ABSTRACT

In the present investigation, a laboratory and bench scale experimental set up is designed and fabricated to study the effect of chemical pre-treatment on low grade coal from Mahanadi Coalfield Limited at various leaching conditions and its characterization was evaluated. The investigation has four distinct parts; the first part describes the detailed comminution of coal and types of minerals present in the coal and its characterization, using single stage chemical leaching under different reagent concentration at moderate leaching conditions. The second part deals with the effect of different particle size and leaching parameters on coal demineralization is expressed. In this case, two different high ash coal were selected for leaching process. The degree of demineralization was obtained to 46% and 34% from coal A consists of 38.8% ash. Similarly the results obtained for coal B was 43% and 32% from 43% ash by the effect of 30% NaOH and 30% H_2SO_4 solvent concentration respectively. Chemical leaching is efficient reduce the ash related minerals, but single stage leaching is inefficient for high ash coal. Therefore two stage leaching method is approached for high ash coal. The third part stated about the two stage leaching effect with varying leaching reagent concentration at different set of experimental variables. The combined treatment method is depicted the maximum percent demineralization of coal. The demineralization was obtained 27% by alkali leaching and 48% demineralization was achieved by acid followed alkali treated coal from 26% ash of Bhubaneswari coal. The size of the particle is also effect on the degree of demineralization. The particle size of -60 and -72 mesh size were found the most effective demineralized by the leaching process. The percent demineralization was obtained up to 53% and 54% for these coal particle size by the combined treatment methods. The calorific value of coal also increased with the degree of demineralization. The degree of demineralization was increased with the rise of reaction temperature and residence time. The fourth part defined the establishment of optimum parameter values for different critical process parameters to improve the ash reduction from low grade coal. Quadratic 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. The study revealed that the concentration was found the most significant effect for ash removal from the coal to produce clean coal. Leaching process optimization was carried out and the experimental values obtained for the ash reduction are found closer to the values obtained as predicted by the models. Optimal conditions for maximizing the ash reduction was obtained at HF concentration 18 vol.% reaction temperature 92°C and leaching time 162 min. The absolute error was obtained 0.08%. The chemical beneficiation by leaching study of coal indicated reduction in ash content as well as substantial reduced the deleterious minerals from the coal.

Keywords: Low grade coal; Mineral matter; Chemical beneficiation; leaching; Demineralization; Ash reduction; Calorific value