11.30 Perlite Processing

11.30.1 Process Description[1,2]

Perlite is a glassy volcanic rock with a pearl-like luster. It usually exhibits numerous concentric cracks that cause it to resemble an onion skin. A typical perlite sample is composed of 71 to 75 percent silicon dioxide, 12.5 to 18.0 percent alumina, 4 to 5 percent potassium oxide, 1 to 4 percent sodium and calcium oxides, and trace amounts of metal oxides.

Crude perlite ore is mined, crushed, dried in a rotary dryer, ground, screened, and shipped to expansion plants. Horizontal rotary or vertical stationary expansion furnaces are used to expand the processed perlite ore.

The normal size of crude perlite expanded for use in plaster aggregates ranges from plus 250 micrometers (µm) (60 mesh) to minus 1.4 millimeters (mm) (12 mesh). Crude perlite expanded for use as a concrete aggregate ranges from 1 mm (plus 16 mesh) to 0.2 mm (plus 100 mesh). Ninety percent of the crude perlite ore expanded for horticultural uses is greater than 841 µm (20 mesh).

Crude perlite is mined using open-pit methods and then is moved to the plant site where it is stockpiled. Figure 11.30-1 is a flow diagram of crude ore processing. The first processing step is to reduce the diameter of the ore to approximately 1.6 centimeters (cm) (0.6 inch [in.]) in a primary jaw crusher. The crude ore is then passed through a rotary dryer, which reduces the moisture content from between 4 and 10 percent to less than 1 percent.

After drying, secondary grinding takes place in a closed-circuit system using screens, air classifiers, hammer mills, and rod mills. Oversized material produced from the secondary circuit is returned to the primary crusher. Large quantities of fines, produced throughout the processing stages, are removed by air classification at designated stages. The desired size processed perlite ore is stored until it is shipped to an expansion plant.

At the expansion plants, the processed ore is either preheated or fed directly to the furnace. Preheating the material to approximately 430°C (800°F) reduces the amount of fines produced in the expansion process, which increases usable output and controls the uniformity of product density. In the furnace, the perlite ore reaches a temperature of 760 to 980°C (1400 to 1800°F), at which point it begins to soften to a plastic state where the entrapped combined water is released as steam. This causes the hot perlite particles to expand 4 to 20 times their original size. A suction fan draws the expanded particles out of the furnace and transports them pneumatically to a cyclone classifier system to be collected. The air-suspended perlite particles are also cooled as they are transported to the collection equipment. The cyclone classifier system collects the expanded perlite, removes the excessive fines, and discharges gases to a baghouse or wet scrubber for air pollution control.

The grades of expanded perlite produced can also be adjusted by changing the heating cycle, altering the cutoff points for size collection, and blending various crude ore sizes. All processed products are graded for specific uses and are usually stored before being shipped. Most production rates are less than 1.8 megagrams per hour (Mg/hr) (2 tons/hr), and expansion furnace temperatures range from 870 to 980°C (1600 to 1800°F). Natural gas is typically used for fuel, although No. 2 fuel oil and propane are occasionally used. Fuel consumption varies from 2,800 to 8,960 kilojoules per kilogram (kJ/kg) (2.4×10^6 to 7.7×10^6 British thermal units per ton [Btu/ton]) of product.

