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Calciners and Dryers in Mineral Industries—Background Information for Proposed Standards

AP-42 Section 11.26
Reference 1
Report Sect. 2
Reference 1

NSPS

silicate-clay process is the basis for much of the present technology and consists of coating the granules with a mixture of sodium silicate and inorganic clay pigments.[106] The coated granules are fed to a coating kiln where they are dried and fired. Granules are discharged from the kiln into a rotary-type cooler or similar device. Rescreening on vibrating screens is usually necessary after the firing and cooling process to maintain granule grade. The rescreening is performed before storage or in the shipping and loading process.

3.2.14.2.1 Dryers. Rotary dryers are the primary ore dryer type used in the industry. (Fluid bed dryers are used by one company to dry a coal-fired boiler slag, which is an atypical granule material.) The function of the ore dryer is to process the crushed rock so that it will not clog the screens that are used to classify the rock.

3.2.15 Talc

3.2.15.1 Background. Talc is a soft, hydrous magnesium silicate ($3MgO \cdot 4SiO_2 \cdot H_2O$), theoretically composed of 63.4 percent SiO_2, 31.9 percent MgO, and 4.7 percent H_2O.[107] The actual composition of commercial talc may vary widely from these levels. Talc may also contain one or more of the following oxides, ranging in concentration from a trace to several percent: iron, titanium, aluminum, calcium, potassium, sodium, nickel, chromium, cobalt, and phosphorus. For most end-uses, these impurities are undesirable and are removed to the extent feasible. The color of talc varies from snow-white to greenish-gray and various shades of green. Its specific gravity ranges from 2.6 to 2.8.[108]

Talc deposits can be found in many parts of the world. In 1980, talc minerals were produced at 40 mines in 11 States. Mines in four States produced about 90 percent of the nationwide annual total.[109] The States producing the highest tonnage, in decreasing order, were Montana, Texas, New York, and Vermont.[109]

The word talc refers to a wide variety of rocks and rock products. Soapstone reportedly contains up to 50 percent talc.[109] It has a slippery feeling and can be carved by hand. Steatite contains a high-purity talc suitable for making electrical insulators. These

talc-containing minerals (soapstone and steatite) will be treated as talc in this section.

Talc is one of the most versatile inorganic materials used by industry. The end-uses for talc are determined by variables such as chemical and mineralogical composition, particle size and shape, specific gravity, hardness, and color. According to 1981 statistics, the largest use of talc-group minerals is for the manufacture of ceramics (31 percent), which includes kiln furniture, sanitary ware, floor and wall tile, dinnerware glazes, and electrical porcelains. For these end-products, the addition of talc to the usual clay-silica-feldspar body mixtures facilitates the firing of the ware and improves the quality.[109]

The second major use of talc minerals is as a filler and/or a pigment for paints (22 percent of total 1981 U.S. production).[109] The plastics industry is the third major user (12 percent) of talc, followed by coating and/or loading of high-quality papers (11 percent). Other applications for talc are cosmetics (7 percent), rubber (4 percent), and roofing (2 percent).[109]

Grades of talc are most frequently identified with the end use. Some of the important desirable properties are softness and smoothness, color, luster, high slip tendency, moisture content, oil and grease absorption, chemical inertness, fusion point, heat and electrical conductivity, and high dielectrical strength.

More specific requirements for talc are described below for the major end uses.[107]

Ceramics. Uniform chemical and physical properties are required. Manganese and iron are objectionable, and for high-frequency insulators, no more than 0.5 percent CaO, 1.5 percent iron oxide, and 4 percent Al_2O_3 are usually tolerated.

Paints. Impurities that turn the talc to colors other than white are highly objectionable. To obtain the desired smooth paint film, at least 98.5 percent must pass a 44 μm (325 mesh) screen.

Paper. The main requirements are chemical inertness, softness, freedom from grit, satisfactory ink acceptance, brightness, and dispersibility in water.

