

Residual Properties of Carbon-bonded Alumina Filter after Contact with Steel Melt

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Ceramic foam filters (CFFs) with a cellular structure have been used for decades for metal melt filtration at high temperatures to remove non-metallic inclusions (NMIs) which could become critical defects after metal solidification. Developed mainly for the aluminum metallurgy at the early stage, CFFs are currently playing important roles also in the steel production industry^[1]. In comparison to aluminum, the melt of steel has a much higher temperature (1500 – 1700°C) as well as a higher freeze-off risk during the filtration.

Carbon-bonded alumina is considered as one of the most promising materials for such a challenge thanks to its various advantages such as low creep sensitivity, high thermal shock resistance, relatively low density and inexpensiveness. To further improve the steel melt filtration efficiency of CFFs, innovative materials design is necessary. The concepts of active and reactive coatings have been successfully employed for filter material development^[2,3]. While active coatings with the same chemistry of the primary or secondary inclusions could enhance the filtration performance due to their identical chemical compositions, the mechanism of reactive coatings is based on the reaction with the dissolved oxygen in the steel melt, generating inclusions above the liquidus temperature which are then deposited on the filter.

In this study, a finger test was carried out for carbon-bonded alumina filter with carbon-containing calcium dialuminate as well as calcium hexaaluminate reactive coatings, respectively ^[4,5]. For that purpose, coated cellular filters were prepared via the replication process. They were then dipped into the melt of 42CrMo4 steel at 1650°C with artificially generated defined alumina impurities under argon atmosphere for 10 seconds before being taken out and cooling down to room temperature. The rest carbon content and open porosity of the filter residues were determined. With an electromechanical high-temperature testing machine, the mechanical strength of the residual filters was tested at 1100°C and 1500°C, respectively. Furthermore, the microstructure of these residues was examined by scanning electron microscopy (SEM).

References

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