-4221 · Moorestown, N.J. 609-235-6200 · New York, N.Y. 212-551-4641 · Philadelphia (Moorestown, N.J. Sales Office) 215-923-3200 · Pittsburgh, Pa. 412-922-5700 · St. Louis, Mo. 314-726-0324 · San Francisco, Calif. 415-982-1360 · Seattle, Wash. 206-723-8660 · Tulsa, Okla. 918-742-5524

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UNION CARBIDE CORPORATION

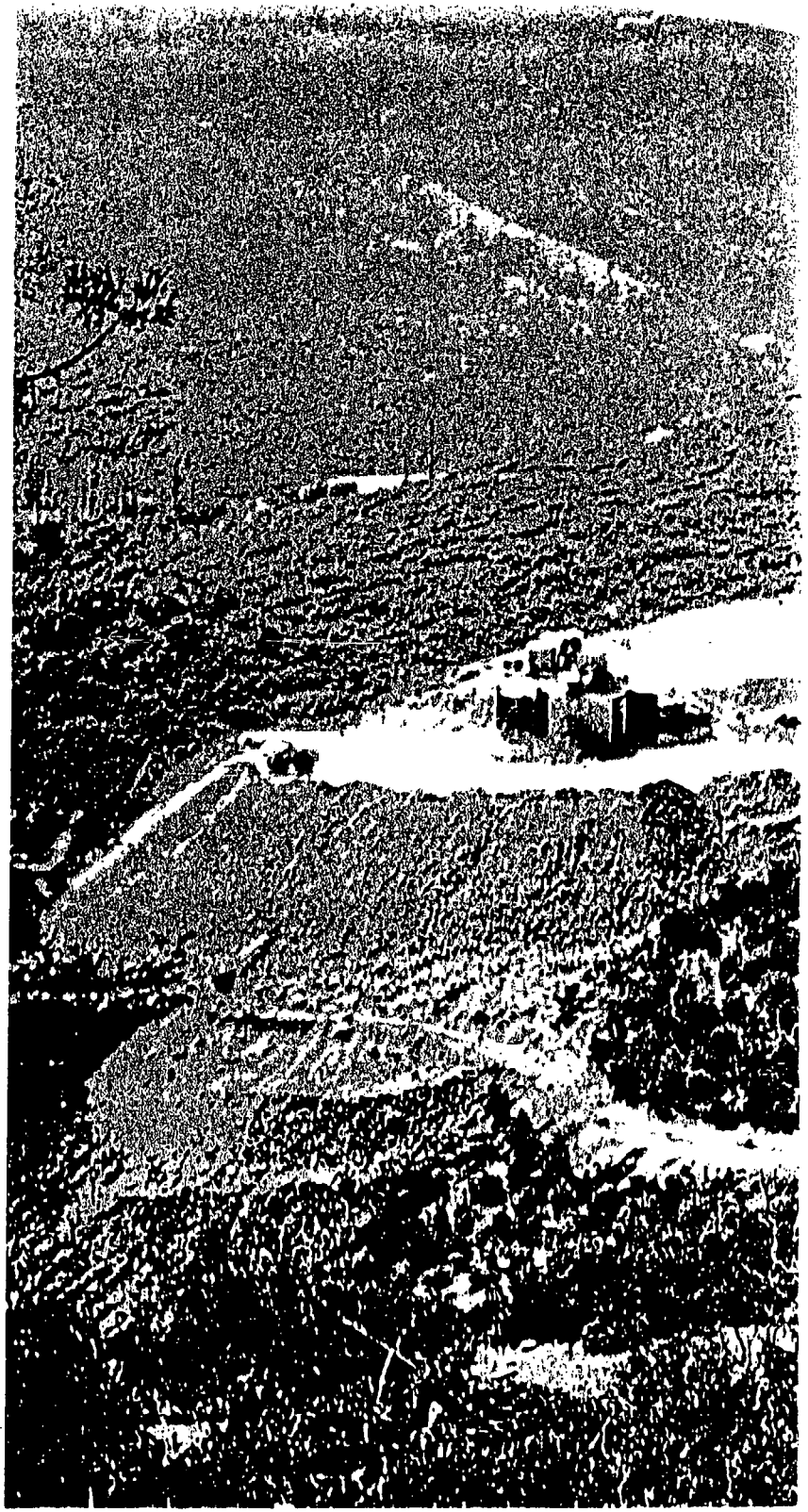
CALIDRIA ASBESTOS

270 Park Avenue · New York, N.Y. 10017
P. O. Box K · King City, Ca. 93930

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169

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ACL Doc 16074 · Page 121 of 130

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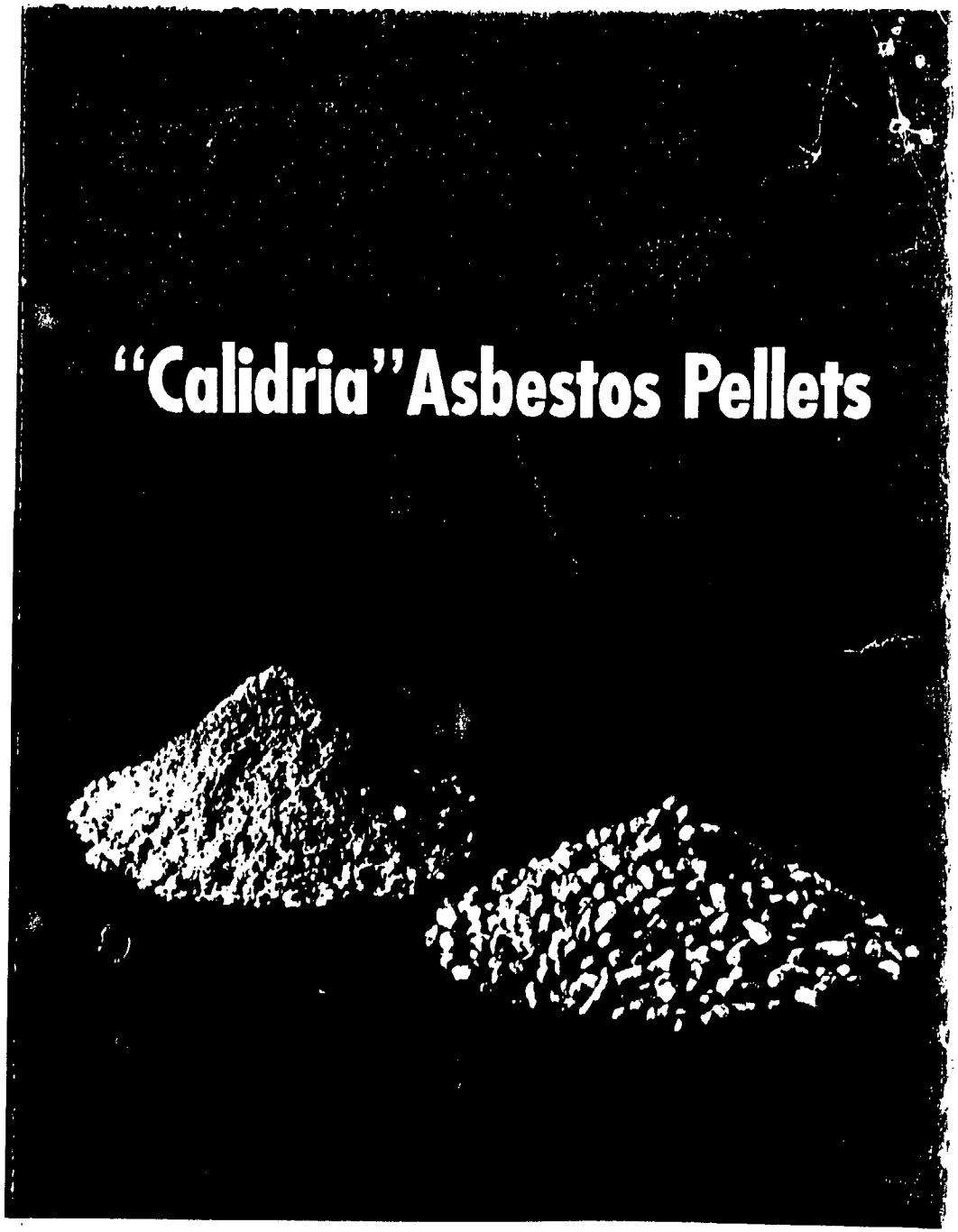
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METALS DIVISION
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Union Carbide Corporation is the only source of pelletized asbestos, essentially dust-free and readily bulk-handled. The front cover of this issue shows a comparison of "Calidria" Asbestos Open Fiber and Pellets.

