

## Feldspar

$KAlSi_3O_8$  - Orthoclase

$KAlSi_3O_8$  - Microcline

$NaAlSi_3O_8$  -  $CaAl_2Si_2O_8$  - Plagioclase

*In the manufacture of high-class, colourless glass, feldspar should have a maximum of 0.1%  $Fe_2O_3$  though upto 0.3% is permissible.*

### The History Says

The word comes from the German "feldt spat", meaning "field spar", "spar" meaning common cleavable material - the material dredged up on farm lands during plowing. Most of them are not affected by acid (exception the Ca rich plagioclase - Anorthite). Orthoclase got its name from the Greek phrase meaning "straight fracture", Microcline from a Greek phrase meaning "small incline", and Plagioclase from the Greek phrase meaning "oblique fracture".

### The Present Scenario

Feldspar is used as bonding agent along with magnesium oxide, magnesium chloride and other synthetic glue in the manufacture of abrasives, wheels, discs and other shapes.

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FELDSPAR comprises a group of minerals containing potassium, sodium, calcium and aluminium silicates. They are the most common rock-forming minerals. The common feldspar is potassium feldspar, namely, orthoclase ( $K_2O, Al_2O_3, 6SiO_2$ ). Sodium feldspar is albite ( $Na_2O, Al_2O_3, 6SiO_2$ ) and calcium feldspar is anorthite ( $CaO, Al_2O_3, 2SiO_2$ ). A variety of crossed, hatched, twinned orthoclase (to be seen under the

petrological microscope only) is called microcline. Sodium and calcium feldspars form an isomorphous mixture known as plagioclase feldspars.

In between sodium and calcium, the other feldspars of the plagioclase series are oligoclase, andesine, labradorite and bytownite. They are composed of suitable proportions of sodium and calcium with an increasing percentage of calcium beginning from mineral oligoclase to bytownite, turning completely into calcium feldspar (anorthite). A rock containing only plagioclase feldspars is called anorthosite.

The commercial feldspar is orthoclase. The potassium molecule is replaced by sodium to some extent and hence, orthoclase feldspar usually contains a small percentage of sodium. The composition range of the commercial feldspar varies within the limits of potash, soda and up to oligoclase.

Potash and soda feldspar occur as essential constituents of granite, syenite and gneisses. However, workable deposits are found in pegmatite veins consisting mainly of feldspar, quartz-feldspar veins and also occur with mica pegmatites. Feldspar is of widespread occurrence and is mined in almost all countries.

### **Feldspar is generally used for three purposes**

- In making the body composition of several types of porcelain, china and earthenware and also in the preparation of glazes and enamel.
- As an important ingredient in the glass sand batch.
- As a bonding agent in the manufacture of bonded abrasives like wheels and discs of garnet, corundum, emery etc.

The glass and ceramic industries are the major consumers of feldspar and account for 95% of the total

consumption.

In ceramic bodies, the main vitrifying (fluxing) agent is feldspar. The majority of white ware bodies contain good proportions of feldspar. It acts as a flux. In the ceramic industry, the flux is defined as that portion of the body which develops glass phase. This is provided mostly by feldspar. The amount of flux in a ceramic body should be only in such a proportion as to develop the desired amount of vitrification. If excess of flux is added, the fired body becomes very glassy and consequently, brittle.

Feldspar is used in varying proportions in porcelain, china and earthenware. Earthenware contains on an average

- 12% feldspar
- 25% ball clay
- 28% china-clay
- 35% quartz

This proportion of feldspar varies in different products like

- Wall tile -5%
- Floor tile -30%
- Statutory porcelain -50%
- Sanitary china and porcelain bodies -30%

In the glass industry also, potash feldspar is used in varying proportions. It may contain 10 to 15% of the batch. Feldspar, in this industry, is valued for two purposes, firstly, it acts as a flux and secondly, for alumina content. Alumina provides the resistance in glass to impact, bendings, and thermal shock.