Rubber. Ground talc is used as filler in the compounding formulations of synthetic rubbers. Volume changes, amount of filler, and particle size all affect the stress-strain relationship of the product.

Roofing. A low-grade, offcolor, and impure talc is acceptable.

Insecticides. The main requirements are chemical inertness with respect to toxicants, satisfactory bulk density, and low abrasive characteristics.

Cosmetics and Pharmaceuticals. Talc must be grit free, finely sized, chemically pure, and pleasing in color.

3.2.15.2 Process Description. More than half the total domestic output of talc is derived from open-pit operations, although underground mines continue to be important sources of this mineral. Mining operations usually consist of conventional drilling and blasting methods.[107] The softness of talc makes it easier to mine and process than most other minerals.

3.2.15.2.1 Dryers. Figure 3-31 is a process flow diagram for a typical Eastern U.S. talc plant. Talc ore is generally trucked to the plant from a nearby mine. The ore is crushed and screened, and coarse (oversize) material is sent through a gyratory crusher. Drying of the two separate fractions is accomplished by a rotary dryer. Secondary grinding is achieved with pebble mills and/or roller mills, producing a product that is 44 to 149 μm (325 to 100 mesh) in size.[110] Air classifiers (separators), generally in closed circuit with the mills, separate the material into coarse, coarse plus fine, and fine fractions. The coarse and coarse plus fine fractions are then stored. The fines undergo a tabling process to remove sulfides (about 1 to 2 percent) and a one-step flotation process. The resultant talc slurry is dewatered and filtered prior to passing through a flash dryer. The flash dried product is then stored for shipment, or it may be further ground to meet customer specifications.

3.2.15.2.2 Calciners. Talc deposits mined in the Western U.S. contain organic impurities and must be calcined prior to additional processing to yield a product with uniform chemical and physical properties. Generally, a separate product line will be used to produce