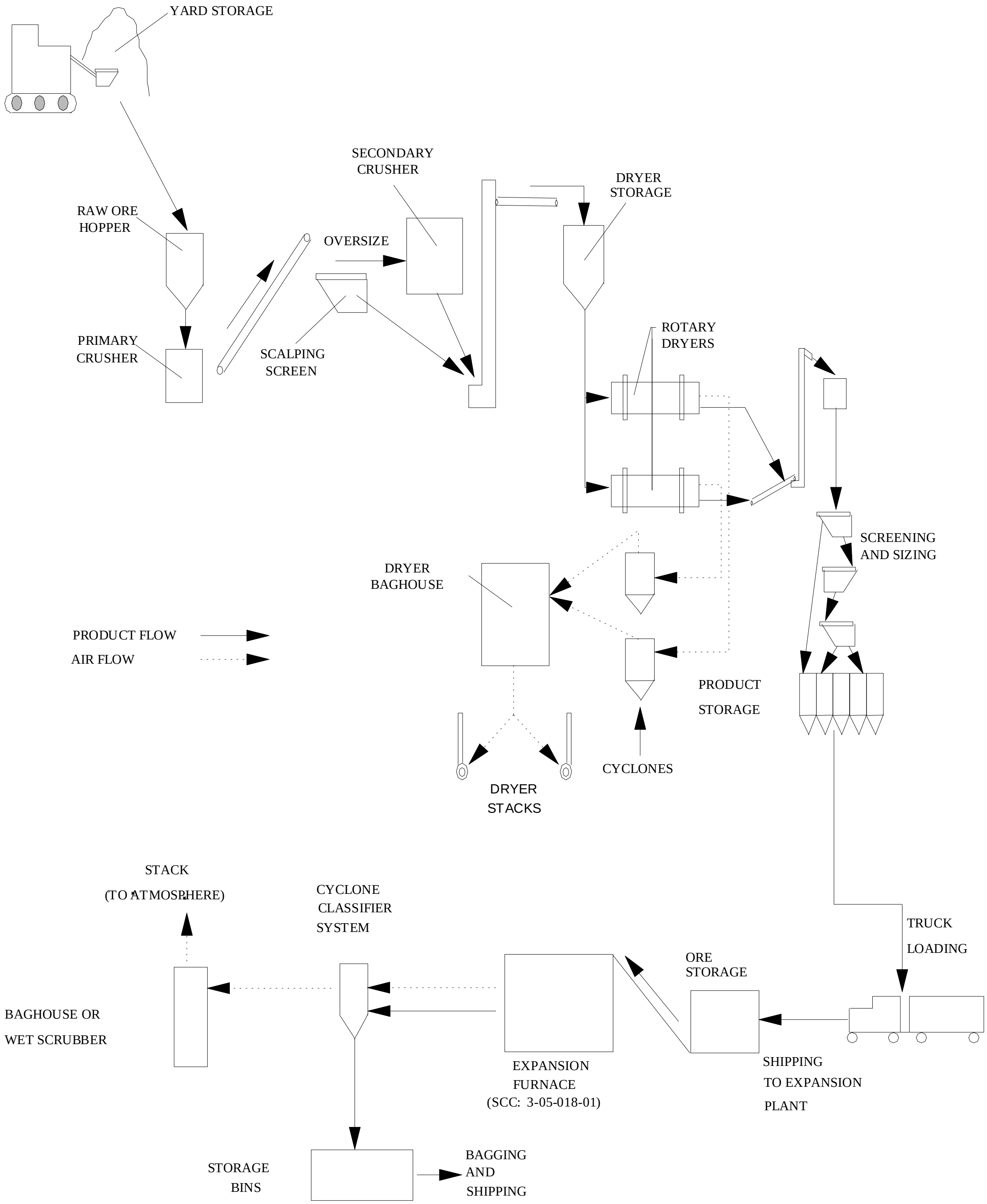

Figure 11.30-1. Flow diagram for perlite processing.[1]
(Source Classification Code in parentheses.)

11.30.2 Emissions And Controls[1,3-11]

The major pollutant of concern emitted from perlite processing facilities is particulate matter (PM). The dryers, expansion furnaces, and handling operations can all be sources of PM emissions. Emissions of nitrogen oxides from perlite expansion and drying generally are negligible. When sulfur-containing fuels are used, sulfur dioxide (SO_2) emissions may result from combustion sources. However, the most common type of fuel used in perlite expansion furnaces and dryers is natural gas, which is not a significant source of SO_2 emissions.

Test data from one perlite plant indicate that perlite expansion furnaces emit a number of trace elements including aluminum, calcium, chromium, fluorine, iron, lead, magnesium, manganese, mercury, nickel, titanium, and zinc. However, because the data consist of a single test run, emission factors were not developed for these elements. The sample also was analyzed for beryllium, uranium, and vanadium, but these elements were not detected.

To control PM emissions from both dryers and expansion furnaces, the majority of perlite plants use baghouses, some use cyclones either alone or in conjunction with baghouses, and a few use scrubbers. Frequently, PM emissions from material handling processes and from the dryers are controlled by the same device. Large plants generally have separate fabric filters for dryer emissions, whereas small plants often use a common fabric filter to control emissions from dryers and materials handling operations. In most plants, fabric filters are preceded by cyclones for product recovery. Wet scrubbers are also used in a small number of perlite plants to control emissions from perlite milling and expansion sources.

Table 11.30-1 presents emission factors for filterable PM and CO_2 emissions from the expanding and drying processes.

Table 11.30-1 (Metric And English Units). EMISSION FACTORS FOR PERLITE PROCESSING[a]

EMISSION FACTOR RATING: D

Process	Filterable PM[b]		CO_2	
	kg/Mg Perlite Expanded	lb/ton Perlite Expanded	kg/Mg Perlite Expanded	lb/ton Perlite Expanded
Expansion furnace (SCC 3-05-018-01)	ND	ND	420[c]	850[c]
Expansion furnace with wet cyclone (SCC 3-05-018-01)	1.1[d]	2.1[d]	NA	NA
Expansion furnace with cyclone and baghouse (SCC 3-05-018-01)	0.15[e]	0.29[e]	NA	NA
Dryer (SCC 3-05-018-__)	ND	ND	16[f]	31[f]
Dryer with baghouse (SCC 3-05-018-__)	0.64[f]	1.3[f]	NA	NA
Dryer with cyclones and baghouses (SCC 3-05-018-__)	0.13[g]	0.25[g]	NA	NA

[a] All emission factors represent controlled emissions. SCC = Source Classification Code. ND = no data. NA = not applicable.
[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train.
[c] Reference 4.
[d] Reference 11.
[e] References 4,8.
[f] Reference 10.
[g] References 7,9.

References For Section 11.30

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