

Exploration and geochemical characterization of Indian coal and coal by-products for extraction of rare earths

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Rare earth elements (REEs) are one of the critical component for green energy technology and advance application system. Increasing demand, limited supply and current geopolitical situation makes the rare earths highly censorious globally. The primary resources of rare earths are widely scattered and limited, therefore focus has been given to explore the alternative resources of rare earths worldwide. Recently, coal which is a major source of thermal energy found to contain these critical rare earth elements. India has a rich deposit of coal, but it is not yet explored for the rare earths. Therefore, in the present paper, coals of Indian origin (Sohagpur coalfield, Korba coalfield and Singrauli coalfield) has been explored to evaluate the presence of rare earths. It was found that the average concentration of total REEs in the above coalfields were ranging from 150-250 ppm. It contains majorly light rare earths (La, Ce, Pr, Nd, Sm). The XRD analysis has confirmed the presence of several minerals such as quartz, kaolinite, monazite, iron oxide (hematite), birnessite, graphite and gypsum in the coal. The by-products of coal *i.e.* flyash was also explored and found to contain around 600 ppm of total REE content. The results of above investigation were also compared with US coal, Chinese coal & world coal average and it is found that Indian coal can be considered as potential resource of REEs. Feasibility studies have also been carried out for the extraction of REEs from coal and coal by-products considering mineralogical and geochemical characterization of coal. Leaching studies have been performed with original coal and coal calcined at 600°C. It was found that the recovery of rare earths from calcined coal is 1.5 times higher that of the original coal. Further, purification processes such as solvent extraction or ion-exchange is suggested for individual separation of REEs from leach liquor. Thus, the present studies focuses on the exploration and extraction feasibility of rare earths from coal and coal by-products. It may create additional source of profit for the mining industries and may fulfil the increasing demand of REEs globally.