BURNERS, COMBUSTION AND HEAT TRANSFER

(633) - (*) - APPLICATION OF THERMAL PLASMA TORCH FOR STEEL HEAT-TREATMENT FURNACES: RESULTS FROM THE 250 KW PILOT-SCALE TESTS

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Draft Paper

Sweden's target to achieve zero net emissions of greenhouse gases by 2045 has urged the Swedish steel industries to omit their reliance on fossil fuels. A lot of attention has been given to the decarbonisation of the iron-making processes, such as the development of hydrogen-based reduced iron. Nevertheless, more efforts are still required to eliminate the emission from the steel-making processes, which account for at least 12% of the CO_2 emission in the Swedish steel plants. Thus, the electrification of the heat-treating furnaces may play a crucial role in completely replacing fossil fuels in the steel-making processes. In this study, pilot-scale experiments were performed to investigate the application of plasma torches for steel-heat treatment furnaces. A 250 kW DC plasma torch was used to heat the furnace from room temperature to the operating temperature of 1200 °C. Different plasma carrier gases were used to study their impact on the furnace heating rate, steel sample heating rate, and NO_X emission. The results show that the furnace could be heated at a relatively uniform temperature and reasonable time. The temperature of the furnace varied approximately 20 °C, which is within an acceptable range. Furthermore, a combination of N_2 and H_2O is least favourable due to the more inferior temperature distribution and lower heating rate. Despite the superior heating rate, air and LPG use in the plasma torch generates the highest NO_X amount in the flue gas due to the extensive thermal NO_X formation in a N_2-O_2 rich atmosphere. The combination of CO_2 and H_2O potentially produces the lowest NO_X emission (522 mg/Nm^3 eq. to CH_4 combustion) than other investigated gas mixtures. From the results of the study, it was concluded that CO_2, regardless the H_2O addition, is the most promising plasma carrier gas as it can provide a good heat transfer with a possibility to prevent the NO_X emission.

Palavras-chave : electrification, decarbonisation, steel making, fossil free