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Monitoring the internal processes of electroslag remelting through an external array of magnetic field sensors

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This paper presents the results of laboratory and industrial scale investigations into the internal processes of electroslag remelting (ESR) facilitated by an external array of magnetic field sensors. Electroslag remelting is a crucial metallurgical process employed for the refinement and production of high-quality metal ingots, particularly in the context of alloy manufacturing. Real-time monitoring of the internal dynamics has remained elusive due to the prohibitive environment inside the ESR furnace. Here, we investigate the applicability of passive magnetic field sensors in measuring such key operational conditions as electrode immersion depth, slag depth, current partition, and the identification of any internal arcing, including the arc location, within the ESR. The approach is based upon 20 years of experience in the use of magnetic field measurements during vacuum arc remelting, however additional signal processing techniques were utilized to analyze the data obtained because of the AC nature of the power. Initial investigations indicate that the use of the magnetic signature of the AC current can be utilized to ascertain clear process condition signatures as outlined. The goal of this work is to enhance our understanding of melt dynamics, fluid flow patterns, and solidification behavior during ESR processing.

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