Fluidised-Bed Chlorination of Oxidised Titania Slag.

By

BUNGU PETER NDULA

A dissertation submitted in fulfilment of the requirements for the degree

MASTER OF SCIENCE (METALLURGY)

in the

Faculty of Engineering, the Built Environment and Information Technology

University of Pretoria

2004

Fluidised-Bed Chlorination of Oxidised Titania Slag.

STUDENT : BUNGU PETER NDULA

SUPERVISOR : P.C. PISTORIUS

DEPARTMENT : MATERIAL SCIENCE AND METALLURGICAL ENGINEERING.

DEGREE : MASTER OF SCIENCE (METALLURGY)

ABSTRACT

High-titanium slag (produced by carbothermic reduction of ilmenite) contains a significant percentage of trivalent titanium, which can be converted to the tetravalent form by oxidation. Oxidation can occur through contact with water vapour, for example during water granulation. This work investigated the degree of oxidation of the different size fractions of water granulated titania slag, and the resultant changes in phase composition. For this oxidised slag, the kinetics and exothermicity of the chlorination process are also reported.

Key words

Oxidised titania slag, water granulation, M_3O_5, anatase, rutile, chlorination, block route slag.

ACKNOWLEDGEMENTS

I wish to express my sincere thanks and appreciation to my supervisor, Professor P.C Pistorius for his constant advice, guidance and direction throughout this research work. I remain indebted to Kumba Resources for their support and sponsorship and the Innovation Fund awarded by the Department of Arts, Culture, Science and Technology.

My appreciation also goes to Professor T.A. Modro, the former head of Chemistry department and Zsussana Foldvari for their motivation, inspiration and support in pursuing studies in the University of Pretoria. Special thanks go to the following:

Late Mr. Johann Borman for his technical assistance, Sarah Havenga for her support, Sabine Verryn for assistance with the XRD analyses, Carl Coetzee for his assistance with the SEM work, Peter Sibiya for polishing the SEM samples, Deon Bessinger for the XRF analyses, and fellow pyrometallurgical students, Daudet T, Ulyate, Mutale and Tomi for their support and advice. The assistance of Giovanni Hearne and Antoine Mulaba (who performed the Mössbauer measurements and analyses) is also gratefully acknowledged.

I wish also to thank my Uncle Pa Lambi Umaru Kumsike for initiating my academic career and my wife Bungu Florence Kuvin for moral support and my daughter Bungu Tracey Ikeh for inspiring me to work harder. Finally, my special thanks go to the Almighty God for providing me with the wisdom, good health, and strength in successfully completing the programme.

DEDICATION

The research work is dedicated to my beloved late mother, Late Ma Ikeh Agnes Ndula who supported me from birth and died on the 30th of August 1994. May her soul rest in peace.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES