World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:12, No:06, 2018

Making of Alloy Steel by Direct Alloying with Mineral Oxides during Electro-Slag Remelting

Authors : Vishwas Goel, Kapil Surve, Somnath Basu

Abstract : In-situ alloying in steel during the electro-slag remelting (ESR) process has already been achieved by the addition of necessary ferroalloys into the electro-slag remelting mold. However, the use of commercially available ferroalloys during ESR processing is often found to be financially less favorable, in comparison with the conventional alloying techniques. However, a process of alloying steel with elements like chromium and manganese using the electro-slag remelting route is under development without any ferrochrome addition. The process utilizes in-situ reduction of refined mineral chromite (Cr_2O_3) and resultant enrichment of chromium in the steel ingot produced. It was established in course of this work that this process can become more advantageous over conventional alloying techniques, both economically and environmentally, for applications which inherently demand the use of the electro-slag remelting process, such as manufacturing of superalloys. A key advantage is the lower overall CO_2 footprint of this process relative to the conventional route of production, storage, and the addition of ferrochrome. In addition to experimentally validating the feasibility of the envisaged reactions, a mathematical model to simulate the reduction of chromium (III) oxide and transfer to chromium to the molten steel droplets was also developed as part of the current work. The developed model helps to correlate the amount of chromite input and the magnitude of chromium alloying that can be achieved through this process. Experiments are in progress to validate the predictions made by this model and to fine-tune its parameters.

Keywords : alloying element, chromite, electro-slag remelting, ferrochrome
Conference Title : ICMSM 2018 : International Conference on Materials Science and Metallurgy
Conference Location : San Francisco, United States
Conference Dates : June 06-07, 2018