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Ecologically-Friendly and Economical Arc Furnace "ECOARC"†

1. Introduction

JFE Engineering has developed an electric arc melting furnace which is capable of meeting the stricter environmental regulations anticipated in the future and operates at a power unit consumption of less than 200 kWh/t. The new ecologically-friendly and economical arc furnace, called ECOARC,* was developed[1,2] through 5 t scale pilot tests based on a new concept free of the conventional fixed ideas about EAFs. The first order for a 70 t commercial unit was received from Kishiwada Steel Co. in May 2000.

2. Outline of ECOARC

2.1 Outline of Furnace and Operation

Figure 1 shows the schematic configuration of the ECOARC furnace developed in this work. Because melting is performed by flat bath operation during the entire process, except while starting, a condition in which scrap exists continuously from the melting chamber into the preheating shaft can be maintained at all times. When a bath of 1 heat or more has formed, the furnace is tilted toward the tap hole side while maintaining a continuous scrap charge from the melting chamber into the preheating shaft, and the operation proceeds to the heating-up stage. After heating-up, the furnace is tilted further and molten steel equivalent to 1 heat is tapped. When tapping is completed, the ECOARC is returned to the horizontal position with the remaining molten metal left in the furnace, and melting of the next heat begins.

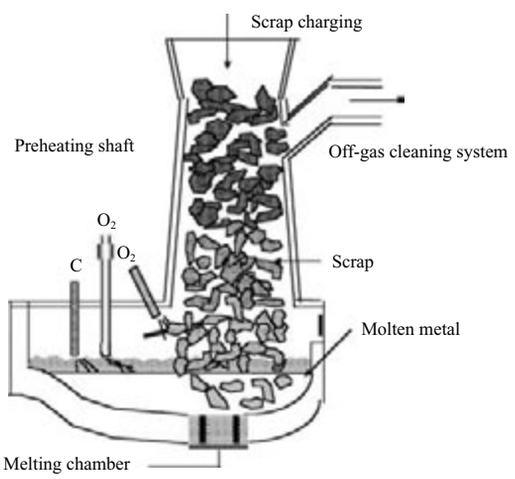

Fig. 1 Schematic configuration of ECOARC

2.2 Features of ECOARC

In ECOARC, the preheating shaft is connected directly to the melting chamber, making it possible to perform melting while maintaining a continuous scrap charge in the melting chamber and preheating shaft at all times. As a result, efficiency is extremely high. Furthermore, because the furnace as a whole has a semi-airtight structure, the oxygen concentration in the atmosphere gas can be held at a low level, suppressing oxidation of the scrap in the preheating shaft. Total exhaust gas is about 1/2 that of conventional arc furnaces. Approximately 30% of the CO generated in the furnace is introduced unburned into a combustion tower installed downstream from the arc furnace, where it is burned, generating a temperature of more than 900°C, which is an adequate measure against white smoke, black smoke, and dioxins (DXN). Downstream from the combustion tower, the exhaust gas is quenched to 150–200°C by spray cooling to prevent resynthesis of DXN, reducing the DXN concentration at the dust collector exit to less than 0.1 ng-TEQ/Nm^3.

3. Pilot Plant Tests and Results of Actual Operation

The tests conducted in a 5 t pilot plant indicated that the power unit consumption of 200 kWh/t or less can be expected in an actual-scale equipment. On the basis of this result, JFE Engineering received its first order for a 70 t commercial unit from Kishiwada Steel Co. in May 2000. In June 2003, the power consumptions of 233 kWh/t at an oxygen unit consumption of 36 Nm^3/t (PSA) and 196 kWh/t at 40 Nm^3/t were achieved.

Because gasification of combustibles occurs slowly in the shaft, ECOARC is suitable for direct melting of press scraps from scrapped automobiles, which have a high content of plastics and other combustibles.[3] In the 5 t pilot plant, an operation with a 20% press scrap ratio was possible, and simultaneously, the DXN concentra-

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tion at the bag filter exit was reduced to less than 0.1 ng-TEQ/Nm^3.

4. Closing Remark

An ecologically-friendly, economical arc furnace called ECOARC was successfully developed, realizing a large reduction in power unit consumption, which had been impossible with conventional arc furnaces, and extremely low dioxin emissions. ECOARC is effective as a “Direct Melting Technology of Pressed End-of-life Vehicles (ELV)” recognized under Japan’s Automobile Recycling Law, which was passed in July 2002.

References

1) Mizukami, H. et al. Ecologically friendly and economical arc furnace (ECOARC). NKK Technical Report. no. 170, 2000, p. 1–7.
2) Mizukami, H. et al. Off-gas treatment technology of ECOARC. NKK Technical Report. no. 176, 2002, p. 1–5.
3) Mizukami, H. et al. Direct melting technology of pressed ELV by EAF with preheating shaft. CAMP-ISIJ. vol. 17, 2004, p. 93.

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