Union Carbide trial exhibit UC-863: Union Carbide Calidria Asbestos Product Brochures for Rubber, Resins, Thix...
ACL Doc 16074 · Page 122 of 130

"Calidria" Asbestos Pellets

[The following article was prepared by John L. Myers, Marketing Manager for Calidria Asbestos Metals Division, Union Carbide Corporation, Niagara Falls, New York. Mr. Myers will gladly handle any requests for samples or additional information regarding Calidria Asbestos pellets and other products.]

An unusual asbestos orebody, one of the world's largest mineral deposits, is located in California near Coalinga. This deposit is unique in that it contains only Chrysotile asbestos and consists entirely of the short-fiber mineral, equivalent to Canadian Grade 7 or shorter. Union Carbide Corporation began development of this deposit several years ago; however, normal markets for the mineral were found to be limited since it occurred in only one basic fiber length. Development and use of a proprietary, hydraulic beneficiation process subsequently enabled Union Carbide to create a series of asbestos products which were completely new to the Industry. Although some of these products are used in conventional applications, many new uses have been found for this extremely versatile material.

The most important innovation which Union Carbide has contributed to the Industry is pelletized asbestos. Asbestos pellets, marketed under the trade name "Calidria," were introduced primarily as a means to minimize asbestos dust. Pellets also cost less to ship and can lead to savings in handling and operating costs.

"Calidria" Asbestos pellets are nominally ⅛" in diameter by ¾" long and they are available in bags on unitized pallets or in hopper cars. They have a bulk density of 44 pounds/ft^3 (50 ft^3/ton) and a 50-55° angle of repose. Pellets can be handled and conveyed by pneumatic or mechanical means, thereby permitting automatic or semi-automatic operations. The use of a closed transfer system, from hopper car storage to point of use, could eliminate exposure to asbestos dust. The pellets are friable and can be dispersed in dry form or in aqueous or resinous systems with conventional grinding equipment. No binder is used to make the pellets and they contain

over 95% fiber, a significantly higher amount than any other short fiber Chrysotile product.

Several grades of "Calidria" Asbestos pellets are available from Union Carbide Corporation for many applications, including: floor tile, drilling fluids, friction materials, plastics, roofing compounds, papermaking, rubber compounds, mineral board (ceiling tile), gypsum compounds and coatings. "Calidria" products are also available in the conventional powder or open-fiber form.

The advantages of the unique Coalinga ore, the proprietary beneficiation process and continuing research have enabled Union Carbide to introduce several products for applications new to the Asbestos Industry. These products include RG-144 which is a highly-refined fiber used as a thixotrope in epoxy and other resins, as a reinforcing filler in PVC and nylon and as a thickener in coating compounds.

"Calidria" Asbestos RG-244 is a surface-coated fiber designed for use as a thixotrope in polyester laminating resins and gel coats. It is also used for sag and viscosity control in vinyl plastisols, organosols and many other systems. RG-244 is less expensive and, in most cases, outperforms pyrogenic silica at similar loadings.

Two titanated asbestos products are now available from Union Carbide. Introduced several years ago as a TiO_2 extender or replacement in papermaking, "Calidria" Asbestos T-135 is now being used in spray acoustic and other interior coatings, and as a combination filler-reinforcer in non-black rubber compounds. T-135, available in pellets or open fiber, is made from highly-refined asbestos and anatase TiO_2.

A similar product, CG-135, has rutile TiO_2 dispersed along the fibers. This product is being introduced for use in latex paint coatings and similar applications as a partial replacement for TiO_2.

