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Concepts for the development of carbon free mold powders for the continuous casting of steels

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In the continuous casting, mold powder is added to the molten steel meniscus, where it forms a liquid slag that also contains a carbon-enriched layer. This phenomenon occurs even in ultra-low carbon steels, where small amounts of carbon are used to control the melting behavior of the mold powder. During the process, the liquid steel may come in contact with this layer leading to steel re-carburization and a subsequent reduction in quality. Therefore, the development of carbon-free mold powders is essential.
First, possible melt controlling additives were selected, and mixtures composed of standard raw materials were defined ensuring the same slag composition as the conventional mold powder after liquefaction. Mold powders and the prepared mixtures were filled into steel crucibles closed by a lid, and inserted in a laboratory furnace preheated to temperatures between 900-1200℃ to simulate high heating rates. After a dwell time of 10 minutes, the samples were quenched to room temperature and mineralogically investigated. SiC, without the addition of any antioxidants, proved to be a suitable replacement of carbon. Attempts to reduce its content led to a significant decrease of CO2-emission from the mold powder. To further minimize the carbon content in mold powders, a new approach was developed. The raw materials required for each mold powder were assigned to a basic or an acidic group. Granules were produced from each group, subsequently mixed and subjected to thermal treatment. Mineralogical analyses revealed that the separation of basic and acidic raw material components delayed the formation of new phases such as cuspidine or equilibrium liquid phase. This may be attributed to suppression of intermediate liquid phases in disequilibrium and increase of diffusion path. Following, the amount of melt-controlling additives was further reduced or even eliminated in selected samples, what did not negatively affect their melting behavior.

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