DURANDAL® RX

IMPROVED CHARACTERISTICS OF REFRACTORIES

Chemical Composition

Al_2O_3
Typical: 58.9%
Min: 58.5%

SiO_2
Typical: 38.5%
Max: 40.0%

Fe_2O_3
Typical: 0.8%
Max: 0.9%

TiO_2
Typical: 0.15%
Max: 0.3%

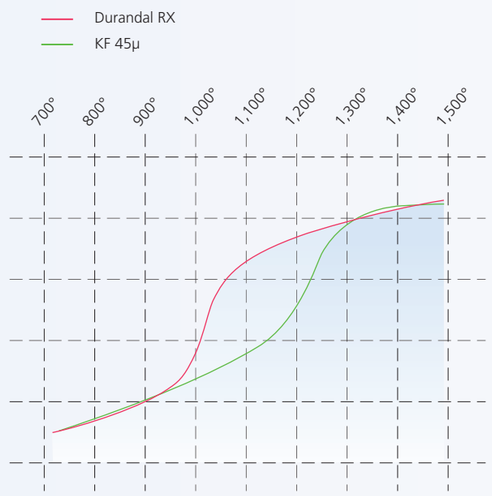
Durandal® RX is a superfine andalusite material milled to a particle size approaching the primary crystallites to increase reactivity within refractory bodies and helping to promote the mineralogical transformation to mullite.

The transformation of andalusite into mullite proceeds with the effects of time and temperature. Studies comparing **Durandal® RX** and coarse grain andalusite show significant levels of mullitisation from temperatures as low as 950°C, approximately 250°C lower than what is more typically expected of andalusite.

This allows for the re-combination of the silica glass produced during the mullitisation process to combine with alumina rich matrices and form secondary mullite, significantly re-enforcing the bonding phase of the material.

The super fine material is essential for producing high density products

Comparison of CMOR between standard Andalusite and Durandal® RX



Improved thermal–mechanical properties

The in-situ formation of mullite from andalusite is a proven method to improve thermal shock resistance in refractories. In the majority of applications, a large percentage of the hot face lining, while still exposed to large temperature variations, do not reach temperatures which enable the transformation of andalusite into mullite (around 1250°C).

In alumino-silicate systems, the primary and secondary mullite phases produced create a mullitic ceramic bond that has superior thermal-shock resistance and signifi-cantly improved creep resistance compared to traditional ceramic "glassy phase" bonding.

The ultra-fine particle size of **Durandal® RX**, enables the mullitisation process to commence at a lower temperature, from 950°C, permitting the material to gain the benefit of andalusite more evenly throughout a monolithic or unfired brick in actual service conditions.

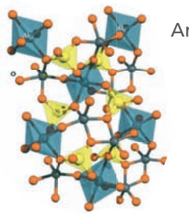
Particle Size Distribution

$D_{99}(\mu)$
Typical: 40
Max: 55

$D_{90}(\mu)$
Typical: 6.5
Max: 13

$D_{50}(\mu)$
Typical: 2.0
Min: 1.5
Max: 2.5

$D_{10}(\mu)$
Typical: 0.7
Max: 1.0



Andalusite Crystal

$$3(Al_2O_3.SiO_2) \rightarrow 3Al_2O_3.2SiO_2 + SiO_2$$

Andalusite — Mullite — Silica glass

$$2SiO_2 + 3Al_2O_3 \rightarrow 3Al_2O_3.2SiO_2$$

Silica glass — Alumina — Secondary Mullite

Chemical Composition

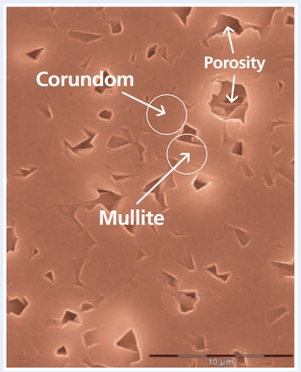
MgO
Typical: 0.10%
Max: 0.2%

CaO
Typical: 0.20%
Max: 0.55%

K_2O
Typical: 0.35%
Max: 0.55%

Na_2O
Typical: 0.10%
Max: 0.2%

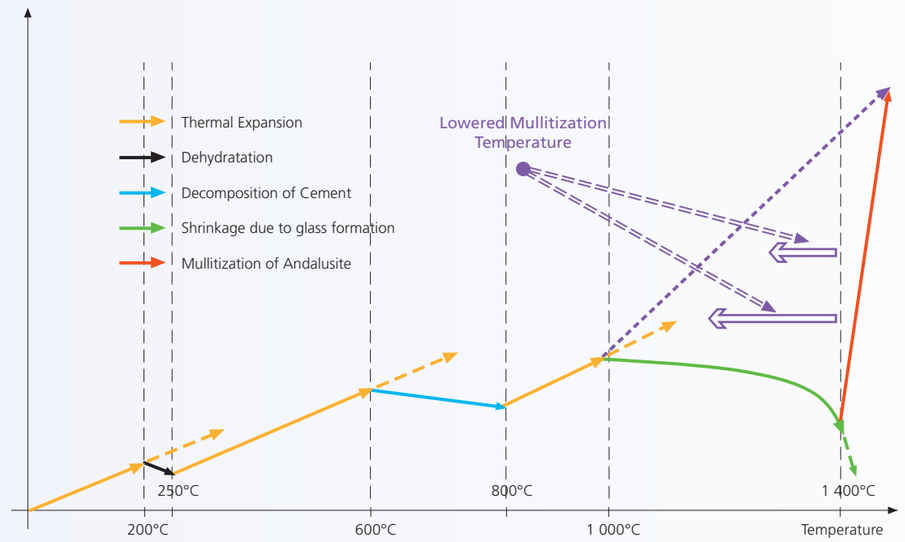
Reactive Alumina and Durandal® rX sintered at 1,600°



Physical properties

True density (g/cm³)	Bulk density (m³/g)
Typical: 3.1	**Typical:** 0.7

Reduced Thermal Expansion Mismatch

A refractory lining is rarely at a constant temperature throughout the entire body and more commonly experiences a significant temperature gradient across the body from hot face to cold face. The difference in thermal expansion between the hot face and the cold face places the refractory material under significant stress, complicated further by the shrinkage of the material due to loss of free moisture, decomposition of cement and glass formation, all potentially leading to hot face spalling during service.

Andalusite's expansive reaction assists refractories by countering these shrinkages with the formation of mullite. By utilizing 'reactive andalusite' it is possible to increase the depth of the mullite re-inforced zone within the refractory body giving a more stable product and reducing the internal stresses that may lead to prema-ture failure of the refractory material.