"Calidria" Asbestos products are available from the processing mill in King City, California, from several warehouse locations throughout the United States, and in several foreign countries.

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Calidria ASBESTOS

UNION CARBIDE CORPORATION • METALS DIVISION • P. O. BOX 579 • NIAGARA FALLS, N.Y. 14302 • TEL: 716-278-3376

RESIN-GRADE 110

A Highly Effective Viscosity Control Agent for Asphaltic Compounds

CALIDRIA Resin-Grade 110 (R-G 110) is a finely-divided short-fiber chrysotile asbestos product designed for use in asphaltic and similar compounds where good bodying is required at low concentrations. Because of its extremely high purity, R-G 110 is essentially non-abrasive and can meet the demanding performance of air-less spray applications.

The thickening efficiency of R-G 110, graphically shown on the opposite side of this sheet, is attributed to its high "liberated fiber" content and its surface area of over 50 m^2 per gram. It is unusually uniform and consistent, the result of a unique hydraulic processing system and a very pure California asbestos ore.

TYPICAL CHARACTERISTICS OF CALIDRIA R-G 110

Specific Gravity	2.45
Reflectance, Photovolt	68%
Surface Area, BET-Nitrogen	55 m^2/gm
Magnetite Content	1.5%
pH (5% aqueous slurry)	9
Alkalinity, as $\%Na_2O$	0.06
Bulking Value	4.8 gal/100#
Oil Absorption, #DOP/100# R-G 110	110
Wet Bulk, 10gm/250ml/1hr, settled vol. (ml)	220
Particle Size, wet screen, retained on 325M	12%
Dry Bulk, aerated	$5\#/ft^3$
Dry Bulk, as packaged	$14\#/ft^3$

A00110

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Calidria® ASBESTOS



Effective: January 1, 1981

RG-110

. . . a low-cost, efficient filler and viscosity control agent for use in asphaltic, polyester premix, and similiar compounds. Enhances dispersion of aluminum and other pigments.

NET PRICES — CENTS PER LB. — F.O.B. SHIPPING POINT — SOLD ONLY IN FULL-PALLET MULTIPLES

SHIPPING POINTS	Carload, 72,800 lb.	23,800 lb. or more	1,400 lb. to 22,400 lb.
	52 pallets	17 or more pallets	1 to 16 pallets
King City, Calif. *(plant)*	13.5	14.5	20.0
Atlanta, Ga. Finderne, N.J. Hammond, Ind. *(warehouses)*	—	23.5	29.0

Prices subject to change without notice.

PACKAGING INFORMATION

Package	Pallet	Carload		Truckload	
Weight	Weight	Weight	Pallets	Weight	Pallets
35 lb.	1,400 lb.	72,800 lb.	52	23,800 lb.	17

• Packages are shrink-wrapped at no extra charge.

TO ORDER . . . OR ASK A TECHNICAL QUESTION — call or write your nearest "Calidria" asbestos office below:
Northeast: P.O. Box 579, Niagara Falls, N.Y. 14302 — Tel.: 716-278-3371
South: 17 Executive Park Drive, Atlanta, Ga. 30329 — Tel.: 404-321-6600
Midwest: P.O. Box 579, Niagara Falls, N.Y. 14302 — Tel.: 716-278-3365
West: 100 Oceangate, Long Beach, Calif. 90802 — Tel.: 213-435-3721
Plant: P.O. Box K, King City, Calif. 93930 — Tel.: 408-385-5961

TRUCKLOAD PRICING is based on minimum quantities shown above. However, to facilitate compliance with DOT regulations, Union Carbide reserves the right to load trucks to full volume or weight capacity and to adjust customer orders accordingly.

COMBINED SHIPMENTS — Shipments of one or more pallets of any "Calidria" asbestos product may be combined with one or more pallets of any other "Calidria" product for total quantity price, based on the total number of pallets ordered.

IMPORTANT — Terms are net cash 30 days from invoice date. Prices apply within continental U.S.A. Union Carbide reserves the right to adjust customer's orders to comply with the ordering quantities shown above.

