THE EFFECT OF CHLORINE ON THE FORMATION OF NITROGEN OXIDES IN A FLUIDIZED BED COMBUSTOR

by

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ABSTRACT

The effect of chlorine on NO_x and N_2O emissions has been studied in an electrically heated bed of fluidized sand. Pyridine (C_5H_5N) was burnt as a model compound in a mixture of O_2 and N_2 to produce NO and N_2O. The experiments were done at temperatures 750, 825 or 900 °C. The concentrations of O_2 and pyridine in the fluidizing gas were maintained at 3.2 or 11.6%, and 500, 1500 or 2000 ppmv, respectively. When pyridine was burnt in the fluidized bed, the concentrations of NO, N_2O, CO_2 and CO were measured continuously in the freeboard. Chlorine was introduced to the fluidized bed as HCl at concentrations up to 6000 ppmv. The effect of $CaCl_2$ on the formation of NO_x, N_2O and CO was also studied.

The addition of HCl to the fluidizing gas mixture decreased the concentration of NO_x, and increased the concentration of CO. However, the addition of HCl caused the concentration of N_2O to decrease or to increase, depending on the temperature. At 750 °C, the addition of HCl reduced the concentration of N_2O, while it increased the concentration at 825 and 900 °C. Temperature has a significant impact on the effect caused by the addition of HCl on the formation of NO_x, N_2O and CO. On the other hand, the concentrations of pyridine and O_2 do not have a significant effect on the percentage decrease or increase in the concentrations of NO_x and CO. The addition of $CaCl_2$ also seems to decrease the concentration of NO_x, while it increases the concentration of CO. However, the presence of calcium based compounds in the fluidized bed also tends to catalyze the formation of NO_x.

The increase in the concentration of CO caused by HCl is due to the suppression of OH radicals, which are the main precursor for the formation of CO_2 from CO. During pyridine combustion, the radical pool of O, H and OH plays a major role in converting HCN and NCO to NO_x. Thus, the decrease in NO_x caused by HCl is due to the suppression of O, H and OH radicals. Again the increase in the concentration of N_2O at 825 and 900 °C is due to the suppression of OH radical by HCl. However, the decrease in N_2O at 750 °C is probably due to the inhibition of pyridine combustion by HCl.

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