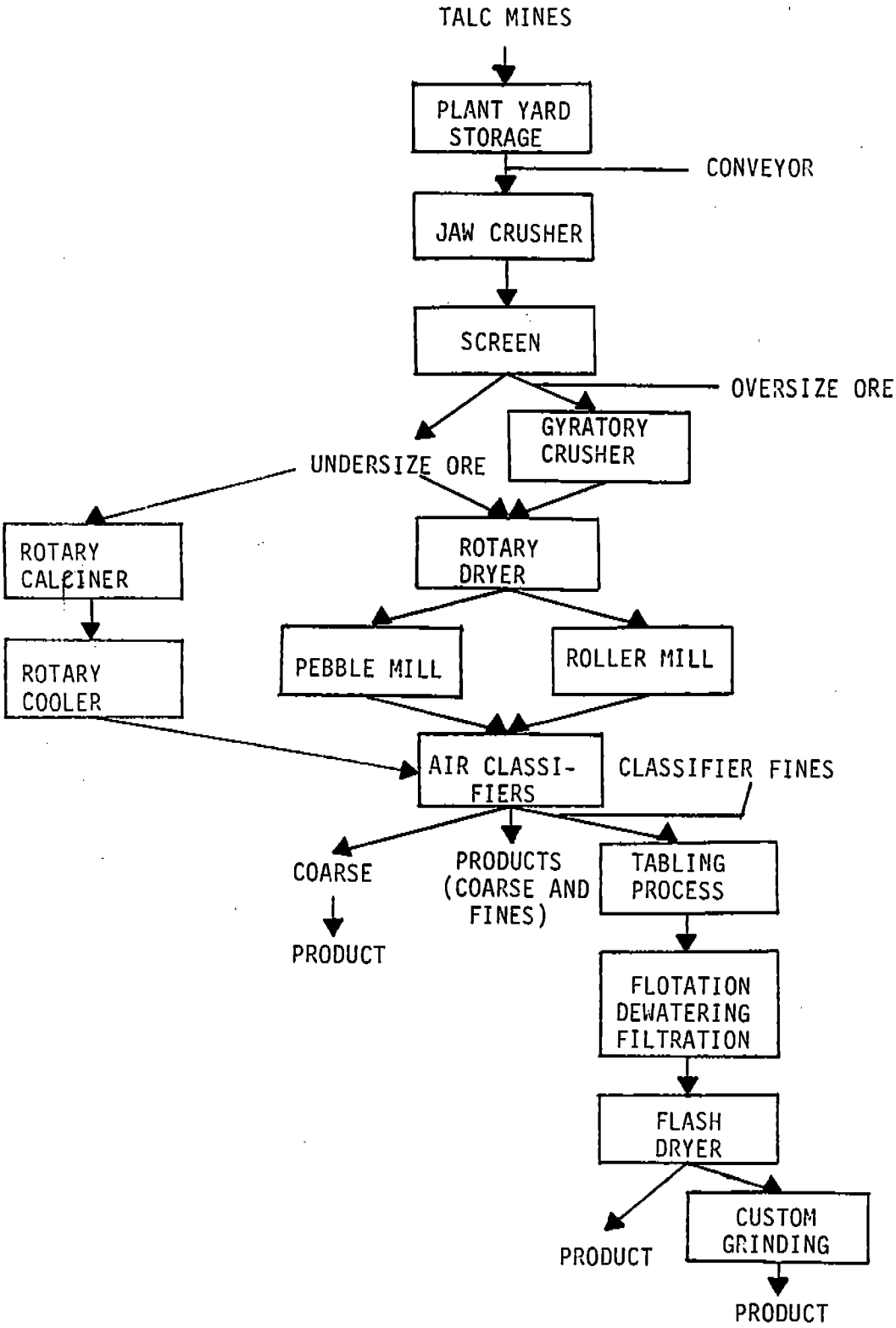

Figure 3-31. Process flow diagram for talc processing.[110]

the calcined talc. Prior to calcining, the mined ore passes through a crusher and is ground to a specified screen size. After calcining is accomplished by a rotary kiln, the material passes through a rotary cooler. The cooled calcine (0 percent moisture) is then stored for shipment or it may be further processed. Calcined talc may be mixed with dried talc from other product lines and passed through a roller mill prior to bulk shipping.

3.2.16 Titanium Dioxide

3.2.16.1 Background. Titanium dioxide (TiO_2) pigments are produced by two processes, the chloride process and the sulfate process. For the chloride process, rutile or ilmenite ore may be used; however, rutile ore is the preferred raw material because the chloride-ilmenite process involves simultaneous beneficiation and chlorination. The sulfate process uses ilmenite or a titanium slag as the raw material. The final product is an anatase pigment, although a rutile pigment can also be produced.

Rutile ore occurs as reddish-brown to red crystals of tetragonal structure or in granular masses. It contains 94 to 98 percent TiO_2. Virtually all of the rutile ore used in the United States is imported. Ilmenite is iron black and crystallizes in the hexagonal system. It contains 37 to 65 percent TiO_2, 30 to 55 percent iron oxide, and trace amounts of silica, alumina, and other metals. Titanium slag may also be considered as an ore. It is produced by smelting a mixture of carbon and titanium-bearing material to yield molten iron and slag containing 70 to 90 percent TiO_2.[111]

Of the 1981 production of titanium dioxide, 74 percent was produced by the chloride process and 26 percent was produced by the sulfate process. Of the chloride production, 92 percent was rutile pigment, and 8 percent was anatase pigment. Of the sulfate production, 11 percent was rutile pigment, and 89 percent was anatase pigment. The rutile pigment is used primarily in the paint, varnish, and lacquer industry, while the anatase pigment is used primarily in the paper industry.

The uses of TiO_2 pigment are numerous. Ninety-two percent of the 1979 titanium consumption in the United States was in the form of TiO_2 pigments.[112] Because of its high refractive index (anatase--2.55,