11.27 Feldspar Processing

11.27.1 General[1]

Feldspar consists essentially of aluminum silicates combined with varying percentages of potassium, sodium, and calcium, and it is the most abundant mineral of the igneous rocks. The two types of feldspar are soda feldspar (7 percent or higher Na_2O) and potash feldspar (8 percent or higher K_2O). Feldspar-silica mixtures can occur naturally, such as in sand deposits, or can be obtained from flotation of mined and crushed rock.

11.27.2 Process Description [1-2]

Conventional open-pit mining methods including removal of overburden, drilling and blasting, loading, and transport by trucks are used to mine ores containing feldspar. A froth flotation process is used for most feldspar ore beneficiation. Figure 11.27-1 shows a process flow diagram of the flotation process. The ore is crushed by primary and secondary crushers and ground by jaw crushers, cone crushers, and rod mills until it is reduced to less than 841 µm (20 mesh). Then the ore passes to a three-stage, acid-circuit flotation process.

An amine collector that floats off and removes mica is used in the first flotation step. Also, sulfuric acid, pine oil, and fuel oil are added. After the feed is dewatered in a classifier or cyclone to remove reagents, sulfuric acid is added to lower the pH. Petroleum sulfonate (mahogany soap) is used to remove iron-bearing minerals. To finish the flotation process, the discharge from the second flotation step is dewatered again, and a cationic amine is used for collection as the feldspar is floated away from quartz in an environment of hydrofluoric acid (pH of 2.5 to 3.0).

If feldspathic sand is the raw material, no size reduction may be required. Also, if little or no mica is present, the first flotation step may be bypassed. Sometimes the final flotation stage is omitted, leaving a feldspar-silica mixture (often referred to as sandspar), which is usually used in glassmaking.

From the completed flotation process, the feldspar float concentrate is dewatered to 5 to 9 percent moisture. A rotary dryer is then used to reduce the moisture content to 1 percent or less. Rotary dryers are the most common dryer type used, although fluid bed dryers are also used. Typical rotary feldspar dryers are fired with No. 2 oil or natural gas, operate at about 230°C (450°F), and have a retention time of 10 to 15 minutes. Magnetic separation is used as a backup process to remove any iron minerals present. Following the drying process, dry grinding is sometimes performed to reduce the feldspar to less than 74 µm (200 mesh) for use in ceramics, paints, and tiles. Drying and grinding are often performed simultaneously by passing the dewatered cake through a rotating gas-fired cylinder lined with ceramic blocks and charged with ceramic grinding balls. Material processed in this manner must then be screened for size or air classified to ensure proper particle size.

11.27.3 Emissions And Controls

The primary pollutant of concern that is emitted from feldspar processing is particulate matter (PM). Particulate matter is emitted by several feldspar processing operations, including crushing, grinding, screening, drying, and materials handling and transfer operations.

