ABSTRACT :

The main objective for the investigation on coal slurries, namely coal-oil mixture (COM) and coal-water slurry (CWS) has been to find out an alternative to the liquid fuel as the oil sources are rapidly depleting and also due to the uncertainties in the oil supply.

However, the commercial application of these slurries has always been beset with a few technical problems, such as the tendency of the coal particles to settle out of suspension, thus causing difficulties in storing, pumping and injection. Also, the combustion of COM and CWS has been reported to be incomplete in many cases.

It is observed that presence of water in COM enhances the combustion process to a certain extent because of splattering of the particles, increases the stability of slurry by forming water bridge between slurry droplets and decreases the total cost of operation. However, presence of water increases the viscosity of slurry which may be not so important by using high ash Indian coal and decreases the calorific value per unit mass of slurry.

In order to establish the technology of coal-oil-water (COW) slurry system, it is essential to have dependable information on the rheology, settling, atomization and combustion characteristics of slurry.

The objective of the program is to establish the effect of different process parameters on COW slurry rheological and settling behaviour using Indian coals as follows :

i) Effect of coal conc., water conc., coal particle size, ash content of coal on the settling characteristics of COW slurry system.

ii) Effect of return bend, 90^0 bend, union joint, gate valve on the pressure drop of COW slurry in the pipe line.

iii) Effect of coal conc., water conc., ash content of coal on the rheological behaviour of COW slurry.

iv) Effect of additives on the settling and rheological characteristics of COW slurry.

The settling characteristics studies are done by taking five graduated glass cylinders containing five slurries with different composition of coal, oil, water and then measuring the decrease of slurry head (line of separation between the black slurry and separated

clear liquid) time to time. Terminal settling velocity is calculated. One semi-empirical equation is developed to show the effect of different process parameters on terminal settling velocity, assuming Stokes Law to be valid.

The rheological studies are done by using different diameter pipe line (1/2", 3/4" & 1") and measuring the pressure drop across the test section and the corresponding volumetric flow rate. The flow rate is maintained in the laminar zone. Pressure drop-flow rate data are fitted in the Metzner-Reed Generalized model and pseudo-plastic nature is observed. Correlations are developed in the form of $n' = f$ (Process parameters and $k' = f_1$ (Process parameters).

For studying the flow behaviour of COW slurry through different fittings the pipe line of 3/4" diameter is used. Four fittings - the return bend, gate valve, 90^{o} bend and union joint are taken into consideration. The pressure drop and volumetric flow rate are noted and K factor is calculated. Generalized Reynolds number is calculated using k' and n'. It is observed that K is only dependent on type of fittings and generalized Reynolds number, N_{Re}^{*}. Four separate correlations are developed for each fitting in the form of

$$K = f_2 (N_{Re}^{*}).$$

K factor decreases with increase in N_{Re}^{*} which is very fast at low N_{Re}^{*}. For all cases, the variation of theoretical values from the experimental values is found to be within reasonable limits.