ABSTRACT

A 200 mm diameter model cupola was developed by scaling down a 1200 mm diameter production cupola, based on similarity principles, for combustion studies under the conditions of actual melting of metal in it. Experimental investigations were undertaken to examine gas composition and gas temperature distribution at different points in the 200 mm diameter experimental cupola, under different conditions of operation. Fortyeight experimental runs were conducted with variations in the following design and process parameters: metal to coke ratio, coke quality, blast rate, coke size, initial coke bed height, tuyere area and cupola effective height.

The data obtained is tabulated and analyzed graphically as well as statistically. From the graphical analysis of the data, the relative positions of melting zone with respect to the zone of maximum carbon dioxide (ZMCO2), the zone of maximum temperature (ZMT), the zone of negligible oxygen concentration (ZNO2) and the zone of maximum heat (ZMH) are identified under each set of operating conditions. These zones and the constant gas composition and temperature profiles in the cupola (particularly in the melting zone and above it) are represented with schematic diagrams. The factors influencing the molten metal temperature at the spout and the melting rate are identified from the multiple correlation and regression analysis of the results.

The presence of solid metallic charge (at elevated temperatures) in the melting zone and above it, is found to catalyze the carbon precipitation reaction and the falling superheated molten metal from the melting zone, is observed to intensify the combustion reactions in the early parts of the combustion zone. The other results of the present investigations regarding the effect of various design and process parameters on the molten metal temperature at the spout, the melting rate and the metal composition, through their effect on the factors related to combustion, are discussed in detail.