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BUREAU OF MINES
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The Talc Industry–An Overview

By Robert L. Virta

UNITED STATES DEPARTMENT OF THE INTERIOR

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(United States. Bureau of Mines)

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

in	inch	st/yr	short ton per year
μm	micrometer	yr	year
st	short ton		

THE TALC INDUSTRY-AN OVERVIEW

By Robert L. Virta[1]

ABSTRACT

This U.S. Bureau of Mines paper discusses the structure of the talc industry, talc production, processing of talc ore, applications and demand for talc, and the outlook for the talc industry.

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INTRODUCTION

The mineral talc, a soft, hydrous magnesium silicate, $Mg_6Si_8O_{20}(OH)_4$, is formed through hydrothermal alteration of ultrabasic rocks and low-grade metamorphism of siliceous dolomites (*1*).[2] In addition to the mineral talc, talc deposits may also contain magnesite, quartz, chlorite, magnetite, serpentine, anthophyllite, tremolite, dolomite, and actinolite (*2*). The mineralogy of each deposit is determined by the metamorphic conditions under which it formed.

A high-purity massive talcose rock is called steatite, while the impure massive variety is referred to as soapstone. Lava is used to designate block talc or finished products made from block talc. French talc is a soft, massive variety of talc used for marking cloth (*3*).

Talc has been used commercially for over 100 yr in the United States. It is most widely recognized for its use in talcum powders, although the major consumers of talc are the ceramics, paint, paper, and roofing industries.

This paper reviews changes that have occurred in the talc industry in recent years and provides background information on the current talc industry.

INDUSTRY STRUCTURE

There were 19 talc mining companies operating in the United States in 1988. These companies generally were structured to cover all aspects of talc mining, from mining to processing (*3*). Only a few of them hired custom grinders to process the ore. Most companies conducted their own marketing programs, although sales were also made through mineral brokers. Most companies conducted in-house research to develop new end uses for their products and to test the performance of their talc in established product lines. The largest companies were Cyprus Industrial Minerals Co.; Dal-Briar Co. (Texas Talc); Gouverneur Talc Co., a subsidiary of R. T. Vanderbilt Co. Inc.; Pfizer Inc., Minerals, Pigments, and Metals Division; Vermont Talc Co.; and Windsor Minerals Inc. (*4*).[3]

More than half of the domestic talc producers are either divisions or subsidiaries of larger, more diversified organizations. These subsidiaries can be affiliated with domestic or foreign companies. Examples include Southern Clay Products Inc., a subsidiary of Eastern China Clay America Inc.; Southern Talc Co., a subsidiary of United Catalysts Inc.; Dal-Briar, a subsidiary of Dal-Tile Inc.; and Westex Minerals Co., a subsidiary of Milwhite Co.

Approximately 120 companies operated between 150 and 200 talc mines in 41 market economy countries (*5*). The largest market economy country companies were AS Norwegian Talc of Norway, Costalco Mineracao e Comercio Ltda. of Brazil, Finnminerals of Finland, the Golcha Group in India, Talcs de Luzenac of France, and Western Mining Corp. Ltd. of Australia.

The increasing international nature of the minerals industry is influencing the industry structure. Many companies, in an effort to offer a wider range of talc grades, have made international marketing agreements. For example, in 1982, R. T. Vanderbilt began marketing certain grades of talc produced by Canada's Steetley Talc Ltd. to supplement its line of tremolitic talc products (*6*). In 1986, Cyprus Industrial Minerals obtained exclusive rights to purchase cosmetic talc produced by Mount Seabrook Talc NL of Australia as a means of improving its market in Europe (*7*).

Many companies, rather than enter into an international agreement, acquire full or partial ownership of foreign mining operations. Doing so permits companies to have access to major markets at lower transportation cost and permits the purchasing company and acquired company to jointly increase their capital investments for process upgrading (*8*). Several companies involved in international ownership are Cyprus Industrial Minerals Co., Eastern China Clay International plc, Talcs de Luzenac, and Steetley Industries Ltd.

PRODUCTION

In 1987, 34 of the 38 active talc mines in the United States were open pit operations. Open pit mines are generally safer than underground mines and have better production rates (*9*). In 1985, over 93% of the talc ore produced in the United States came from open pit operations (*10*).

Open pit mining involves removing the overlying soil and rock to gain access to the talc ore, fragmenting the ore using explosives, and transporting the fragmented ore to a mill for processing. The cost of removing the overburden and waste rock is a major concern in such talc mining. The amount of waste removed is greatest during the initial stage of mine development and when the open pit is being expanded. The ratio of waste rock to talc ore removed from open pit mining operations was 6.8 to 1 in 1985; i.e., for every ton of talc ore recovered from the deposit, 6.8 tons of waste material was removed (*10*). Waste rock to

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[2] Italic numbers in parentheses refer to items in the list of references at the end of this report.

