PLAINTIFF'S EXHIBIT

UC-3844

THE UNION CARBIDE "CALIDRIA" ASBESTOS BUSINESS

In 1957 a Union Carbide exploration geologist was in central California looking for nickel or other metallic mineral deposits which could be of value to the Corporation. He took note of a peculiar white, leathery mineral which was eventually determined to be chrysotile asbestos in a unique physical form. Exploration activities were centered in the nearly town of Coalinga, and the deposits have become known as Coalinga Asbestos.

Asbestos (from a Greek word meaning non-burning) is a commercial term applied to several fibrous metal silicate minerals which are fire-proof and capable of being processed into flexible fibers. There are six varieties of asbestos which are divided into two groups, serpentine and amphibole, based on their crystal structure ([redacted]). Chrysotile is the only member of the serpentine group while the amphiboles include crocidolite, amosite, anthophyllite, tremolite and actinolite.

Chrysotile accounts for over 95% of world consumption; and, of the amphiboles, only crocidolite and amosite have any commercial significance. Sources and general uses of the three varieties are shown in Att. 2; and Att. 3 summarizes comparative data for them.

Based on epidemiological and other data, many medical and scientific authorities agree that crocidolite and amosite are more harmful to human health than chrysotile. Although U.S. regulations do not reflect this, the UK and other countries have severely restricted the use of crocidolite and amosite.

Chrysotile has several characteristics which are responsible for its widespread usage in over 3000 applications: worldwide availability, positive surface charge, flexibility, softness, high tensile strength (see Att. 4). Chrysotile occurs only in serpentine (California's official State Rock), which is a fine-grain rock composed almost entirely of hydrous magnesium silicate minerals similar to chrysotile in composition. Canada is the free world's largest producer of chrysotile asbestos, and supplies about 90% of the U.S. asbestos requirements.

The Canadian and most other deposits of serpentine contain chrysotile in cross-fiber veins that are rarely more than half an inch thick. A typical ore contains only 6-10% fiber, of random lengths and tightly bonded together in a parallel configuration (see Att. 5). The Coalinga Asbestos deposit bears little resemblance to other serpentine bodies found throughout the world since most of the mass has been highly sheared and pulverized by nature. It consists of soft, friable sheets and clumps of asbestos fibers, and the only other known ore body of this type is the Stragari deposit in Yugoslavia. In contrast to the cross-fiber arrangement of conventional ores, the Coalinga deposit occurs as a swirling mesh of disoriented fibers (see Att. 5). Each fiber or fiber bundle is only in point contact with its neighbor, and the fiber content ranges from 50-60%.

The Coalinga deposit is located in the southern part of the Diablo Mountain range, in Fresno and San Benito Counties ([redacted]). It is in what is known

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as the New Idria mining district, which has long been famous as the oldest producing mercury mine (since 1853) in the United States, and is thought to be the largest single mineral deposit in the world. (Union Carbide's trade-name "CALIDRIA" is a combination of "CAL" from California and "IDRIA" from New Idria.) Rich asbestos ore has been found over an area of 40-50 square miles, and to depths of over 500 feet. Conservative estimates indicate that over one hundred million tons of Chrysotile asbestos are available, while Canada's ore reserves have been estimated at less than 50 million tons.

In addition to having a very low fiber content, Canadian ore deposits contain fibers of various lengths, from a few microns up to several inches. These are defined by Canadian screening tests and designated as Grades 3 through 7 (see Att. 8). Conventional Canadian processing techniques include blasting, crushing, grinding and air classifying. A typical Canadian Grade 7 product will contain about 30-40% serpentine rock dust and 60-70% asbestos fibers. Most of the fibers will still be in bundles as shown in Att. 5.

Union Carbide mines the Coalinga ore by conventional open pit methods ([redacted]). After removing 20 feet or less of overburden, ripper-equipped bull-dozers and self-propelled scrapers are used to remove ore from the deposit. Before hauling the ore 55 miles to the plant near King City, it is screened to minus 3/4-inch. Mining operations are carried out every other year during the dry season (May to October), and ore is delivered to the plant every year during this same period. Mining and hauling are sub-contracted, but supervised by plant personnel.

Union Carbide evaluated various dry processing methods but the best product looked little different than that depicted in Att. 5 and performed very similar to Canadian asbestos. An investment to produce such a product for conventional asbestos applications was not justified. In order to take full advantage of the unique features of the Coalinga ore deposit (summarized in Att. 11), a hydraulic beneficiation process was developed. Conventional mineral processing techniques were combined with the innovative use of special equipment and a plant was designed with three basic systems: rock fiber separation, refining, and special treatment (see Att. 12). This enables production of three basic product categories: fiber, colloidal, and modified, all with liberated fibers as shown in Att. 5.