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CALIDRIA

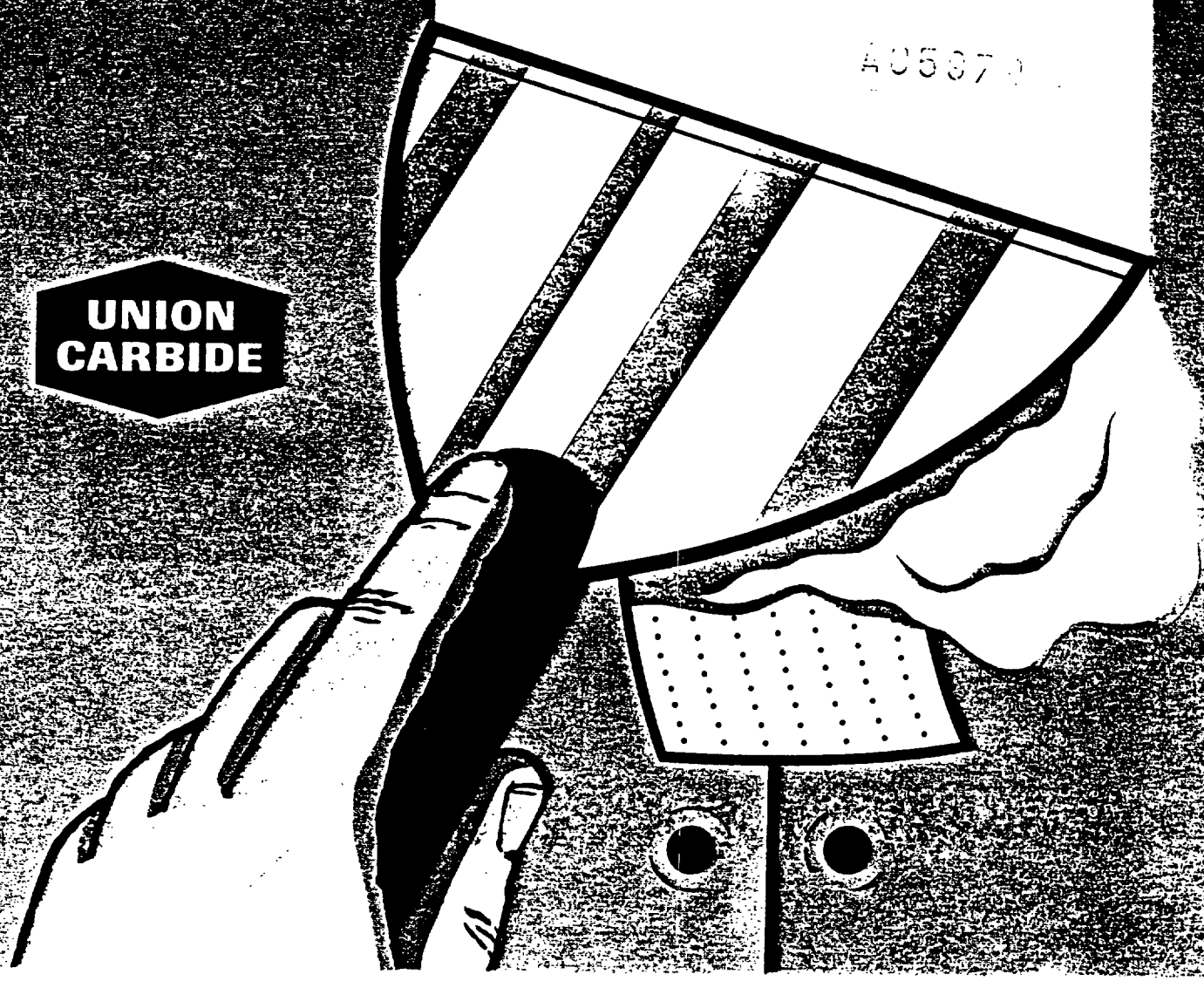
ASBESTOS SG-210

...an economical, highly efficient product to strengthen and control viscosity of dry and ready-mix

