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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_3O_5 phase is the most prominent and important. Other phases include rutile, metallic iron and glass phases. The M_3O_5 phase (with M being mainly Ti and Fe) is essentially a solid solution, with Ti_3O_5 and $FeTi_2O_5$ 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_2O_3 and 55 per cent TiO_2. It was established that there is a linear relationship between the Ti_2O_3 content and FeO content of the slag. This relationship can be explained in terms of the M_3O_5 solid solution end members, Ti_3O_5 and $FeTi_2O_5$. 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_3O_5 phase to form a M_6O_{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_3O_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 M_3O_5 fase die mees prominente en belangrike fase. Ander fases wat teenwoordig is sluit in rutiel, metalliese yster en glas fases. Die M_3O_5 fase (met M hoofsaaklik Ti en Fe) is 'n vaste oplossing, met Ti_3O_5 en $FeTi_2O_5$ as die eindsamestellings van die mengreeks. Al, Mg en Mn is teenwoordig as onsuiwerhede in die vaste oplossing. Die samestelling van tipiese hoë titaanslakke is ongeveer 10 persent FeO, 30 persent Ti_2O_3 en 55 persent TiO_2. 'n Lineêre verwantskap tussen die Ti_2O_3 en FeO inhoud van die slak is bepaal. Die verwantskap is verduidelik in terme van die M_3O_5 vaste oplossing eindsamestellings, Ti_3O_5 en $FeTi_2O_5$. '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 gedekrepiteer nie. Die gedekrepiteerde monsters het 'n groot aantal krake vertoon. Dekrepitasie van die hoë titaanslak is verduidelik in terme van die oksidasie van die M_3O_5 fase om 'n M_6O_{11} 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, M_3O_5, slak afkoeling.

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