Chapter-8

(Conclusions)

Chapter 8

Conclusions

The present work attempts to tackle three major problems associated with the alumina-carbon refractories:

1. Reduction of total carbon content,
2. Suitable protection of carbon during first heat up and use,
3. Dimensional control over *in situ* spinelization.

In the third chapter, a zero-dimensional carbon was introduced, and its quantity was optimized to obtain a refractory with half amount of total carbon as when compared to conventional products. The optimized addition of nano carbon black resulted in a much better dispersion of carbon in the refractory matrix thereby leading to increased mechanical properties, enhanced spalling resistance but reduced hydration properties. A significant achievement was the control over inherent anisotropy of graphite, which resulted in overcoming the different crushing strength of the various faces of the bricks.

In chapter four of the work a refractory with a reduced content of antioxidants is designed. The mechanical activation and subsequent reduction of antioxidants particle size result in a superior oxidation property, greater thermal shock resistance, and denser microstructure.

In the fifth chapter, it was shown that added boron carbide and aluminum metal, bring about a self-repairing function. The self-repairing function includes:

1. Reduction of CO(g) to C(s) by non-oxides and aiding in reducing carbon loss,
2. The decrease of the porosity of the refractory,
3. Strengthening the modulus of rupture of the refractory,
4. Promotion of the crystallization of free carbon from the binder, and
5. Formation of the protective layer, the refractory surface, and an increase of oxidation resistance and corrosion resistance.

The sixth chapter describes that an optimized 21 wt% *in situ* spinelization is essential for the alumina-magnesia-carbon matrix to resist slag and develop high-temperature properties. Any further increase in this *in situ* spinel results in a self-destructive matrix. A new and hybrid class of refractory containing both pre-formed and *in situ* spinel was designed in the seventh chapter. This hybrid refractory can withstand a better slag attack than both pre-formed and *in situ* spinel containing bricks. It has much better hot properties and is dimensionally more stable than the samples comprised of only *in situ* spinel containing briquettes.

Scope of the future work

- ❑ It is tough to incorporate and wet graphite in the matrix perhaps a thin coating on the flake graphite surface can improve this.

- ❑ Field trials to be carried out with the low carbon-containing samples.

- A more detailed kinetic studies are required to prove the validity of the antioxidant used.
- Pre-formed carbide and borides can be a better way to increase oxidation properties.
- A slag with varying basicity index can be used to study the as produced hybrid system.
- An introduction of nickel as a catalyst to promote shaped spinel can be done.