The semi-works plant (~~see Att. 14~~) was started in 1963 and was expanded to its present capacity, except for RG-244, in 1966. The asbestos business was in the Nuclear Division until 1965 when it was transferred to the Metals Division.

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I

ASBESTOS - HYDRATED METAL SILICATE

SERPENTINE

CHRYSOTILE

AMPHIBOLE

CROCIDOLITE

AMOSITE

ANTHOPHYLLITE

TREMOLITE

ACTINOLITE

#9

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~~ATT. 2~~

GENERAL ASBESTOS INFORMATION - U.S.

	Major Sources	Applications	1978 Estimated U.S. Consumption
Chrysotile	U.S., Canada *Russia - starting to export.	Cement, tile, friction materials, textiles, plastics, insulation, asphaltics	632,000 T
Crocidolite	So. Africa	Reinforcing, insulation	16,500 T
Amosite	So. Africa	Insulation, packings	1,500 T
		TOTAL	~~641,000~~ T + 650,000

*World's biggest producer, but did not export until recently

*Prior US ~ 500,000 tons

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COMPARATIVE DATA FOR ASBESTOS MINERALS

	CHRYSOTILE	*CROCIDOLITE	*AMOSITE	ANTHOPHYLLITE
FORMULA	$3MgO \cdot 2SiO_2 \cdot 2H_2O$	$Na_2O \cdot Fe_2O_3 \cdot 3FeO \cdot 8SiO_2 \cdot H_2O$	$1.5MgO \cdot 5.5FeO \cdot 8SiO_2 \cdot H_2O$	$7MgO \cdot 8SiO_2 \cdot H_2O$
COMPOSITION,%				
SiO_2	37-44	49-53	49-53	56-58
MgO	39-44	0-3	1-7	28-34
FeO	0-6	13-20	34-44	3-12
Fe_2O_3	0-5	17-20	-	-
Al_2O_3	0-2	-	2-9	0-2
H_2O	12-15	2-5	2-5	1-6
CaO	0-5	-	-	-
Na_2O	-	4-8	-	-
$CaO+Na_2O$	-	-	0-3	-
CRYSTALS	FINE FIBERS	BRITTLE FIBERS	PRISMATIC CRYSTALS	PRISMATIC CRYSTALS
COLOR	GRAY/GREEN	BLUE	GRAY/BROWN	GRAY
TEXTURE	SOFT/SILKY	HARSH	HARSH	HARSH
FLEXIBILITY	VERY GOOD	GOOD	GOOD	POOR
HARDNESS,Mohs	2.5-4	4	5.5-6	5.5-6
FIBER DIA., Å	180-300	600-900	600-900	600-900
TENSILE, Mpsi	800	600	200	<4
SURFACE CHG.	POSITIVE	NEGATIVE	NEGATIVE	NEGATIVE
RES. TO ACID	POOR	GOOD	GOOD	VERY GOOD
RES. TO ALK.	GOOD	GOOD	FAIR	GOOD

SOURCE: MODERN PLASTICS ENCYCLOPEDIA (1972-3), AND ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY, VOLUME 2, P. 136 (1948).

*Belived most harmful forms.

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ADVANTAGES OF CHRYSOTILE FIBER