...TAPE-JOINT COMPOUNDS

A0537

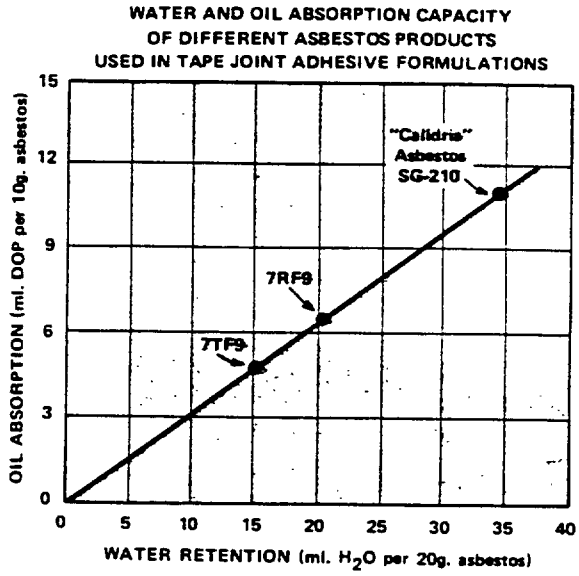
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Calidria ASBESTOS

SG-210 for TAPE-JOINT COMPOUNDS



The high-purity, finely ground fibers of "Calidria" asbestos SG-210 offer many advantages compared to other types of asbestos including:

MORE EFFICIENT STRENGTHENING

"Calidria" asbestos SG-210 fibers are ground to a fine size, with over 85% of the fibers less than 325 mesh. The product therefore has a large surface area and more active sites to interact with the inert fillers in the compound. Formulators using "Calidria" asbestos therefore need less material to give dimensional strength to the finished joint.

MORE EFFICIENT VISCOSITY CONTROL

The fibers of "Calidria" asbestos SG-210 can absorb vast amounts of water – generally about 400 times their weight. As shown by the graph above, this unique asbestos absorbs from 70 to 125% more water and oil than other types of asbestos. Thus, less "Calidria" asbestos is needed to reach a given viscosity.

40% SMALLER ADDITIONS

This reduction can be made by most users switching to "Calidria" asbestos SG-210 from other types of asbestos. Such a reduction allows substantial savings in the amount of asbestos to be handled and stored. To make up for the weight difference, extra limestone should be added to the system.

LESS CRACKING

The smaller addition needed with "Calidria" asbestos SG-210 reduces shrinkage problems that often occur with large asbestos additions. SG-210 users have reported that cracking over nailholes and along feathered edges has been minimized.

SMOOTHER, WHITER COMPOUNDS

The tiny particles of "Calidria" asbestos SG-210 give very smooth compounds when spread and dried. The absence of rock dust and abrasive fillers in this asbestos also contributes to the smoothness. There are no impurities that can discolor the system, so that a whiter compound can also be obtained.

CONVINCE YOURSELF

To test the effectiveness of "Calidria" asbestos SG-210, make up a small batch of your present formulation. Add 60% of your normal asbestos addition using "Calidria" asbestos SG-210. Then make up for the difference in weight using limestone. Overall water demand should be about the same but sometimes varies according to the ingredients in the formulation. Withhold about 10% of the water for final viscosity adjustment at the end of mixing. Then test the properties of the formulation made with SG-210 . . . and compare.

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Why is "Calidria" asbestos different?

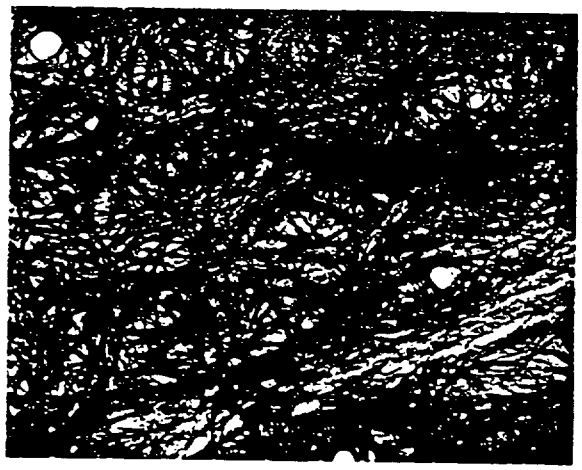
"Calidria" products are made from high-purity, short-fiber chrysotile asbestos obtained from a unique deposit about 160 miles south of San Francisco, California. Unlike conventional deposits that extend through the host rock, this deposit is essentially free of hard, consolidated rock masses. Further, the ore assays up to 60% asbestos compared to conventional deposits which contain from 6 to 10% asbestos.

Special hydraulic beneficiation techniques developed by Union Carbide efficiently break down the fiber bundles and remove the rock and impurities from the asbestos fiber. As a result, all "Calidria" products are over 95% pure asbestos whose fibers are 98% liberated from fiber bundles.

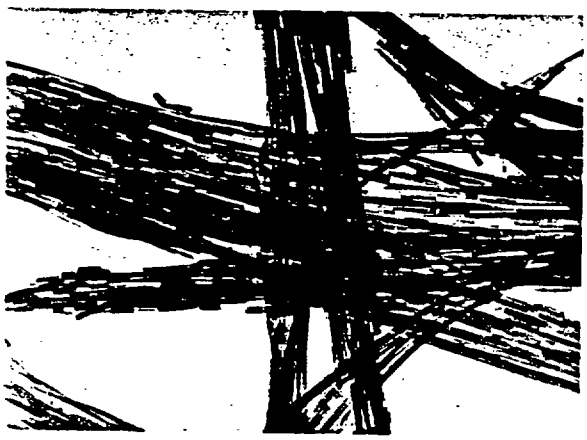
SG-210 is finely ground for use in tape-joint compounds.



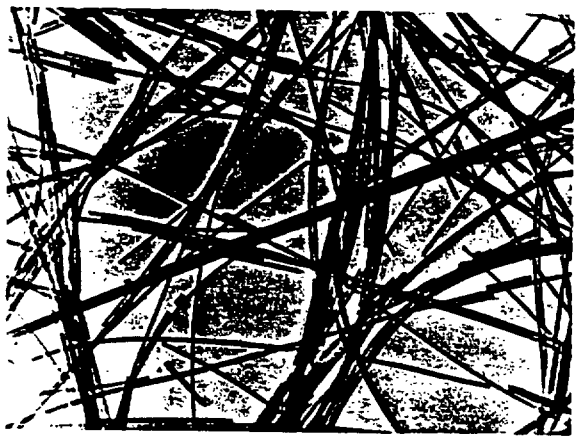
CANADIAN ASBESTOS – AS-MINED – Individual fiber bundles are straight and tightly bonded, surrounded by consolidated rock masses. In this form, the fibers defy separation from each other and from the host rock.



"CALIDRIA" ASBESTOS – AS-MINED – Here the fibers are randomly oriented and essentially free of hard rock masses. Further, the ore assays up to 60% asbestos, considerably more than the Canadian ore.



"CALIDRIA" ASBESTOS – IF DRY-PROCESSED – Even the most exacting dry processes do not completely break down the fiber bundles into individually liberated fibers. Union Carbide technology developed a special wet process to liberate the fibers.



"CALIDRIA" ASBESTOS – UNIQUELY WET-PROCESSED – Union Carbide's process separates 98% of the fibers from the fiber bundles. The fibers contain virtually no rock dust, abrasive fillers, or impurities that can mar tape-joint compounds.

AC5321

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Use "Calidria" Asbestos T-135 in Acoustical and Texturing Compounds

Containing high-purity asbestos and TiO_2, "Calidria" asbestos T-135 is a low-cost pigment with secondary thickening action. The titanium dioxide particles are uniformly dispersed along the asbestos fibers and are firmly fixed to the fiber surface by electrostatic attraction. These dispersed TiO_2 particles give maximum optical efficiency and allow T-135 to replace TiO_2 on a pound-for-pound basis. The effective thickening ability of the high-purity asbestos fibers also allows removal of asbestos and partial removal of other thickeners. "Calidria" asbestos T-135 therefore provides savings in many spray-ceiling acoustic and wall-texturing compounds.

[redacted]

UNION CARBIDE

UNION CARBIDE CORPORATION
MINING AND METALS DIVISION
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MARKETING AND TECHNICAL CENTER: P.O. Box 579, Niagara Falls, N.Y. 14302 Tel.: 716-278-3376

PLANT: P.O. Box K, King City, California 93930 Tel.: 408-385-5961

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"Calidria," "Cellosize," "UCAR," and "Union Carbide" are registered trade marks of Union Carbide Corporation.

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ORMANCE DATA IN 3 READY-MIX FORMULATIONS

	BEDDING-COAT TAPE-JOINT COMPOUND		GENERAL-PURPOSE TAPE-JOINT COMPOUND		TAPE-JOINT TOPPING COMPOUND	
ND ORDER OF ADDITION*	lbs. per 100 Gal.	% by Weight	lbs. per 100 Gal.	% by Weight	lbs. per 100 Gal.	% by Weight
ickener	424.16	31.39	421.67	31.35	399.81	28.27
	4.41	0.32	4.41	0.32	6.96	0.49
	1.72	0.13	1.73	0.13	1.84	0.13
	14.01	1.04	14.01	1.04	–	–
0	90.94	6.73	–	–	80.47	5.89
1	–	–	97.55	7.25	–	–
	5.23	0.39	–	–	4.62	0.33
	8.74	0.65	8.74	0.65	9.39	0.66
SG-210	39.62	2.92	39.19	2.92	42.17	2.97
	–	–	91.60	6.81	–	–
	184.34	13.66	91.60	6.81	23.36	1.65
	–	–	–	–	93.20	6.60
	35.04	2.60	21.71	1.62	9.24	0.66
No. 1 white	542.17	40.11	–	–	729.53	51.56
	0.88	0.06	–	–	–	–
	–	–	–	–	9.24	0.66
	–	–	4.35	0.32	4.67	0.33
	–	–	8.77	0.65	–	–
No. 1 white	–	–	539.69	40.13	–	–
	1351.26	100.00	1345.02	100.00	1414.50	100.00
TIES	35.1%		35.1%		30.66%	
	700 B.U.		600 B.U.		840 B.U.	
ard Tape	100%		100%		100%	
esistance	99%		95%		92%	
	Good		Good		Good	

-gallon mixer at 79 r.p.m.

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TYPICAL PHYSICAL PROPERTIES

Reflectance (G.E. Photovoltmeter)	69%
Magnetite Content	2% max.
Alkalinity	0.5 to 0.6% of Na_2O
pH in Water (5% slurry)	8.5 to 9.5
Surface Area (BET)	50 to 60 sq. m. per g.
Oil (DOP) Absorption	100 to 110 lb. per 100 lb. asbestos
Water Absorption	62 to 65 weight % in filter cake
Wet Bulk Density (settled volume after 1 hour)	220 ml. for 10 g. asbestos in 250 ml. container
Dry Bulk Density	4 to 5.5 lb. per cu. ft.

SIZE DISTRIBUTION

Cumulative retained on 100 mesh screen	0.6%
Cumulative retained on 200 mesh screen	3 to 6%
Cumulative retained on 325 mesh screen	10 to 15%

PACKAGING AND AVAILABILITY

One Package – Weight (3-ply paper bag)	30 lb.
One Pallet – Weight – Dimensions	1,200 lb. approx. 53 in. x 44 in. x 69 in. high
Full 50-ft. Carload (available from King City, Calif. plant)	52 pallets 62,400 lb.
Full 40-ft. Truckload (available from several locations nationwide)	17 pallets 20,400 lb.

TYPICAL PER

INGREDIENTS
Water
"Cellosize" TJC
Bacteriastat
Anionic Dispers
"UCAR" Latex
"UCAR" Latex
Dibutyl Phthala
Ethylene Glyco
"Calidria" Asbe
Mica, AA
Mica, P-80-F
Mica, Ser-X
Clay, ASP-400
Calcium Carbon
PD #1 Defoam
Talcum Powder
Water Conditior
Talc
Calcium Carbor
T
TYPICAL PRO
Water Content
Brabender Visc
Adhesion to W
Nailhole Cracki
Sandability

*Mixed 1.5 to 2.0 hou

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