Comparing Study of Reduction of Titano-magnetite Concentrate (Produced from Rossita Illmenite Ore) Pellets or Briquettes via Hydrogen or Coke against That Pellets or Briquettes Produced from El-Baharia Iron Ore

Thesis Submitted

For

Ph.D. Degree in Chemistry

By

Atef Elamir Owis Sayed Basheer

M.Sc. Chemistry, 2012

To

Chemistry Department, Faculty of Science,

Ain Shams University

2016

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Approval Sheet

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Abstract

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Thesis Title: Comparing Study of Reduction of Titano-magnetite Concentrate (Produced from Rossita Illmenite Ore) Pellets or Briquettes via Hydrogen or Coke against That Pellets or Briquettes Produced from El-Baharia Iron Ore

The main objective of this study is to develop a comparative study of the kinetics of reduction of different sources of iron ores "titanomagnetite concentrate TMC produced from Rossetta illmenite ore and El-Baharia Iron ore" using different forms for preparing the initial material like briquettes and pellets via hydrogen or coke as a reducing agent at different temperatures.

The results indicated that the optimum conditions for the reduction process for briquettes produced from TMC are 1.5 L/min hydrogen flow rate at 950˚C. The kinetic model shown by the briquettes is Diffusion through ash layer model for cylindrical briquettes with activation energy 17.17 kJ/mole, While Diffusion through thin ash layer model (Jander equation) and Diffusion through ash layer model (Crank-Ginslling-Brounshtein equation) for pellets with activation energy 23.64 and 22.67 kJ/mole respectively. Also the main crystalline phases of reduced briquettes as obtained by XRD were: metallic iron (syn. Fe), rutile (syn.TiO_2) with some traces of magnetite (Fe_3O_4). Also for TMC pellet at 2 L/min hydrogen flow rate and temperature 950°C, the main crystalline phases of reduced pellets were metallic iron, rutile with some traces of magnetite (Fe_3O_4). For TMC with coke the optimum temperature is 900 ºC and stoichiometric coke =1, the kinetic model was Diffusion through ash layer model for cylindrical briquettes and activation energy = 63.68 kJ/mole.

The reduction process of briquettes produced from El-Baharia iron ore was performed at 1.5 L/min hydrogen flow rate at 950˚C. The kinetic model followed by the briquettes is Diffusion through ash layer model. And the activation energy = 55.63 kJ/mole. Also the main crystalline phases of reduced briquettes were metallic iron, and some traces of magnetite (Fe_3O_4). For El-Baharia iron ore pellets at 2 L/min hydrogen flow rate and 950°C the kinetic model is diffusion through thin ash layer (Jander equation) and activation energy = 56.43 kJ/mole. The main crystalline phases of reduced pellets were metallic iron, with some traces of magnetite (Fe_3O_4). And for El-Baharia reduced with coke at 1050ºC and Stoichiometric coke = 1, the kinetic model was diffusion through ash layer for cylindrical briquettes and activation energy = 42.52 kJ/mole.

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