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BORON IN CASTING POWDER: INSIGHTS FROM PROSIMET STUDIES

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Fluorine has been widely used in continuous casting mold fluxes due to its ability to reduce surface tension, lower viscosity, and decrease melting temperatures. However, its dissolution in secondary cooling water leads to hydrofluoric acid formation, posing significant environmental and safety hazards. As a result, research has focused on alternative fluxing agents, with borate compounds emerging as a promising substitute due to their ability to form borosilicate structures.

The present work consolidates findings on the role of boron in mold fluxes, focusing on its effects on viscosity, structural behavior, and environmental impact. Studies indicate that boron can act as either a network former or modifier depending on its concentration and interactions with elements such as calcium and sodium. The viscosity and structure of borosilicate-based fluxes have been analyzed using high-temperature viscometry, solid-state NMR, Raman spectroscopy, DSC, XRD, and laser flash analysis. Results show that viscosity initially decreases when replacing CaF_2 with B_2O_3 but increases at higher B_2O_3 concentrations due to changes in tetrahedral borate (3D) structures, which require cationic support, particularly from sodium. ^{19}F NMR analysis suggests that fluorine selectively interacts with sodium, disrupting tetrahedral borate formation.

Additionally, the dissolution of boron from overcooled slag glasses into secondary cooling water has been assessed using ICP-OES to evaluate its environmental implications. While boron-containing mold fluxes show potential as low-fluorine alternatives, their long-term stability, crystallization behavior, and industrial performance require further investigation.

Overall, boron-bearing mold fluxes provide a viable pathway toward reducing fluorine-related pollution while maintaining effective mold flux properties. However, further research is needed to optimize their composition and industrial applicability in order to control all the possible environmental issues.

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