ABSTRACT

In the light of the realization of the supremacy of coal to meet the future energy demands, rapid mechanisation of mines is taking place to augment the coal production from the present rate of 230 million tonnes per annum to an expected level of around 400 million tonnes per annum by the turn of this century and most of this coals are from low-rank coal seams. Furthermore, super thermal power stations necessitate large-scale storage of coals near the mines and at the users-side. This can create problems due to their catching fire from spontaneous heating. Despite the immensity of the problem, no systematic methodology has so far been evolved for the safe and proper storage of coal and no standard test is available for determining the liability index. However, the crossing point temperature (CPT) is being used to predict the spontaneous heating tendency of coals. This approach is questionable, as coals having different liabilities to specific heating show the same CPT and most of the coals have CPTs liabilities to specific heating within a very narrow range. In addition, coals get oxidised to a certain extent, in situ, in the mines due to air-leakage which is unavoidable, particularly, in the high productivity areas. As the extent of oxidation drastically affects the spontaneous heating tendency of coals, it is very important to link-up the degree of oxidation of coals to the spontaneous heating tendency. Moreover, the heterogeneity of

coal added to the unavoidable mine dilutions, due to which, not only the organic coaly-matter along with moisture and mineral matter are to be considered but also the individual constituents of the adventitious mineral matter have also to be included in predicting the liability of coals to spontaneous heating. Certain constituents of mineral matter have been found to catalyse/assist and certain others inhibit the oxidation reactions. As such, selective demineralisation, preferably retaining the possible inhibiting components would be an economical and right approach.

In the present work, therefore, a liability index based on the complete heat-up curve of the crossing point method has been derived which takes into account not only the degree of oxidation of coals prior to experimentation but also the effect of moisture and ash contents. An attempt has also been made to correlate the liability index based on the CPT method and the degree of oxidation based on Chemical (Puff) method with the moisture- and ash-contents.

The effect of mineral matter on the spontaneous heating tendency has also been determined using washed fractions obtained by float and sink method. Microwave pretreatment technique has also been applied to selectively demineralise the coals, prior to the determination of the respective spontaneous heating tendencies. Both the washed and microwave pretreated samples were separated magnetically and their corresponding spontaneous heating tendencies were also determined. Another significant contribution is the study of the effect of trace elements on the

ignition temperatures.

Seven coal samples from two coalfields of Chirimiri and Talcher areas were used for experimentation. The effect of proximate constituents, viz. moisture and ash on spontaneous heating liability index gave an excellent fit for all the coals studied. The effect of mineral matter based on washed-, magnetically-separated and microwave treated-, magnetically separated-samples clearly indicated the segregation of mineral matter at certain levels which inhibit the spontaneous heating reactions. Thermal analyses and X-ray Diffraction analyses further confirmed in a limited way, the segregation of minerals in certain fractions which may possibly help in the judicious washing/selective demineralisation of coals for their safe storage.

Key Words : **Spontaneous heating, ignition temperatures (CPT, PT, FT), crossing point curve analysis, liability index, susceptibility potential, degree of oxidation, coal washing, trace elements, microwave treatment, selective demineralisation, thermal analysis (DSC/TG), petrographic analysis, X-ray diffraction (XRD) techniques, inhibition of spontaneous heating.**