

Investigation into the effect of cooling conditions on the particle size distribution of titania slag

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A thesis submitted in partial fulfilment of the requirements for
the degree

PhD (Metallurgical Engineering)

*In the Department of Materials Science and Metallurgical
Engineering, Faculty of Engineering, University of Pretoria*

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June 2007

Acknowledgements

Several people over the years contributed to this work. It was, and still is, a privilege to work with all of you.

My appreciation goes to the staff of Exxaro R&D and Exxaro KZN Sands. The block cooling trials during campaigns 9 and 10 and the subsequent plant trials were characterised by intensive preparations, sampling and monitoring. My gratitude to all those involved in these activities for their unselfish contributions and time. My sincere appreciation to Exxaro KZN Sands for financially supporting this work.

My gratitude goes to all official and unofficial mentors who guided my growing process over the years: Dr. Willem van Niekerk, Matie von Wielligh, Geoff Randall, Johan Meyer, Gerrit van Zyl, Jeremy Bosman and Rob Hattingh. I learned immensely from you. May I bless others with the same dedication you have afforded me.

My deep gratitude to the staff of the University of Pretoria - Professor Chris Pistorius, Professor Johan de Villiers and Jeremy Bosman: thank you for your dedicated time, patience, contributions and support. Thank you Dr. Johan Zietsman for coding the block cooling model!

To my parents who somehow, through loving me unconditionally, taught me tenacity: thank you. May I be a mirror of your values.

To Manie and Willemien: thank you for showing me the balance in life. It seems appropriate that I had to understand this, before I could complete this work. Thank you for your motivation during the completion stages (which seemed never ending) of this thesis.

Thank You for the opportunities You are giving to me throughout my whole life. Thank You for your immensely beautiful and interesting creation. May I never cease to wonder at it's intricate, yet unadorned, interactions.

Abstract

Titania slag is a feedstock to the pigment industry, which in turn provides titania pigment to producers of everyday products like paper, cosmetics and toothpaste. Titania slag is the primary product of the pyrometallurgical process of ilmenite smelting – the other products being iron and CO gas. Titania slag is typically tapped from the furnace into blocks of approximately 20 tons. After cooling these blocks are crushed and milled to size fractions suitable for the processes of the pigment producers. These processes are broadly grouped into two types of technology: the chloride route (during which titania slag is reacted with chlorine and subsequently re-oxidised thereby removing the impurities) and the sulphate route (in this process the titania slag is purified after dissolving the slag in sulphuric acid). Due to the nature of these two processes, several specifications are imposed on the quality of the titania slags.

The fluidised-bed technology used in the chloride process limits the size distribution of the slag to between 106 μm and 850 μm . Ilmenite smelting industries consequently crush and mill the titania slag to below 850 μm . The fraction below 106 μm is then sold to the sulphate market. Since the coarser chloride grade product is the more valuable product, slag producers continuously strive to improve the ratio between the coarser and finer fractions.

This study reports on parameters which influence the particle size distribution of titania slags and therefore the split between the coarser (more valuable) and finer (less valuable) products. Pilot-scale slag ingots were used to identify chemical and process variables which influence the yield of coarser material. The microstructure of as-cast and milled slag was examined, and indicated a role of silicate phases in the crushing behaviour. Industrial-scale slag ingots were used to test whether the roles of tapping rate and water cooling (as identified from the pilot-scale ingots) also applied under industrial conditions. A numerical method was applied to estimate the thermal conductivity of the solidified slag (from measurements on pilot-scale ingots), and to predict the cooling and solidification behaviour of industrial-scale ingots.

The study concludes that the chemical composition and cooling conditions of the slag block play central roles in the final particle size distribution of the slag.

Key words: titania slag; pseudobrookite; solidification; ilmenite smelting

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