POSITIVE SURFACE CHARGE

FLEXIBILITY

TENSILE STRENGTH

LOW REFRACTIVE INDEX

SOFTNESS

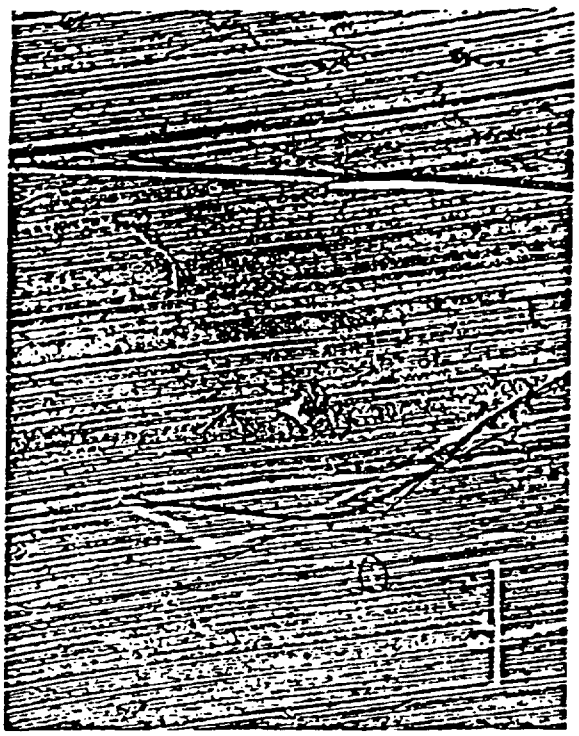
WORLDWIDE AVAILABILITY

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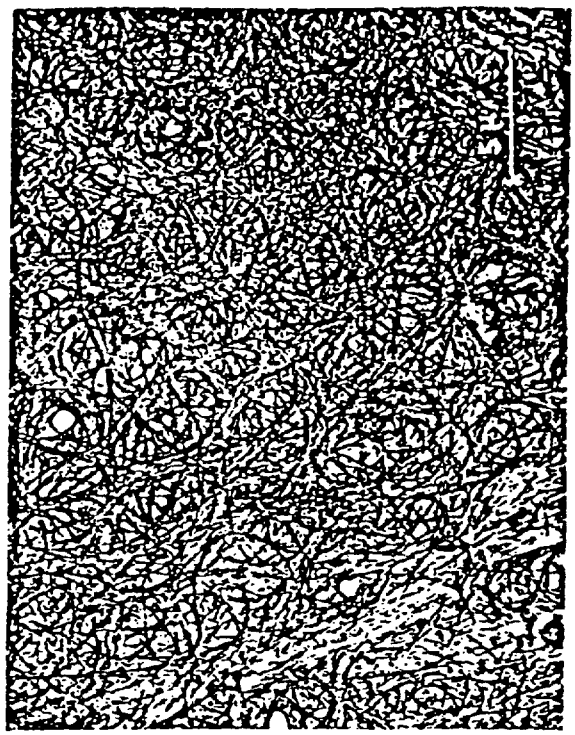
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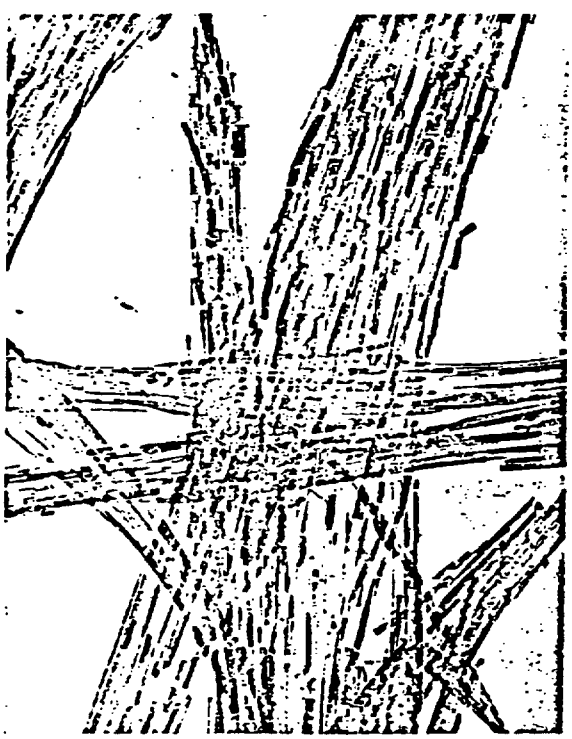
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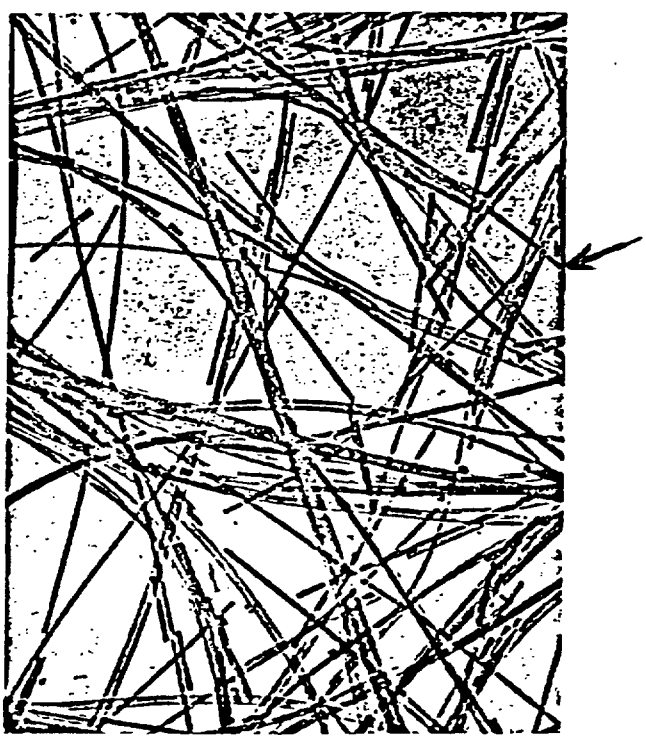
Typical Canadian asbestos fiber structure
ORE