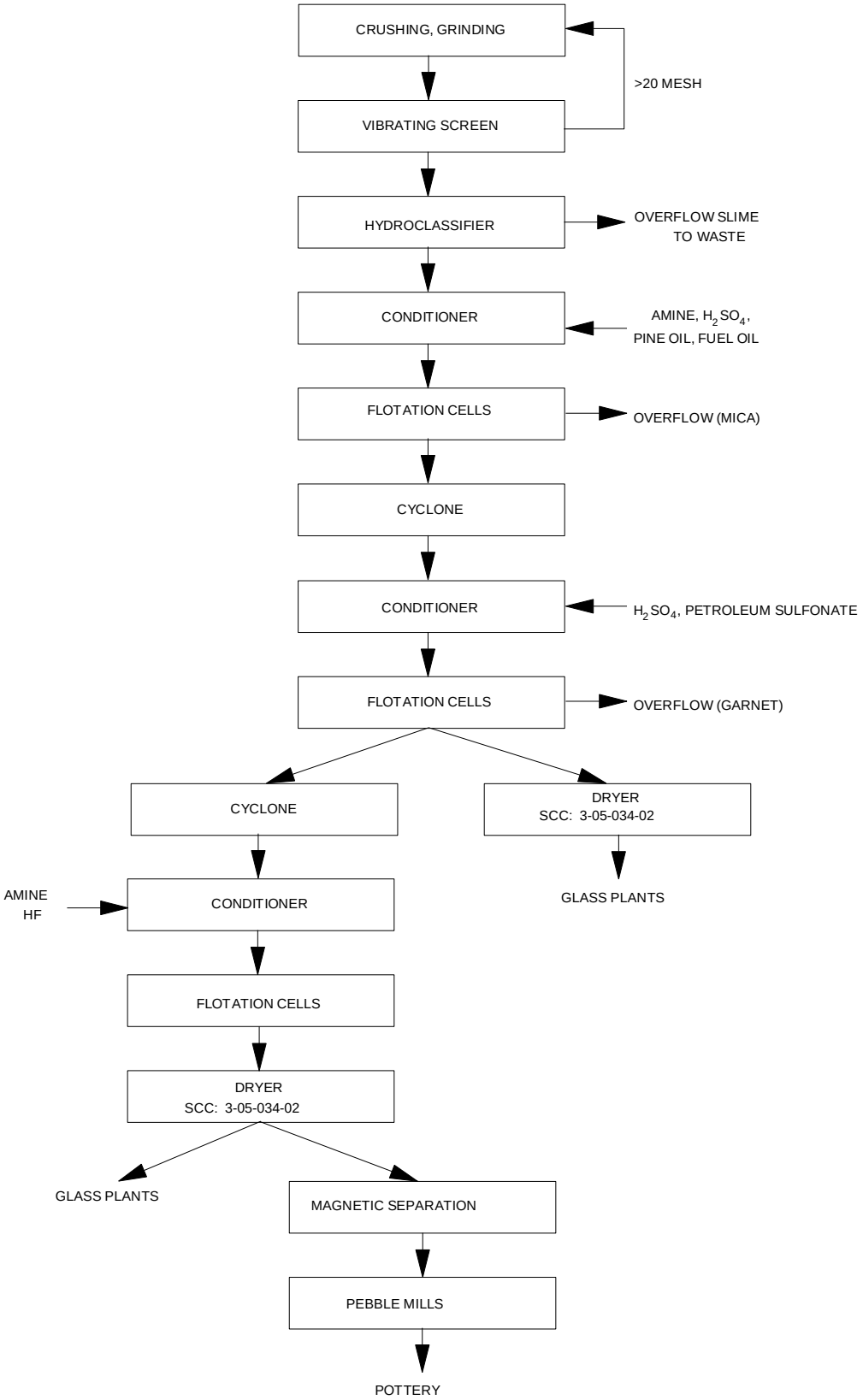

Figure 11.27-1. Feldspar flotation process.[1]

Emissions from dryers typically are controlled by a combination of a cyclone or a multiclone and a scrubber system. Particulate matter emissions from crushing and grinding generally are controlled by fabric filters.

Table 11.27-1 presents controlled emission factors for filterable PM from the drying process. Table 11.27-2 presents emission factors for CO_2 from the drying process. The controls used in feldspar processing achieve only incidental control of CO_2.

Table 11.27-1 (Metric And English Units). EMISSION FACTORS FOR FILTERABLE PARTICULATE MATTER[a]

Process	Filterable Particulate		
	kg/Mg Feldspar Dried	lb/Ton Feldspar Dried	EMISSION FACTOR RATING
Dryer with scrubber and demister[b] (SCC 3-05-034-02)	0.60	1.2	D
Dryer with mechanical collector and scrubber[c,d] (SCC 3-05-034-02)	0.041	0.081	D

[a] SCC = Source Classification Code
[b] Reference 4.
[c] Reference 3.
[d] Reference 5.

Table 11.27-2 (Metric And English Units). EMISSION FACTOR FOR CARBON DIOXIDE[a]

Process	Carbon Dioxide		
	kg/Mg Feldspar Dried	lb/Ton Feldspar Dried	EMISSION FACTOR RATING
Dryer with multiclone and scrubber[b] (SCC 3-05-034-02)	51	102	D

[a] SCC = Source Classification Code.
[b] Scrubbers may achieve incidental control of CO_2 emissions. Multiclones do not control CO_2 emissions.

References For Section 11.27

1. *Calciners And Dryers In Mineral Industries--Background Information For Proposed Standards*, EPA-450/3-85-025a, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1985.

2. *US Minerals Yearbook 1989:* Feldspar, Nepheline syenite, and Aplite: US Minerals Yearbook 1989, pp. 389-396.

3. *Source Sampling Report For The Feldspar Corporation: Spruce Pine, NC,* Environmental Testing Inc., Charlotte, NC, May 1979.

4. *Particulate Emission Test Report For A Scrubber Stack At International Minerals Corporation: Spruce Pine, NC*, North Carolina Department of Natural Resources & Community Development, Division of Environmental Management, September 1981.

5. *Particulate Emission Test Report For Two Scrubber Stacks At Lawson United Feldspar & Mineral Company: Spruce Pine, NC*, North Carolina Department of Natural Resources & Community Development, Division of Environmental Management, October 1978.