[3] Vermont Talc and Windsor Minerals were purchsed by Cyprus Industrial Minerals in 1988 and early 1989, respectively.

ore ratios up to 10 to 1 are not uncommon in talc mining operations.

Drilling and blasting are carefully planned to minimize costs and to achieve good fracturing of the ore. Massive talc ores require more blasting than fractured ores (*11*). Blasting is kept to a minimum and is carefully planned to produce blocks of adequate size when steatite-type talc is mined for sculpturing (*3*). In poorly indurated deposits, backhoes may be adequate to rip the material loose.

When the waste rock to ore ratio becomes too large, open pit mining becomes uneconomical and underground mining is used. Room-and-pillar and shrinkage stoping methods are used to mine talc underground (*11*). Room-and-pillar mining is used on flat or gently dipping ores. As the ore body is mined, pillars of ore are left in a regular pattern to support the roof of the mine (*12*). Shrinkage stoping is used on steeply dipping ore bodies. For the shrinkage stoping method, tunnels are driven into the base of the ore. Drilling and blasting proceed upward into the ore body. Following each blast, approximately one-third of the broken ore is removed for processing. The remainder supports the side walls of the stope and serves as a working platform for the miners as drilling proceeds upward into the ore body. When the stope is completed, all of the broken ore is removed and the walls of the stope are allowed to collapse. Typically, production is only a few tons per hour by either method (*11*).

A minimal amount of waste material is removed during underground mining because the mine is located essentially within the ore body. In 1985, the ratio of waste rock to talc ore was approximately 1 to 10.5 in underground mining (*10*).

In talc mining operations, the slipperiness of the talc ore can pose some unusual problems. Slip-reducing tires or chains may be used on mechanized loaders and haulers, and haulage slopes generally have gentle gradients. When mining underground, extensive cribbing and timbering may be required to support the rock and are placed carefully to minimize lateral forces acting on these support members (*3*).

PROCESSING

In many instances, the processing of the talc ore begins at the mine site. Selective mining and/or hand sorting are used to produce a high-grade feed for the mill. Optical sorters are used at a few operations to automate the sorting process. Sometimes the talc ore is washed to remove fine dust and impurities (*9, 13*).

At the mill, a variety of grinding and beneficiation strategies are used to produce the final ground product. Hammer mills and jaw crushers are used to reduce the size of the largest ore received (*9*). Roller mills commonly are used to produce the final product. When used in conjunction with air classifiers, roller mills can be used to grind talc to an approximate mean particle size of 5 to 10 μm or 0.00004 in. Where color is a critical factor, a ceramic-based grinding apparatus, such as a ceramic pebble mill, can be used. Talc is very soft, and reasonable grinding rates can be achieved by using ceramic grinding media (*11*). The grinding mills are sometimes equipped with oil or gas combustion chambers to permit simultaneous grinding and drying of the ore and are frequently used in closed circuit with air separators (*3*).

More sophisticated grinding techniques must be employed when particle sizes of approximately 3 μm or less are required. Fluid-energy mills or pulverizing mills are usually used for ultrafine grinding of the talc ore (*3, 9, 11*). Air pressure, moisture content, and temperature are carefully controlled for ultrafine grinding to optimize the process (*9*).

Flotation processes are used when the desired product purity cannot be obtained using conventional processing. Ore that has passed through a grinding circuit is used as the feed material for the flotation circuit. The ground material is chemically treated to prepare the ore for the flotation process. The treated ore is passed through rougher and cleaner cells, often making multiple passes, before being dewatered and thickened. The filter cake is dried in a flash dryer and ground in a pulverizer (fig. 1) (*3, 11*). Ore composition, reagent type, pulp density, pH of the flotation system, and residence time in the flotation circuits affect flotation efficiency. Sodium silicate is a common modifier used in flotation processes, and methyl isobutyl carbinol is a common flotation reagent. Details on the conditioning process and reagents generally are not released by the companies.

For some filler applications, additional processing of the talc products is desirable or required. For instance, most of the talc mined in Texas is dark green to black in color. The talc must be calcined to increase its whiteness before it can be used in many applications. Calcined talc that is used in plastics must be low in calcium, acid solubles, and impurities. Sometimes talc is surface-treated with an organic compound to enhance its performance in the manufactured product (*9*). The additional processing benefits the talc producer because it increases the value of the talc.