Typical Calidria asbestos fibers
ORE



Dry processed asbestos fibers



Wet processed Calidria asbestos fibrils

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ATT. 19

MAJOR WORLD SOURCES OF ASBESTOS

(BASED ON 1977 USBM ESTIMATES)

COUNTRY	SHORT TONS
USSR	2,710,000
CANADA	1,700,000
SO. AFRICA	419,000
SO. RHODESIA	220,000
P.R. OF CHINA	220,000
ITALY	170,000
BRAZIL	105,000
U.S.A.	102,000
AUSTRALIA	61,000
TOTAL	5,879,000

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CHRYSOTILE ASBESTOS CLASSIFICATION

	Group No.	Description	Application	Quebec Price Range (7/1/79)
long fibers	3	Spinning Fiber	Textiles	$1023-1606/T
	4	Shingle Fiber	Asbestos Cement	687-1011
med.	5	Paper Fiber	A/C, Paper, Felt, Friction Products	388- 580
	6	Waste	" " " " "	330- 352
short	7 D-M	Shorts	Millboard, Paper & Felt, Roofing, Friction Prod.	113- 218
	7 R,T	"	Floor Tile, Roofing, Drilling Mud, Caulks, etc.	

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CALIDRIA is shorter than grade 7.

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U.S. Chrysotile Consumption - 1978

	Tons	% of Total**
Asbestos-cement pipe	153,000	24.0
Flooring Products*	147,000	23.0
Friction Products	86,400	13.5
Roofing Products*	61,000	9.5
Asbestos-cement sheet	41,400	6.5
Coatings & compounds*	35,200	5.5
Packings & gaskets	25,600	4.0
Paper	22,400	3.5
Insulation (Thermal & Electric)	19,200	3.0
Textiles	9,600	1.5
Plastics*	6.400	1.0
Other*	32,000	5.0
TOTAL	640,000	100

