Thermal energy storage for waste heat recovery in the steelworks: The case study of the REslag project

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Abstract

This work attempts to find a technological solution for heat recovery from the exhaust gases at high temperature exiting in the electric arc furnace of a steelmaking plant. A thermal energy storage system based on a dual-media packed bed is proposed as low-cost and suitable technology, using a by-product produced in the same plant, the steel slag, as filler material. The main objective of this system is to achieve a continuous heat supply from the inherent batch operation of the steel furnace. This implementation strategy presents great advantages. Among them, the added value of a continuous heat source can be highlighted as it opens a wide number of applications for the recovered heat, not accessible for discontinuous sources. The obtained results have revealed the large pressure drop values induced by the packed bed as the critical design parameter. This phenomenon is associated to the large amount of released energy from the furnace, together with the short times for its capture and storage. Besides, the influence of the idle period, inherent to the batch operation of the furnace has also been investigated. In this case, the short time of static operation together with the thermal stratification behavior have demonstrated the negligible impact of this idle period in the thermal energy storage unit operation. Finally, the research carried out has shown that, after an appropriate optimization process, efficiency values above 65\% and 85\% could be achieved for the cycle and filler material usage, respectively. These values show the great waste recovery potential of the proposed solution. It should be noted that, the definition of the design and operation parameters of a demonstration plant, to be constructed in a steelwork, is the final target of the presented work.