APPLICATIONS AND SPECIFICATIONS

Properties such as softness (1 on the Mohs scale), purity, fragrance retention, whiteness, luster, moisture content, oil and grease adsorption, chemical inertness, low electrical conductivity, high dielectric strength, and high thermal conductivity are important for commercial applications (*3*). These properties are not universal to all talcose materials

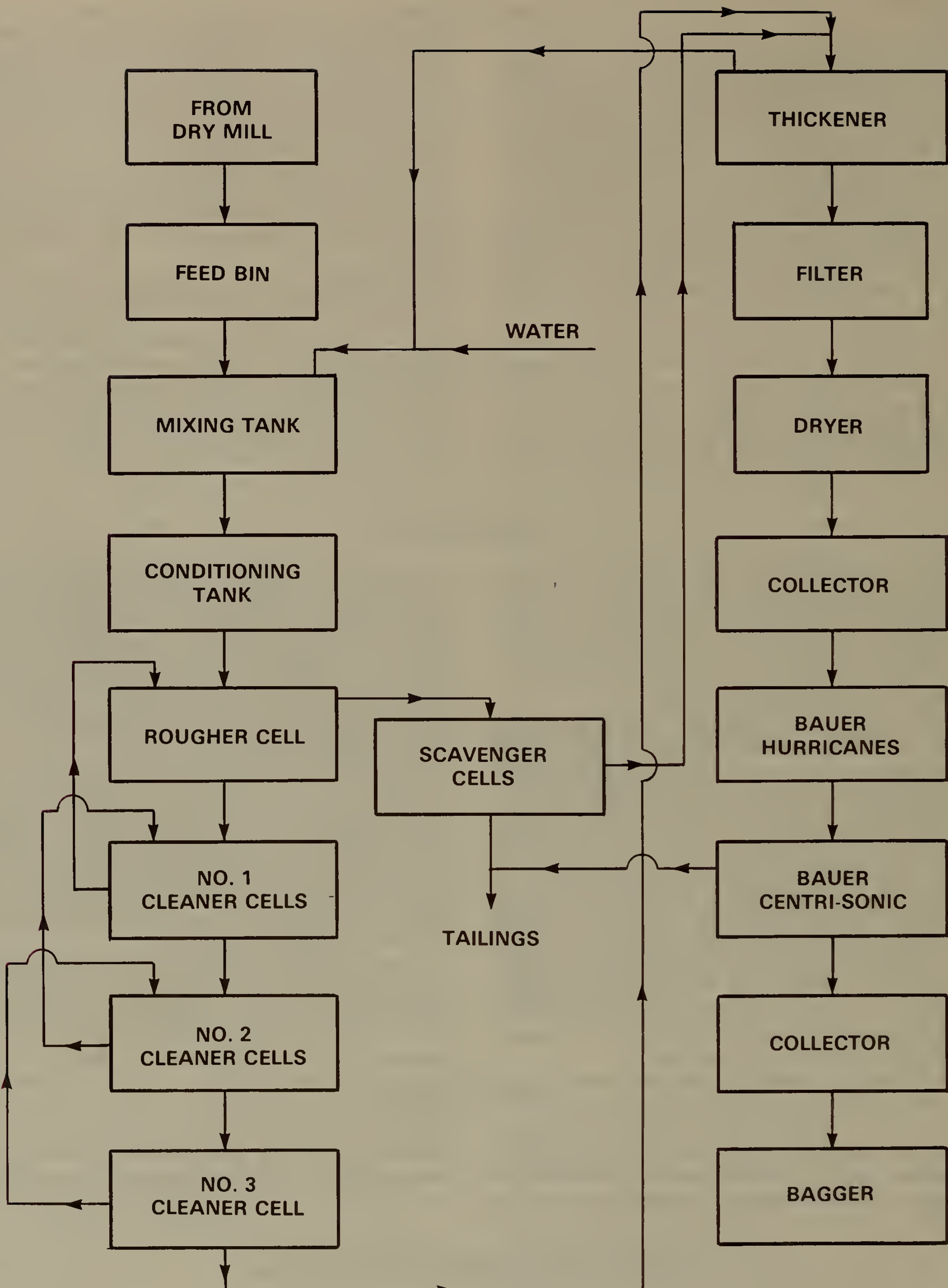

Figure 1.–Flowsheet for a talc flotation mill.

because of differences in the mineralogical compositions and particle shape (table 1). Mineral content is extremely important because it usually dictates the end use.

Table 1.–Mineral composition of talc deposits, percent

Mineral	California	Montana	New York	North Carolina	Vermont
Talc	85-90	90-95	35-60	80-92	80-92
Tremolite	0-12	0	30-55	0	0
Anthophyllite .	0	0	3-10	0- 5	0
Serpentine ...	0	0	2- 5	0	0
Quartz	<1	<1	1- 3	1- 3	<1
Chlorite	0	2- 4	0	5- 7	2- 4
Dolomite	0- 3	1- 3	0- 2	2- 4	1- 3
Calcite	0	0	1- 2	0	0
Magnesite ...	0	0- 5	1- 3	0	0- 5

Source: Grexa (*24*).

