Mechanical and thermal properties of spinel refractories mixed with blast furnace waste slag

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Steel-making waste slag is one of the most ubiquitous and intractable industrial waste materials in industrialised countries. It consists mainly of very hard semi-crystalline metal oxides with large amounts of oxides of iron and zinc as well as Na_2O and CaO and others, depending on the original composition of the ore mixture. It is essentially an inert material but, because of its very high hardness it has found few high value uses since it requires lots of energy to grind it to a usable size. It is mainly used as a road-filler and as a sand-blasting material. Over the years vast amounts have accumulated next to blast furnaces and steel-making plants which would only be reduced if a high-value application could be found.

In this work, an effort at utilising such slags has been made. Waste slag from steel-making plants was mixed with high temperature spinel refractory masses and tested to ascertain the effect on their mechanical and physical properties. Spinel refractory masses are used as bonding material in the construction of large kilns or furnaces for the production of ceramics and steel. The slag was first ground to various grain sizes and mixed up to 50% with the spinel refractory and sintered up to 1450^{o}C. The specimens produced were tested under compressive and flexure load and by measurements of their thermal conductivity, thermal expansion, density, porosity and water absorption. The morphology of the starting materials and resulting specimens was examined by Scanning Electron Microscopy.

The results indicate that the use of up to 50% slag in spinel refractories does not affect the mechanical properties of the refractory and in some cases the strength is improved. At the highest sintering temperatures used the slag reacts with the spinel resulting in new high density, high strength refractories.