**"Asbestos", December 1978, pp. 16-18

* Markets in which UCC participates

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UNUSUAL CHARACTERISTICS OF CALIDRIA COALINGA ORE

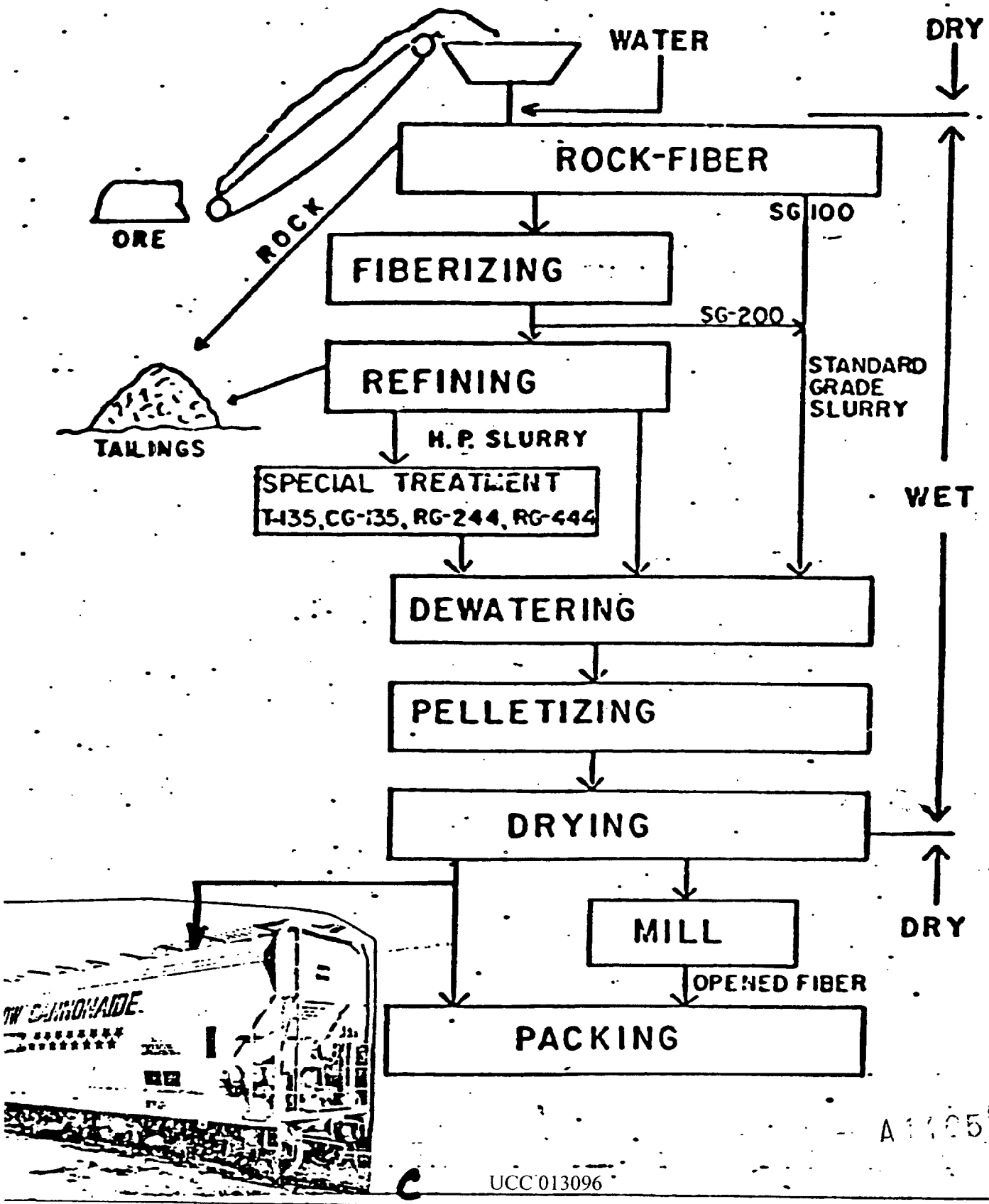
1. ALL CHRYSOTILE
2. ALL SHORT-FIBER
3. RANDOM-ORIENTED FIBERS
4. OVER 50% FIBER CONTENT
5. STRIP-MINING

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CALIDRIA ASBESTOS PRODUCTION



UCC 013096

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IMPORTANT CHARACTERISTICS OF CALIDRIA FIBER

- HIGH SURFACE AREA, 60-80 m^2/gm
- HIGH TENSILE STRENGTH, UP TO 800,000 psi
- CATIONIC SURFACE CHARGE
- COLLOIDAL FORM, AVERAGE L/D OF 200
- EXTREMELY HIGH PURITY, 90-99% FIBER
- ESSENTIALLY INERT
- HIGH TEMPERATURE STABILITY-TO ABOUT 700°C
- LOW REFRACTIVE INDEX, 1.51 - 1.55

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CHRYSOTILE ASBESTOS PRODUCTS

PROPERTIES:

	magnetite grit (%)	reflectance (brightness) (% MgO)	specific surface (m^2/g)	dry bulk density (lb/ft^3)	wet bulk volume (ml/2g)	water reten. (g/20g)	oil adsorption (ml/10g)
UCC HIGH PURITY	0.5	75-76	50-70	3-4	990	40	10-14
UCC STANDARD	2-3	60-70	40-60	10-12	300-400	22	7-9
QUEBEC NO. 7	3-4	55-65	10-30	14-16	300-400	14	4-5

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AD

1978

CALIDRIA ASBESTOS DOMESTIC APPLICATIONS AREAS

(1)	Floor Tile	SG-100 SG-200
(1)	Phenolic Compounds	SG-210 HPO
(1)	Roofing Compounds	SG-210 HPO
(1)	Asphaltic Coatings	SG-130 SG-144 RG-110
(1)	Rubber-Sheet Goods	HPP RG-100
(2)	Adhesives	RG-144 RG-244
(2)	Sealants	RG-144 RG-244
(2)	Polyester Laminates	RG-244
(2)	Coatings	CG-135 RG-144 RG-244
(1)	Drilling Muds	Visb. CSV SHUR
(1)	Miscellaneous	

(1) Asbestos Industry

(2) Non-Asbestos Industry

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UCC 013099

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