Talc is used primarily in ceramics, cosmetics, paint, paper, plastics, roofing, and rubber. Minor amounts of talc are also used for sculpturing block, foundry facings, and rice polishing, and as filler in asphalt, caulking, floor tile, insecticides, joint compounds, refractories, and stucco.

Ceramic-grade talc is used to produce wall tile, electrical ceramics, sanitaryware, stoneware, opaque glasses, vitreous china, catalytic converters, and other whiteware. Wall tile, electrical ceramics, sanitaryware, and stoneware are the most common uses of ceramic-grade talc. Although talc composes less than 5% by weight of most ceramics, talc content may be 40% to 50% for catalytic converters and may approach 70% for ceramic insulators and ceramic tiles (*5*).

Talc is usually mixed with clay, quartz, and fluxes in the final product. Talc serves as an inexpensive source of magnesium oxide, acts as a flux to lower firing temperatures, improves the thermal shock resistance of the final product, permits fast firing techniques, has low-moisture expansion characteristics, and is amenable to dry-pressing techniques. In general, ceramic talc must be less than 325 mesh, have low iron and manganese contents, have low aluminum oxide and calcium oxide contents if used in electrical insulators and catalytic converters, and not discolor the product on firing (table 2) (*3, 5, 11*).

Table 2.–Selected properties of ceramic-grade talc

Property	*Specification*
MgO content	30.0% minimum.
SiO_2 content	60.0% minimum.
Al_2O_3 content	4.0% maximum.
CaO content	1.0% maximum.
Fe_2O_3 content	1.5% maximum.
Alkali content	0.4% maximum.
Loss on ignition	6.0% maximum.
Acid-soluble lime content	1.0% maximum.
Particle size	95.0% less than 325 mesh; 99.0% less than 200 mesh.

Source: Bentzen (*14*).

Cosmetic uses for talc encompass all varieties of face powders and body dusting powders. Cosmetic-grade talcs also include talc used in pharmaceutical products and medicinal tablets, creams, and soaps (*14*). Over 50% of most cosmetics is talc, the remainder being a combination of oxides, stearates, perfumes, and starch. Talc is used in cosmetics to impart softness and lubricity, improve the hiding power of the product, and aid in retaining added perfumes (*5, 15*). Cosmetic talcs (and talcs used as fillers in pharmaceutical products) must meet strict standards to assure the quality of the product. The major requirements are that 98% of the particles should be less than 200 mesh and that the talc should contain no gritty material, contain less than 6% acid-soluble minerals and no amphiboles, and have a consistent color and mineralogical composition (table 3) (*3, 5*).

Table 3.–Selected properties of cosmetic-grade talc

Property	*Specification*
Color	As specified by buyer, with no color change on heating.
Talc identification	Positive using infrared spectrophotometry or x-ray diffractometry.
Water-soluble substances	0.1% maximum.
Acid-soluble substances	6.0% maximum.
Particle size	100% less than 100 mesh; 98% less than 200 mesh.
Loss on ignition	6.0% maximum.
Arsenic content	3 ppm maximum.
Lead content	20 ppm maximum.
Fibrous amphibole content	None detected.

Source: Cosmetic, Toiletry, and Fragrance Association Inc., Washington, DC.

The insecticides category includes fertilizers, insecticides, herbicides, and fungicides. Talc serves principally as a carrier to distribute the fertilizer, insecticide, herbicide, or fungicide, and to dilute the chemical to prevent damage from concentrated dosages (*5, 16*). Talc also serves as an anticaking agent for dry compounds. Talc is useful because it is absorbent, disperses in liquids, does not react with insecticides, will not clog equipment when finely ground, and will not abrade nozzles (*3, 5, 16*). Fuller's earth is the leading competitor with talc, followed by kaolin, bentonite, diatomite, perlite, sepiolite, and attapulgite (*5, 16*).

The paint category covers all varieties of paints: water-based, oil-based, synthetic resin paints, and lacquers. In the United States, talc is used primarily in topcoats, industrial paint, and industrial primers (*17*). Particularly when it contains prismatic tremolite, talc is an excellent reinforcer and greatly reduces cracking in the dry paint film (*3, 5, 11*). Talc also reduces settling and separation of the paint components, helps to smooth ridges left during brush applications, is an inexpensive extender for more expensive white pigments, and absorbs oil better than most minerals (*3, 5, 11, 14*). Its softness minimizes abrasion of high-speed paint mixers, and it disperses well in both oil- and water-based paint (*5, 11*). Talc is selected for use in paints based on chemical composition, oil absorption, particle size, particle shape, particle size distribution, refractive index, and water-soluble matter content (table 4). Talc competes with calcium carbonate, kaolin, barite, and mica as a filler and extender in paint (*5, 18*).

