Abstract

Air dense medium fluidized bed separators gained importance in coal beneficiation as they are less restrictive for small capacities, avoids water circuits, and lower operating cost. In the present investigation, a cylindrical shape air dense medium fluidized bed, of 15 cm inside diameter and 150 cm height with adequate instrumentation facility to monitor the operating variables, has been designed and fabricated to investigate its separation performance for beneficiating high-ash Indian coal. The investigation has two distinct parts; the first part describes the detailed coal characterization and their beneficiation results under various operating conditions. The second part deals with the establishment of optimum values for different critical process parameters to improve the equipment separation performance. The E_p values in the range of 0.01-0.055 and combustible material recovery values in the range of 78.97-94.56 for -50+25 mm size of different coals conforms that the separation is quite sharp and the impurity elimination was almost complete. However, for -25+13 mm size coal, the sharpness in separation is noticeably poor which can be judged from the E_p and combustible material recovery values of 0.059-0.244 and 66.24-83.97, respectively. Similarly, the sharpness in separation is very poor for the -13+4.75 mm size coal with corresponding E_p and combustible material recovery values of greater than 0.4 and 58.96-72.87, respectively. Also, careful analysis of the experimental data indicates that most of the trace elements of greatest environmental concern are strongly associated with the organic matter of the investigated coal, thus during beneficiation these elements are concentrated in the clean coal fraction. The experimentally determined optimum values for different parameters were: superficial gas velocity from 18.94 to 20.42 cm/s; bed height from 25.94 to 29.36 cm; coal to magnetite weight ratio of 0.02; feed coal size from 15 to 50 mm; fluidizing medium size from 106 to 150 μm. Mathematical models have been developed and subsequently these model predictions are validated against experimental results. The results obtained are found to have good agreement with the experimental values.

Keywords: Coal; Air dense medium fluidized bed; Minimum fluidization velocity; Response surface methodology; Distribution curve; Solver in spreadsheet tool; Separation efficiency