In ceramic bodies, potash feldspar is preferred although soda feldspar works as a good flux and can be satisfactorily used in developing ceramic bodies. Potash feldspar has p.c.e. value 10, while soda feldspar has 8-9. Anorthite (the calcium feldspar), though it contains twice as much alumina as soda and potash feldspars and also contains lime which is an important ingredient of glass, is not preferred in the glass industry because it is more refractory (p.c.e. 12). Glass industry prefers to use mainly orthoclase (potash feldspar) because it tends the melt to clear glass while albite (soda feldspar) tends the melt to a translucent glass.

Feldspar is used as bonding agent along with magnesium oxide, magnesium chloride and other synthetic glue in the manufacture of abrasives, wheels, discs and other shapes. In the preparation of glazes the fine powder of feldspar is mixed with silica powder and a thin slurry is made. The fired up goods are dipped into the slurry and fired again. This imparts glaze to the surface. Some other ingredients are also added to the slurry to impart glaze and lustre. Each pottery factory has its own technique of preparing slurry which is regarded as a trade secret.

### **Colour**

Orthoclase - usually light colored white, pink, yellow, or cream, and not transparent. The gem variety is clear to pale yellow, and some called "noble orthoclase"

Microcline - white, pink, pale yellow, or sometimes green-blue, and not transparent. The green-blue variety is called "amazonite"

Plagioclase - gray to grayish-white is common, but may also be white, pink or pale yellow. More semi-

opaque than the other feldspars on average, and contains striations on some crystal faces or cleavage surfaces.

### **Hardness**

6-6.5

### **Environment**

The feldspars make up the major constituent of many igneous and metamorphic rocks, they form at medium to high temperature and at some depth. Microcline can form in granite pegmatites and at lower temperatures.

### **Associated**

Quartz

Other feldspars

Hornblende

### **General Information**

Orthoclase - when transparent it is faceted into a gemstone. Clear or pale yellow in color it is a collectors item, and of little value to the jewelry industry as both beryl and even citrine are harder and more durable.

Microcline - variety amazonite, is sometimes cut into cabochons, and used in jewelry. The blue-green color is caused by a lead impurity. It is rarely used as more people are aware of turquoise and chrysocolla.

Moonstone - moonstone can be made up of any number of different feldspars including, orthoclase,

plagioclase, albite, and microcline. They are all very similar when cut into cabochons, they can best be distinguished by their different densities. Moonstone tends to be silver, pale green, pale blue, or creamy colored. It is translucent and shows a blue-white sheen sometimes called "adularescence".

Plagioclase - there are two distinct varieties used in jewelry, the dark-blue-black Labradorite, and the orange-honey colored Sunstone.

- Labradorite gets its coloring from a "labradorescence", reflected light from a multitude of small parallel, plate-like structures, with minute inclusions of ilmenite, rutile, and magnetite. The color patterns are similar in that shown in nature with oil on water. It is rarely faceted, but often cut into attractive cabochons. Value is not really very high as it has not caught on as a popular material and is abundant.
- Sunstone is a species of plagioclase called "oligoclase" or known sometimes in the jewelry industry as "adventurine feldspar". It gets its shimmer in the same way that labradorite does, but the background color is brown to orange, and the composition is full of small hematite crystals that give it additional sparkle.

### **Market Specifications**

In the manufacture of high-class, colourless glass, feldspar should have a maximum of 0.1% Fe<sub>2</sub>O<sub>3</sub> though upto 0.3% is permissible. The presence of iron in the batch composition for glass is not liked because its presence, even in very small quantity, tends to colour the glass. The mesh size required is 40-80 BSS in the glass industry. A still finer mesh can be utilized in the ceramic industry. In this industry, a little higher percentage of iron content in feldspar is not objected to. However, in the preparation of white wares feldspar containing below 0.4% Fe<sub>2</sub>O<sub>3</sub> is preferred.

Feldspar is also an important constituent for the preparation of white and coloured enamels for metallic and ceramic surfaces. Of late research is being done to utilize feldspar in the production of good quality, white portland cement.

In recent years, nepheline syenite has been found as a good substitute for potash feldspar and is being used in an increasing amount in Canada and USA. Nepheline syenite is an igneous rock consisting chiefly of nepheline, microcline and albite.