Table 4.–Selected properties of paint-grade talc

Property	Specification
Calcium oxide content	10% maximum.
Magnesium and calcium silicate content	88% minimum.
Loss on ignition	7% maximum.
Moisture and other volatiles content	1% maximum.
Water-soluble matter content	1% maximum.
Particle size	2% maximum greater than 325 mesh.
Oil absorption	Negotiated.
Color	Do.
Consistency	Do.
Fineness	Do.

Source: ASTM (25).

Talc is used in a variety of paper products, including wrapping paper, writing paper, packaging paper, and paperboard products (*19*). It is used principally for pitch control; the pitch adheres to the surface of the talc and is dispersed throughout the paper rather than agglomerating to form spots in the paper products. Talc also fills the interstices between the cellulose fibers, reduces the transparency of the paper, increases the brightness of the paper, improves ink reception, increases paper density, and reduces the demand for more expensive paper pulp (*3, 5, 11, 19*). Printing and writing papers can contain up to 30% filler; paperboard products, 10%; and newsprint, 8% (*5*). Talc is selected as a filler because of its high whiteness, its nonabrasive nature, its chemical inertness, and its availability in ultrafine particle size (*3, 5, 11*). Competing minerals as paper fillers include calcium carbonate, kaolin, and titanium dioxide (*5, 19*).

The plastics category includes polypropylene, nylon, polyvinyl chloride, polyethylene, polystyrene, and polyester (*5, 9*). Talc is used primarily as a filler in polypropylene (*5, 9, 20-22*). It can compose up to 50% by weight of the components in plastics (*5, 9*). As a bulk filler, it reduces the amount of resin required in the product and thus reduces costs. Talc also imparts desired physical, electrical, and processing properties to the plastic. Talc can also be used as a dusting agent to reduce friction between plastic-coated electrical wires in electric cables and cords. Chemical and heat resistance, impact strength, dimensional stability, thermal conductivity, tensile strength, creep resistance, and electrical conductivity can be improved using talc as a plastics filler (*3, 5, 9, 11, 20-22*). Talc competes with carbonates, clays, feldspar, mica, silica, and wollastonite as a mineral filler (*5*).

Talc is one of the few minerals used by the plastics industry as a reinforcer. Its platy nature provides rigidity to the composite (*9, 20*). Plastics with talc fillers exhibit higher stiffness and creep resistance at ambient and elevated temperatures than do plastics with mineral fillers such as calcium carbonate. For example, a polypropylene with a 40% loading of talc filler has a stiffness 3 times that of polypropylene with no filler and 1.5 times that of polypropylene with a 40% loading of calcium carbonate (*20*). Talcs selected as fillers are chosen according to color, particle size and shape, resin absorption, moisture content, and iron content (*5, 9, 11*). Platy talc offers better heat resistance and is softer than acicular talcs. Acicular talcs offer better reinforcement (*5*).

Talc is used in the manufacture of roofing products as a filler and a dusting agent. It is added to asphalt and bitumen to increase their viscosities, melting points, hardness, and resistance to stress and weathering (*3, 5*). Talc also is used to dust the surfaces of asphalt roofing products to prevent sticking during manufacture and storage. Talc used by the roofing industry generally is ground to minus 80 mesh, and although it is usually low grade, it must have high absorbency (*5, 11*).

Talc is used by the rubber industry in the production of tires, tubing, sheets, valves, flooring products, backing for textiles, and electric cable insulation (*5*). Talc is used as a dusting agent to prevent sticking of the rubber to the mold, to reduce the amount of expensive resins used to produce rubber products, to increase the stiffness of uncured compounds, and to reinforce rubber products (*3, 5, 11*). The talc should be less than 45 μm in size and contain no abrasive minerals that could cause wear of the processing equipment. Talc should be white when used as a filler in latex fabric backings, but color is not critical for most other uses (*11*). Talc competes with calcium carbonate, kaolin, and silica. Talc comprised less than 10% of the rubber filler market in 1983 (*5*).

Specifications for the minor uses vary widely. For sculpturing, the talc block should be free of cracks and other imperfections that could reduce its integrity. The most desirable color for sculpturing block is apple green, although dark green talc blocks are also used. For use in asphalt, joint compounds, and stucco, the talc should be ground relatively fine. Color would be more important for stucco than for asphalt fillers and joint compounds.

PRICES

Prices for processed talc range from \$50 to \$250 per ton. Talcs used as fillers for roofing, rubber, insecticides, and some plastics are the least expensive. Prices for these materials range from \$50 to \$100 per ton. Talcs for end uses such as cosmetics, some plastics, and paints command the highest prices (approximately \$175 to \$250 per ton). Prices, quoted by the Engineering and Mining Journal, December 1987, per short ton of domestic ground talc, in carload lots, f.o.b. mine or mill including containers, follow:

New Jersey:	
Mineral pulp, bags extra	$18.50-$20.50
Vermont:	
98% through 325 mesh, bulk	70.00
99.99% through 325 mesh, bags:	
Dry processed	147.00
Water beneficiated	213.00-228.00
New York:	
96% through 200 mesh	67.00- 75.00
98% to 99.25% through 325 mesh	83.00-100.00
100% through 325 mesh, fluid-energy ground	165.00
California:	
Standard	130.00
Fractionated	37.00- 71.00
Micronized	150.00-220.00
Cosmetic steatite	44.00- 65.00
Georgia:	
98% through 200 mesh	50.00
99% through 325 mesh	60.00
100% through 325 mesh, fluid-energy ground	100.00

Approximate equivalents, in dollars per short ton, of price ranges quoted in Industrial Minerals (London), December 1987, for talc, c.i.f. main European ports, follow:

Norwegian:	
Ground (ex store)	$162-$180
Micronized (ex store)	207- 288
French, fine-ground	216- 342
Italian, cosmetic-grade	315
Chinese, normal (ex store):	
UK 200 mesh	254
UK 325 mesh	265
New York, paint, minimum 20-st lot	175

Talc prices often are reduced from quoted prices because of the competitive nature of the talc industry. The average sales price of talc, based on a 1983 constant dollar, increased from $69.82 per ton in 1963 to $93.55 per ton in 1983 (*3*).

SUPPLY AND DEMAND

In 1987, talc was produced by 22 companies operating 38 mines in 10 States. The largest of these companies were Cyprus Industrial Minerals, Dal-Briar (Texas Talc), Gouverneur Talc, Pfizer, Vermont Talc, and Windsor Minerals. These companies, operating mines in Alabama, California, Montana, New York, Texas, and Vermont, produced approximately 79% of the talc ore mined in the Unites States. The remainder was produced from mines in Arkansas, Georgia, Oregon, and Virginia (*4*).

Historically, talc production in the United States has exceeded demand, and there has been minimal dependence on imported talc. In 1977-87, production ranged from 980,000 to 1.27 million st/yr, and demand ranged from 847,000 to 970,000 st/yr. U.S. exports ranged from 234,000 to 322,000 st/yr during this period. Neither production nor demand nor exports have shown the steady growth observed prior to 1973. Imports, however, have steadily risen from 22,000 to 53,000 st/yr between 1977 and 1987 (table 5).

Table 5.–Salient talc statistics, thousand short tons

Year	Production	Exports	Imports	Consumption
1977	1,099	322	22	943
1978	1,268	267	19	917
1979	1,268	316	22	960
1980	1,127	275	21	903
1981	1,236	311	27	982
1982	1,049	232	27	847
1983	980	218	44	901
1984	1,042	256	45	970
1985	1,188	237	47	921
1986	1,219	234	52	983
1987	1,258	318	53	938

Source: U.S. Bureau of Mines (26).

The largest domestic demand for talc is by the ceramics, paint, paper, and roofing industries, which accounted for 74% of the talc consumed in 1987. Over the past 10 yr, consumption of talc by the paper and roofing industries has increased; consumption by the ceramics industry, the major user, has fluctuated around 310,000 st; and consumption by the cosmetics, insecticides, paint, plastics, refractories, and rubber industries has decreased (table 6). Percentages for 1977 and 1987 follow:

	1977	*1987*
Ceramics	32	33
Cosmetics	8	6
Insecticides	2	<1
Paint	22	15
Paper	7	14
Plastics	13	8
Refractories	1	<1
Roofing	3	12
Rubber	6	2
Other	6	9

Internationally, 39 other countries also mined talc. Production of talc and pyrophyllite was estimated to be 7.0 million st in 1987. The major talc-producing countries were Brazil, China, Finland, France, India, the Republic of Korea, the United States, and the U.S.S.R. (*4*). Canada, India, the Republic of Korea, and the United States had the greatest increase in production over the past 5 yr (table 7).

End use patterns for other nations differed from those in the United States. The major reasons for end use

Table 6.–End uses for ground talc in the United States, thousand short tons

Year	Ceramics	Cosmetics	Insecticides	Paint	Paper	Plastics	Refractories	Roofing	Rubber	Other	Total
1977	300	75	23	211	69	120	13	25	52	55	943
1978	257	69	13	192	87	147	6	18	36	92	917
1979	260	74	13	237	105	112	6	19	39	95	960
1980	282	59	11	197	102	110	2	20	37	83	903
1981	375	75	13	206	88	111	2	26	36	50	982
1982	292	45	7	170	79	54	2	94	21	83	847
1983	319	50	5	166	81	57	2	98	28	95	901
1984	358	44	8	189	100	67	4	86	29	85	970
1985	296	46	7	144	125	70	5	100	27	101	921
1986	343	46	6	168	127	69	3	106	25	90	983
1987	313	60	.5	138	127	79	2	112	19	88	938

Source: U.S. Bureau of Mines (*26*).

Table 7.–Talc and pyrophyllite: World production, by country,[1] short tons

Country[2]	1983	1984	1985	1986	1987
Argentina (talc, steatite, pyrophyllite)	32,729	30,629	23,366	27,900	27,900
Australia (talc, chlorite, steatite, pyrophyllite)	194,644	205,867	153,652	207,287	193,000
Austria (unground talc)	134,623	147,722	144,903	146,959	143,000
Brazil (talc and pyrophyllite)[3]	437,025	455,637	426,647	463,742	468,500
Burma	141	100	141	62	66
Canada (shipments) (talc, pyrophyllite, soapstone)	106,924	138,891	139,993	135,584	155,000
Chile	702	465	1,432	2,488	2,200
China	1,050,000	1,050,000	1,100,000	1,100,000	1,100,000
Columbia	7,318	7,479	9,492	20,393	20,400
Egypt	4,981	13,463	8,488	9,700	9,900
Finland	351,009	360,976	351,138	313,253	364,000
France (ground talc)	315,812	322,315	342,705	347,189	346,000
Germany, Federal Republic of (marketable)	15,773	19,030	22,835	24,123	23,100
Greece (steatite)	2,388	1,887	1,901	2,000	2,050
Hungary	18,700	19,300	18,700	17,700	16,500
India (pyrophyllite and steatite)	389,162	460,473	422,111	436,520	457,500
Italy (talc and steatite)	175,239	157,329	142,875	166,676	166,400
Japan[4]	1,615,791	1,652,303	1,580,978	1,470,441	1,380,000
Korea, North	185,000	185,000	185,000	185,000	185,000
Korea, Republic of (talc and pyrophyllite)	696,810	935,475	1,027,880	879,291	880,000
Mexico	12,161	9,811	32,959	22,000	27,500
Nepal[5]	16,825	8,372	6,630	9,678	9,900
Norway	110,000	[6]124,561	110,000	110,000	110,000
Pakistan (pyrophyllite)	17,588	17,161	22,248	25,376	27,500
Paraguay	132	165	132	132	132
Peru (talc and pyrophyllite)	5,767	10,183	551	1,200	1,100
Philippines	968	1,022	380	1,100	1,100
Portugal	6,018	6,838	3,976	4,565	4,400
Romania	66,000	72,000	72,000	72,000	72,000
South Africa, Republic of[7]	12,337	15,886	15,925	14,602	14,600
Spain (steatite)	76,574	79,628	97,859	81,476	88,000
Sweden	23,210	19,712	15,432	2,205	2,200
Taiwan	29,821	20,591	19,357	23,757	22,000
Thailand (talc and pyrophyllite)	22,209	31,393	47,926	43,046	44,000
U.S.S.R.	560,000	570,000	570,000	570,000	580,000
United Kingdom	17,600	21,000	22,046	13,230	13,200
United States (talc and pyrophyllite)	1,066,400	1,127,421	1,268,750	1,302,179	[6]1,301,440
Uruguay	755	1,828	1,700	1,700	1,700
Zambia	1,447	405	10,504	293	290
Zimbabwe	607	314	482	879	880
Total	7,781,190	8,302,632	8,423,094	8,255,726	8,262,458

[1]Table includes data available through May 27, 1988.
[2]In addition to the countries listed, Czechoslovakia produces talc, but available information is inadequate to make reliable estimates of output levels.
[3]Total of beneficiated and salable direct shipping production of talc and pyrophyllite.
[4]Includes talc, pyrophyllite, and pyrophyllite clay.
[5]Data based on Nepalese fiscal year beginning mid-July of year stated.
[6]Reported figure.
[7]Includes talc and wonderstone.
Source: Virta(*4*).

variations are availability of appropriate grades of talc, transportation costs, size of the markets, and availability of competing minerals. For example, the paper industry is the largest consumer of talc in Canada, China, and Europe (table 8) (*5*), owing to both the availability of talc and extensive research on its use as paper fillers (*5, 19*).

There is a considerable amount of international trade despite the widespread occurrence of talc and the high cost of transportation relative to the product value. International trade was geographically restricted in most cases. The United States supplied talc to the North American continent, the major European producers restricted their trade to the European continent, and China and Australia exported talc to Japan. The few exceptions were Canadian exports to Denmark, Australian exports to Belgium-Luxembourg and the United Kingdom, and U.S. exports to Japan. In general, transoceanic shipments were restricted to small tonnages (*23*).

China and the United States were the major talc-exporting countries, accounting for almost 940,000 st in trade.

