MULLITE - CHROME REFRACTORY

Mullite - Chrome refractory phase is a part of the Alumina - Chrome - Silica (Al_2O_3-Cr_2O_3-SiO_2) ternary system. It won't be irrelevant to mention here that I, the author of this blog, obtained my PhD in Refractories for my work on Mullite - Chrome refractories especially, study on the kinetics and mechanism of sintering, densification behaviour, and various physical, thermo-mechanical properties of compositions in the Alumina - Chrome - Silica (Al_2O_3-Cr_2O_3-SiO_2) system, optimization of the various controlling parameters along with characterization of the sintered samples in terms of XRD, Microstructural analysis, Hot Modulus of Rupture (HMOR) etc. A review of the previous work done on the Alumina - Chrome - Silica system has been discussed in one of our earlier posts.

In a refractory the mullite phase can be developed by in-situ reaction sintering between the alumina (Al_2O_3) and silica (SiO_2) containing raw materials or can be imparted directly by adding synthetic mullite grains. In the same way, *Mullite - Chrome phase* (with some C*hrome Corundum*solid solution) containing refractories can be formed using natural raw materials mainly calcined bauxite (of low iron, low impurity), calcined fireclay and green chrome oxide (ultrafine) with some sintering aid (?) through reaction sintering at a comparatively lower temperature around 1450 - 1500^{O}C. Alternatively, such refractories can be made using synthetic raw materials such as fused alumina, calcined alumina or even synthetic mullite grains in suitable grading along with green chrome oxide (preferably high purity, ultrafine type) homogeneously dispersed throughout the refractory mix (powder). In the later case the firing temperature would be around 1600 - 1650^{O}C with soaking time depending upon the various known factors.

The addition of Chrome (Cr_2O_3) to alumino-silicate and mullite refractories improves certain high temperature properties of these refractory products. Creep as well as slag corrosion resistances of high alumino-silicate and mullite containing refractories are considerably increased with the addition of Chrome (chromium oxide, Cr_2O_3) in them. The creep resistance enhancement of high alumino-silicate refractories is attributed to an increase in viscosity for the glassy phase in the bonding matrix due to the addition of Chrome while reasons for the better slag corrosion resistance of chrome - containing (Cr_2O_3- containing) high aluminosilicate and mullite refractories are -

(1) Formation of a dense, Cr-spinel (Chrome-spinel) layer at the slag / refractory interface,

(2) Formation of an impermeable layer due to the crystallization of fibrous mullite facilitated by the presence of Cr_2O_3 in the refractory brick immediately adjacent to the interface which restricted the slag penetration,

(3) Formation of corundum solid solution (Alumina-Chrome corundum solid solution) which increases the inter-granular direct bonding near the interface at 1500^{O}C to 1600^{O}C reinforced the bonding matrix.

Because of these improved properties mullite-chrome refractories and alumina-chrome (Al-chrome) refractories have been found to perform better than the conventional refractories in furnace hearth areas of lead-zinc smelter and in secondary steel making processes such as in slide-gate refractory assemblies (nozzles, well blocks, porous plug seating blocks etc.) in the steel industry. Laboratory data have shown exceptional resistance to corrosion of these refractories to highly siliceous slag along with better results for these refractories containing mullite-chrome phase from coal gasifier, fiber glass tank furnace, and carbon reactors.

Source : http://viewforyou.blogspot.in/2009/12/mullite-chrome-refractory.html