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## Kyanite and the Sillimanite Group of Minerals

Kyanite is a member of the sillimanite group of minerals, which includes kyanite, andalucite, and sillimanite; all of these minerals are naturally occurring polymorphs of  $\text{Al}_2\text{O}_3 \cdot \text{SiO}_2$ . Despite their similarities, each of these minerals has a unique crystalline structure, and it is these differing crystal structures that give each compound its distinct physical properties.

## Kyanite and its Properties

Kyanite, which occurs in nature as elongated, "lath-like" crystals, has many important (and several unique) properties that make it a valuable raw material in refractory and ceramic products. Pure kyanite contains 63% alumina and is, therefore, an inexpensive source of alumina.

When heated it decomposes into mullite, ( $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ ) at  $1200^\circ\text{C}$  -  $1450^\circ\text{C}$ , a lower decomposition temperature than that for either sillimanite and/or andalucite. This fact means that kyanite converts to mullite at a lower temperature than andalucite and/or sillimanite.

Most importantly, kyanite undergoes a large irreversible volume expansion at its decomposition temperature. It is this expansion that is used by many refractory and ceramic manufacturers to counter balance the firing shrinkage of various clays, cement and other binders.

The irreversible expansion of kyanite is much larger than that for the other minerals in the sillimanite group. The amount of volume expansion is particle size dependent and ranges from over 25% for 35 mesh material to about 3% for 325 mesh kyanite. The "lath-like" kyanite crystals also enhance green strength of ceramics and refractories.

## Uses

Kyanite finds many uses in refractory and ceramic products. Monolithic refractories are the largest user of kyanite. Besides being a source of expansion to counteract shrinkage associated with cement and binders, it is an excellent source of alumina and mullite. Finer mesh kyanite is used in bricks that take advantage of its expansion and fineness while helping reduce porosity, and is a source of mullite in the matrix. Kyanite is used in the foundry industry as mold coatings where gas permeability is an important criterion. Kyanite is also used in kiln furniture to offset shrinkage from clays and provide an economical source of Mullite at higher temperatures that is beneficial.

## Virginia Kyanite Concentrates

Virginia Kyanite™ is an industrial mineral concentrate that contains 56%-61% alumina by weight. Kyanite is sold in granular or powder form and can be shipped in a variety of grain sizes, ranging from 35 mesh (425 microns) material to 325 mesh (45 microns).



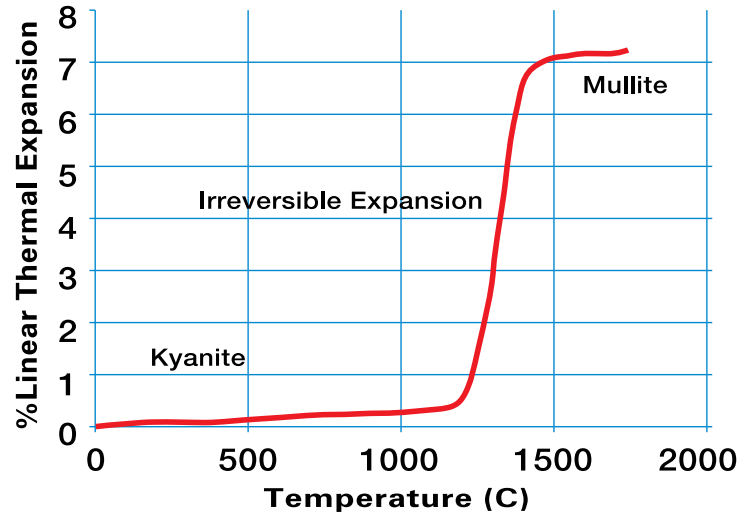
**Typical Chemical Analysis (%)**

Al <sub>2</sub> O <sub>3</sub>	57.5 (55.0 min)
SiO <sub>2</sub>	40.3
TiO <sub>2</sub>	1.2
Fe <sub>2</sub> O <sub>3</sub>	0.6 (0.85 max)
CaO	<0.04
MgO	<0.03
Na <sub>2</sub> O	<0.04
K <sub>2</sub> O	<0.07
P <sub>2</sub> O <sub>5</sub>	<0.15

**Mineralogy (%) Typical**

Kyanite	92-98
Quartz	2-8

**Thermal Expansion**



**Screen Analysis Specification of Virginia Kyanite**

	35m (425 microns)	48m (300 microns)	100m (150 microns)	150m (106 microns)	200m (75 microns)	325m (45 microns)	Pan	Total % Volume Expansion at Approximately 7% Addition
35 Mesh	13-25	10-30	20-50				15-40	8-9%
48 Mesh		6-14	18-30	10-20	10-20		25-45	4-5%
100 Mesh			5-10	5-11	6-15		65-85	2-3%
200 Mesh					10 max		90 min	1-2%
325 Mesh						10 max	90 min	1-2%

Screen analysis is reported on Tyler standard sieves. Pan designates material passing the last reported screen. All analysis are expressed in weight %.

