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Review

Basic oxygen furnace slag for road pavements: A review of material characteristics and performance for effective utilisation in southern Africa

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HIGHLIGHTS

- BOF slag aggregates are environmentally safe by-products and have superior physical and mechanical characteristics compared with most natural stone aggregates.
- A most appropriate range of BOF slag chemical compositions has been proposed.
- Despite its poor hydraulicity, BOF slag can activate other materials and can improve strength and durability of weak soils.
- Even when used in asphalt, unconditioned BOF slag can hydrate and lead to pavement star cracking and salt inflorescence.
- Southern Africa must embrace increased use BOF slag in road construction for environmental and sustainability benefits.

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ABSTRACT

Basic oxygen furnace (BOF) slag aggregates exhibit several favourable technical and environmental characteristics compared with natural stone aggregates, making them potentially valuable road construction materials. BOF slag-bitumen mixes have shown better resilient moduli, rutting resistance, bonding and moisture damage resistance and stripping resistance than mixes with natural aggregates and they can also be high quality substitutes for natural aggregate in lower road pavement layers. Regrettably, most southern African specifications do not cater for slags resulting in limited BOF slag reuse hitherto. This may be due to observed pavement performance problems arising from some chemical constituents in this slag. Excessive free lime ($\text{f-C}_2\text{O}$) and periclase (MgO) in slags react with water, resulting in large volume expansions which can lead to premature failure when used in roads. Aging treatment hydrates these oxides, thus ensuring allowable slag expansion. Low C_2S and C_3S contents in BOF slag make it a poor hydraulic binder. It may nonetheless, be used in soil stabilisation when activated by lime and other pozzolans. Heavy metals such as chromium, vanadium and nickel in the slag could potentially leach and pollute the environment. Assessment and monitoring of such elements are necessary for the environmental acceptance of using BOF slag in road pavements.

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