Table 8.–Consumption of talc by end use, percent

	Canada (1984)	China (1984)	Europe (1986)	United States (1987)
Ceramics	6	2	6	33
Cosmetics	3	1	3	6
Insecticides . . .	([1])	([1])	3	([2])
Paint	11	2	11	15
Paper	34	60	52	14
Plastics	([1])	([1])	7	8
Refractories . . .	([1])	([1])	([1])	([2])
Roofing	25	([3])	7	12
Rubber	6	1	([1])	2
Other	15	34	11	9
Total	100	100	100	100

[1]Included under "Other" category.
[2]Less than 0.5%.
[3]Included under "Paint" category.
Sources: Virta (*4*); Roskills (*5*).

Other major exporting countries were Australia, Austria, Finland, France, Italy, Norway, and the Republic of Korea. These countries each exported 40,000 to 185,000 st of talc in 1986 (table 9). The Federal Republic of Germany, Japan, Mexico, Belgium-Luxembourg, and the United Kingdom were the major importing countries in 1986 (table 10) (*23*).

Table 9.–Major talc-exporting countries, 1986

Major exporting countries	Quantity, st	Major destinations and quantity, st
Australia	202,080	Japan - 132,584. Netherlands - 16,808. Republic of Korea - 17,351.
Austria	124,933	Italy - 16,926. Switzerland - 10,841. West Germany - 62,466.
China	588,102	Hong Kong - 35,454. Japan - 502,862. Pakistan - 14,830.
Finland	53,209	Netherlands - 9,371. Sweden - 13,272. United Kingdom - 8,992.
France	109,695	Belgium-Luxembourg - 13,890. Netherlands - 16,279. West Germany - 34,137.
Italy	47,469	East Germany - 15,318. Mexico - 350. United Kingdom - 8,203.
Korea, Republic of . .	46,820	Japan - 15,648. Taiwan - 6,430. Thailand - 11,538.
Netherlands	9,716	Belgium-Luxembourg - 2,354. Italy - 1,286. West Germany - 4,854.
Norway	47,058	Netherlands - 10,055. United Kingdom - 11,556. West Germany - 8,722.
Sweden	8,975	Denmark - 1,276. Netherlands - 5,053. Norway - 1,230.
United States (1987 data).	350,436	Belgium-Luxembourg - 33,060. Canada - 67,222. Mexico - 164,198.

Source: U.S. Bureau of Mines (*23*).

Table 10.–Major talc-importing countries, 1986

Major importing countries	Quantity, st	Major sources and quantity, st	Major importing countries	Quantity, st	Major sources and quantity, st
Belgium-Luxembourg	75,615	France - 13,915. Netherlands - 13,797. Spain - 22,403.	Mexico (1984 data) . .	113,125	Italy - 716. Republic of Korea - 221. United States - 111,821.
Canada	43,516	France - 325. United Kingdom - 149. United States - 42,896.	Netherlands	51,695	Austria - 6,641. France - 13,442. West Germany - 5,193.
France	19,758	Austria - 3,734. Belgium-Luxembourg - 4,983. Italy - 5,556.	Poland	25,516	China - 2,229. Czechoslovakia - 7,224. North of Korea - 10,378.
Germany, Federal Republic of.	163,424	Austria - 63,716. France - 35,998. Italy - 13,805.	Sweden	30,044	Belgium-Luxembourg - 4,633. Finland - 13,719. Norway - 7,502.
Italy	32,469	Austria - 17,132. France - 5,669. Spain - 3,562.	Switzerland	16,444	Austria - 11,110. France - 1,319. Italy - 2,345.
Japan	655,980	Australia - 117,189. China - 486,727. North Korea - 15,850.	Thailand	24,373	China - 13,574. Republic of Korea - 9,918.
Korea, Republic of . .	46,202	Australia - 17,329. Hong Kong - 11,038. United States - 3,869.	United Kingdom	75,386	Belgium-Luxembourg - 11,915. France - 13,800. Norway - 12,898.

Source: U.S. Bureau of Mines (*23*).

OUTLOOK

In recent years, U.S. demand for talc has slowed considerably. The average annual growth in demand was 3.1% between 1967 and 1977. Between 1977 and 1987, the average annual growth in demand was slightly negative. Demand, however, averaged approximately 930,000 st/yr for this period. Relative increases and decreases in demand have been the result of minor market fluctuations rather than long-term trends. Demand for talc is expected to continue to fluctuate around 930,000 st/yr in the near future.

The major U.S. demand for talc will continue to be by the ceramics industry, which will account for 30% to 35% of the total demand. Demand by the paint industry, if it continues to follow its 10-yr downward trend, will drop below that of the paper industry in several years. The use of talc by the paper industry should continue to increase as paper consumption grows. Demand by the plastics industry should grow slightly, following a large decline in the early 1980's.

Demand for roofing-grade talc has increased over the past 10 years; however, this growth is not expected to continue at its current pace. Demand for cosmetic-grade talc will remain relatively constant, and demand by the insecticide, refractory, and rubber industries is likely to continue to decline in the near future.

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