11.22 Diatomite Processing

11.22.1 Process Description[1-2]

Diatomite is a chalky, sedimentary rock consisting mainly of an accumulation of skeletons remaining from prehistoric diatoms, which are single-celled, microscopic aquatic plants. The skeletons are essentially amorphous hydrated or opaline silica occasionally with some alumina. Diatomite is primarily used to filter food processing products such as beer, whiskey, and fruit juice, and to filter organic liquids such as solvents and oils. Diatomite also is often used as a filler in paint, paper, asphalt products, and plastic. The six-digit Source Classification Code (SCC) for diatomite processing is 3-05-026.

Most diatomite deposits are found at or near the earth's surface and can be mined by open pit methods or quarrying. Diatomite mining in the United States is all open pit, normally using some combination of bulldozers, scraper-carriers, power shovels, and trucks to remove overburden and the crude material. In most cases, fragmentation by drilling and blasting is not necessary. The crude diatomite is loaded on trucks and transported to the mill or to stockpiles. Figure 11.22-1 shows a typical process flow diagram for diatomite processing.

The processing of uncalcined or natural-grade diatomite consists of crushing and drying. Crude diatomite commonly contains as much as 40 percent moisture, in many cases over 60 percent. Primary crushing to aggregate size (normally done by a hammermill) is followed by simultaneous milling-drying, in which suspended particles of diatomite are carried in a stream of hot gases. Flash and rotary dryers are used to dry the material to a powder of approximately 15 percent moisture. Typical flash dryer operating temperatures range from 70° to 430°C (150° to 800°F). The suspended particles exiting the dryer pass through a series of fans, cyclones, and separators to a baghouse. These sequential operations separate the powder into various sizes, remove waste impurities, and expel the absorbed water. These natural-milled diatomite products are then bagged or handled in bulk without additional processing.

For filtration uses, natural grade diatomite is calcined by heat treatment in gas- or fuel oil-fired rotary calciners, with or without a fluxing agent. Typical calciner operating temperatures range from 650° to 1200°C (1200° to 2200°F). For straight-calcined grades, the powder is heated in large rotary calciners to the point of incipient fusion, and thus, in the strict technical sense, the process is one of sintering rather than calcining. The material exiting the kiln then is further milled and classified. Straight calcining is used for adjusting the particle size distribution for use as a medium flow rate filter aid. The product of straight calcining has a pink color from the oxidation of iron in the raw material, which is more intense with increasing iron oxide content.

Further particle size adjustment is brought about by the addition of a flux, usually soda ash, before the calcining step. Added fluxing agent sinters the diatomite particles and increases the particle size, thereby allowing increased flow rate during liquid filtration. The resulting products are called "flux-calcined". Flux-calcining produces a white product, believed to be colored by the

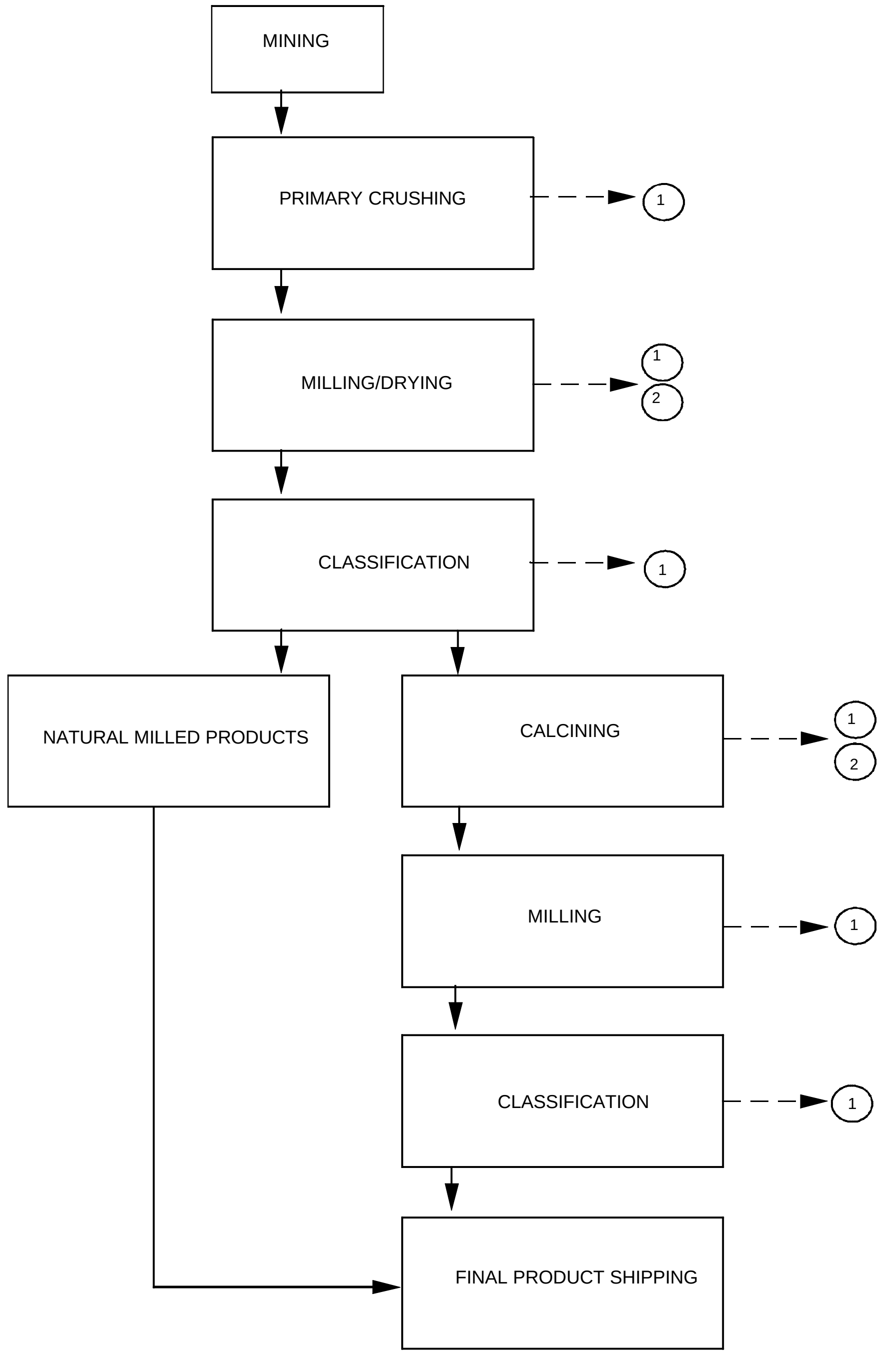

Figure 11.22-1. Typical process flow diagram for diatomite processing.

conversion of iron to complex sodium-aluminum-iron silicates rather than to the oxide. Further milling and classifying follow calcining.

11.22.2 Emissions And Controls[1-2]

The primary pollutant of concern in diatomite processing is particulate matter (PM) and PM less than 10 micrometers (PM-10). Particulate matter is emitted from crushing, drying, calcining, classifying, and materials handling and transfer operations. Emissions from dryers and calciners include products of combustion, such as carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), and sulfur oxides (SO_x), in addition to filterable and condensible PM. Table 11.22-1 summarizes the results of a trace element analysis for one type of finished diatomite. These elements may constitute a portion of the PM emitted by the sources listed above.

Wet scrubbers and fabric filters are the most commonly used devices to control emissions from diatomite dryers and calciners. No information is available on the type of emission controls used on crushing, classifying, and materials handling and transfer operations.

Because of a lack of available data, no emission factors for diatomite processing are presented.

TABLE 11.22-1. TRACE ELEMENT CONTENT OF FINISHED DIATOMITE[2]

Element[a]	ppm[b]	Element	ppm
Antimony*	2	Mercury*	0.3
Arsenic*	5	Molybdenum	5
Barium	30	Neodymium	20
Beryllium*	1	Nickel*	120
Bismuth	<0.5	Niobium	5
Boron	100	Osmium	<0.5
Bromine	20	Palladium	<1
Cadmium*	2	Platinum	<2
Cerium	10	Praseodymium	2
Cesium	5	Rhenium	<0.5
Chlorine	400	Rhodium	<0.5
Chromium*	100	Rubidium	10
Cobalt*	5	Ruthenium	<1
Copper	40	Samarium	2
Dysprosium	<1	Scandium	20
Erbium	<0.5	Selenium*	10
Europium	1	Silver	<0.5
Fluorine	50	Strontium	20
Gadolinium	<1	Tantalum	20
Gallium	5	Tellurium	<2
Germanium	<10	Terbium	<0.2
Gold	<0.5	Thallium	<0.5
Hafnium	<0.5	Thorium	5
Holmium	<0.2	Thulium	0.2
Indium	<0.5	Tin	<1
Iodine	1	Tungsten	<0.5
Iridium	<0.5	Uranium	5
Lanthanum	10	Vanadium	200
Lead*	2	Ytterbium	<0.5
Lithium	1	Yttrium	100
Lutetium	<0.2	Zinc	<10
Manganese*	60	Zirconium	20

[a] Listed hazardous air pollutants indicated by an asterisk (*).
[b] < indicates below detection limit.

References For Section 11.22

1. *Calciners And Dryers In Mineral Industries - Background Information For Proposed Standards*, EPA-450/3-025a, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1985.

2. F. L. Kadey, "Diatomite", *Industrial Rocks And Minerals, Volume I*, Society Of Mining Engineers, New York, 1983.