# CHARACTERIZATION OF THE MINERALOGY OF STEELMAKING SLAG BY X-RAY DIFFRACTION FOR INDUSTRIAL APPLICATIONS: CASE STUDY OF DELTA STEEL COMPANY, NIGERIA, STEELMAKING SLAG

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## ABSTRACT

Fifteen representative samples of Nigerian steelmaking slag were subjected to X-ray Diffraction (XRD) analysis with a Phillips PW 1050 diffractometer using copper radiation attenuation in order to characterize the slag mineralogy for possible industrial applications. Representative oven-dried powdered samples ground 1x30 seconds in a Tema mill, sieved through a Bolton No. 120 sieve and ground in an agate mortar were step-scanned from 5 to 60° at 4 x $10^2$ cps for the qualitative and semi-qualitative analysis. The X-ray diffraction patterns of the slag samples were analyzed by comparing the peaks present in the XRD patterns with those provided in The Joint Committee for Powder Diffraction Standards, Hanawalt System for identification of inorganic compounds (JCPDS). There was serious peaks overlap in the XRD diffraction patterns creating a complex situation of mineral occurrence and identification necessitating the use of least intensities to identify mineral occurrence and for qualitative and semi-quantitative interpretation. The mineral phases present were belite, merwinite, melilite, wustite, periclase, peruvvskite, native iron, and tricalcium aluminate. The semi-quantitative mean mineral composition was silicates(33.49%) wustites(44.81%), calcium aluminate(12.66%), periclase (5.38%) peruvskite(1.8%) native iron(1.18%). Qualitatively, mineral phase/polymorph occurrence was beta dicalcium silicate-β(24.70); tri-calcium aluminate, $C_3A$ - C(28); calcium silicate hydrate -S(10.24); peruvskite - P(9.05), alpha low dicalcium silicate - $\alpha'$(7.23); gehlenite - G(7.23); alpha high dicalcium silicate - α(6.63); akermanite - A(6.02); calcium aluminate hydrate - H(6.02); wustite W(2.41); merwinite - M(1.18), magnesio-wustite - R(1.20); and native iron, α-Fe - F(0.60) out of a mean general total occurrence of 166. Ca, Si, Mg, Al, Fe and Ti were the elemental concentration in the minerals/phases and polymorhs. The mineral and polymorph occurrences jndicated the slag suitability for use in the construction/aggregates, agriculture, blastfurnace and agriculture industries.

**Keywords:** Slag, minerals/phases, construction, agriculture, blastfurnace feed.