ABSTRACT

The purpose of this dissertation is to study the reducibility of chromite ore and reactivity of carbonaceous reductants. The effect of temperature, particle size, composition, reducing agent and reducing atmosphere on the kinetics of the reduction of given chromite (obtained from Xstrata) was studied.using tga,and to test reactivity of the reductant, present experimental data was applied to Arrhenius model.

The ore is reduced by reductants namely coke, coal, charcoal and graphite at temperatures between 1000 ºC and 1300 ºC under argon atmosphere. Particle size range of as received, (+50µm-100µm), (+100µm-150 µm), (+150µm–200 µm) were used. For each experiment a calculated mixture of chromite and reductant was mixed with acetone and the mixture was reduced using a TGA furnace.The results indicated that the reduction rate was a function of temperature and particle size.The reduction at 1000 ºC under argon atmosphere is minimal.As temperature is increased to 1100 ºC, 1200 ºC and 1300 ºC it was observed that reduction rate of this chromite increased and sample having finer particle size fraction showed higher reduction rate at all temperature.

The effect of the type of reducing agent namely coal, coke, charcoal and graphite was variable.At lower temperatures: 1000ºC and 1100ºC coke, coal, charcoal and graphite was order of reduction from highest reduction to lowest whereas at higher temperatures: 1200 ºC and 1300ºC order was coal, coke, charcoal and graphite.The phases formed at the end of each reduction stage were studied using SEM and optical microscope which helped to confirm the experimental data.

To test reactivity of the reductant, present experimental data was applied to various models.A model which was found to be suitable was the Arrhenius model.The value of the activation energies obtained from fitting the data into the Arrhenius equation was used to determine the relative reactivity of the reductants, the values of the chemical reaction rate constants and effective diffusion constants were used to determine the relative speed at which the reductants can reduce the chromite ore.

The TGA test suggest that coke has the highest reactivity since its activation energies are lowest and require less energy to induce the reductants reaction The tests also suggest that the rate controlling mechanism is diffusion of species to the reactive site since the effective diffusion

coefficients were of the order $10^{-11,}$ which were far less then the chemical rate constant of the order 10^{-6} to 10^{-5}.Test also suggest that coal is fastest to react since its D_e values are high