COOLING CHARACTERISTICS OF HIGH TITANIA SLAGS

by

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ABSTRACT

Various aspects relevant to the cooling of high titania slags were investigated. Rapidly quenched slags contain several phases, of which the M$_3$O$_5$ phase is the most prominent and important. Other phases include rutile, metallic iron and glass phases. The M$_3$O$_5$ phase (with M being mainly Ti and Fe) is essentially a solid solution, with Ti$_3$O$_5$ and FeTi$_2$O$_5$ as end members of the solid solution series. Impurities such as Al, Mg and Mn are also present in this solid solution. The composition of a typical high titania slag is approximately 10 per cent FeO, 30 per cent Ti$_2$O$_3$ and 55 per cent TiO$_2$. It was established that there is a linear relationship between the Ti$_2$O$_3$ content and FeO content of the slag. This relationship can be explained in terms of the M$_3$O$_5$ solid solution end members, Ti$_3$O$_5$ and FeTi$_2$O$_5$. A linear relationship between the tap temperatures and the FeO content of titania slags was also obtained.

Decrepitation behaviour of one ton slag blocks was observed during slow cooling of the high titania slag. For the purpose of this study decrepitation was defined as the disintegration or crumbling of a material into component parts or smaller fragments. This decrepitation process was simulated on a laboratory scale by heating various slag samples in air at temperatures below 600 °C for various times. Samples heated at temperatures above 600 °C did not decrepitate. The decrepitated samples were characterised by extensive cracking of the material. Decrepitation of the high titania slag was explained by oxidation of the M$_3$O$_5$ phase to form a M$_6$O$_{11}$ phase and anatase. This decrepitation, and the associated cracking of the slag, was probably caused by volume changes due to the formation of these new phases.

Key words
Titania slag, ilmenite smelting, decrepitation, anatase, rutile, pseudobrookite, oxidation, tapping temperatures, M$_3$O$_5$, slag cooling.
OPSOMMING

Verskeie aspekte relevant tot die afkoeling van titaanslak is ondersoek. Slakke wat vinnig geblus is bevat verskeie fases. Hiervan is die M₃O₅ fase die mees prominente en belangrike fase. Ander fases wat teenwoordig is sluit in rutiel, metalliese yster en glas fases. Die M₃O₅ fase (met M hoofsaaklik Ti en Fe) is ‘n vaste oplossing, met Ti₃O₅ en FeTi₂O₅ as die eindsamestellings van die mengreeks. Al, Mg en Mn is teenwoordig as onsuwerhede in die vaste oplossing. Die samestelling van tipiese hoë titaanslakke is ongeveer 10 persent FeO, 30 persent TiO₂ en 55 persent TiO₂. ‘n Lineêre verwantskap tussen die TiO₂ en FeO inhoud van die slak is bepaal. Die verwantskap is verduidelik in terme van die M₃O₅ vaste oplossing eindsamestellings, Ti₃O₅ en FeTi₂O₅. ‘n Lineêre verwantskap tussen die tap temperature en die FeO inhoud van titaanslakke is ook bepaal.

Dekrepitasiegedrag van een ton slak blokke is waargeneem tydens stadige afkoeling van die hoë titaanslak. Vir die doel van die studie is dekrepitasie gedefinieer as die disintegrasie of verbrokkeling van ‘n materiaal in kleiner komponente of fragmente. Die dekrepitasie proses is gesimuleer op ‘n laboratorium skaal deur verskeie slak monsters te verhit in lug by temperature onder 600 °C. Slak monsters wat bokant 600 °C verhit is het nie gedekripteer nie. Die gedekrepiteerde monsters het ‘n groot aantal krake vertoon. Dekrepitasie van die hoë titaanslak is verduidelik in terme van die oksidasie van die M₃O₅ fase om ‘n M₅O₁₁ fase en anataas te vorm. Die volume veranderings in die slak (en die verwante krake) as gevolg van die vorming van die nuwe fases is die mees waarskynlike oorsaak van dekrepitasie in die titaan slak.

Sleutelwoorde
Titaanslak, ilmeniet smelting, dekrepitasie, anataas, rutiel, pseudobrookiet, oksidasie, tap temperature, M₃O₅, slak afkoeling.
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