Abstract

The concentration of CO_2 in the atmosphere increases time to time due to various industrial activities. This trend will rise unless and until we put up a mechanism that will not only curb CO_2 concentration but also put us the development agenda in front. To mitigate this CO_2 emission coming out from flue gas, A four stage fluidized bed reactor with down comer was designed and fabricated to study the stable operating range in respect of gas and solids flow rate capable of operating in continuous manner and operating at low temperature. The adsorbent used for this reactor was Monoethanol amine activated carbon (MEA-AC) and Diethanol amine activated carbon (DEA-AC) of different impregnation ratio (0.4 and 0.6). Hydrodynamics of the fluidized bed reactor was performed for MEA-AC to understand its loading and flooding characteristic of the reactor. Experiments were conducted on reactor to measure the gas pressure drop at gas velocities ranging from 0.188-0.353 m/s and solids flow rate ranging from 2.15-4.12 kg/h under different weir heights. The maximum pressure drop inside the column was obtained 220 N/m^2 for low gas velocity (0.188 m/s), high solid flow rate (4.12 kg/h) and high weir height (70 mm). Similarly, minimum pressure was drop found to be 92.2 N/m^2 for high gas flow rate (0.353 m/s), low solid flow rate, (2.15 kg/h) and low weir height (30 mm). The maximum percentage removal of CO_2 occurs for MEA-AC (0.6) which led to 94.9 % removal under low gas flow rate (0.188 m/s), high solid flow rate (4.12 kg/h) and weir height of 50 mm at 3000 ppm. From this experiment MEA-AC (0.6) has been found to be the most suitable adsorbent for removal of CO_2 inside a four-staged fluidized bed reactor. From the process optimization, the optimum CO_2 removal efficiency was found to be 95.17 %. From the experimental result, it was found that for the same operating condition the CO_2 removal efficiency was 95.97 %. Results indicate that the experimental and predicted removal efficiency of CO_2 fits well.

Keywords: Monoethanol amine; Diethanol amine; Impregnation; Hydrodynamics; Loading and Flooding; Pressure Drop; Adsorbent; Four Stage; Carbon Dioxide; Activated Carbon