UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

DETERMINATION OF FACTORS INFLUENCING THE DEGREE OF REDUCTION DISINTEGRATION IN NORTHERN CAPE LUMP ORE AND THE ROLE OF GANGUE MINERALS IN THE PROPAGATION OF CRACKS

WF VAN DER VYVER

Dissertation submitted in partial fulfilment of the requirements of the degree Philosophiae Doctor (Metallurgy) in the Faculty Engineering, Built Environment and Information Technology, University of Pretoria, Pretoria

2008-07-29

DETERMINATION OF FACTORS INFLUENCING THE DEGREE OF REDUCTION DISINTEGRATION IN NORTHERN CAPE LUMP ORE AND THE ROLE OF GANGUE MINERALS IN THE PROPAGATION OF CRACKS

WF VAN DER VYVER

Promotor :	**Prof PC Pistorius**
Department	**Material Science and Metallurgical Engineering**
Degree	**Philosophiae Doctor (Metallurgy)**

SYNOPSIS

The fundamental cause of low temperature breakdown (reduction disintegration) is reduction of hematite to magnetite, resulting in a volume expansion and stress relief through the formation of cracks. Serious reduction disintegration causes poor gas permeability, high flue dust production and scaffolding, poor gas distribution, higher fuel consumption and lower productivity.

Northern Cape iron ore generally performs well when tested for reduction disintegration properties both for blast furnaces and Corex; nevertheless, significant breakdown is experienced when used in the Corex process (at Saldanha Steel).

This study was hence conducted to determine the effects of the following on reduction disintegration:

- different ore types (from Northern Cape)
- initial particle size
- temperature range
- reduction gas composition

Although disintegration is clearly triggered by reduction, no direct correlation could be established between the percentage reduction and the percentage fines generated.

The results indicated that the presence of gangue minerals alone does not cause fractures to form, but does influence the direction and intensity of fractures to some extent. In many cases cracks form randomly, with no specific preference for either gangue minerals or iron oxides. For most of the samples, an incubation period was observed before the first cracks formed. No crack propagation was observed after initial cracking.

This study indicates that the degree of reduction disintegration depends mostly on furnace conditions. Reduction disintegration increased with higher hydrogen percentages (>5%), higher temperatures (in the 500ºC-700ºC range) and longer exposure. Disintegration of the samples decreased at temperatures higher than 750°C.

For particles smaller than 16 mm an inverse relationship was found between the average particle size and the percentage of fines generated, in line with the observation that most of the disintegration is due to spalling from particle edges rather than particles breaking into smaller clumps.

The results indicate that it is important to manage the temperature in the top of the blast furnace and the COREX shaft, and the time spent at temperatures below 750°C, to minimize the amount of fines generated.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES