ABSTRACT

The investigations presented in this thesis, primarily experimental, pertain to rheology and transportation of solid-liquid system. For flow characteristics of solid-liquid suspension, the knowledge of their rheological behaviour is of considerable importance. The mixture of suspensions vary widely. They may be stable, slow or rapidly settling types. The rapidly settling suspension with which present work is concerned offer considerable difficulty in the determination of apparent viscosity due to quick phase separation.

The present study deals with a careful investigation on the effect of solids concentration, particle size, size distribution, surface characteristics and drag reducing agent on the apparent viscosity of the suspensions. In the present investigation, a specially designed rotational viscometer has been used. Two solids namely Coal and Cu-ore which are opposite in surface characteristics have been chosen. It is observed that the coarse size coal in water exihibit less apparent viscosity compared to fines whereas Cu-ore behave in a reverse way. It is also found that particle size distribution has a marked influence on apparent viscosity of suspension. Coal-water suspension shows a minimum viscosity at around 60:40 weight proportion of coarse to fines whereas that of Cu-ore at around 40:60. The drag reducing agent namely Guar-gum has profound influence on the apparent viscosity of coal-water suspension.

The effect of solids concentration, surface characteristics and particle size distribution has also been studied in the hydraulic transportation of solids in 0.0254m and 0.019m pipeline. For accurate and continuous monitoring of data, a PC based data acquisition system has been utilised. The coarse size of coal show less pressure drop as compared to fines at any velocity of suspension whereas Cu-ore exihibit the opposite

trend. This study also observed that pressure drop exihibited in the flow of solid-liquid suspension of binary mixture is less at certain weight proportion of coarse to fines as compared to either of the single size. These results are quite expected and are supported by the findings of the rheological studies.

Based on experimental findings, an empirical expression has been developed for the prediction of apparent viscosity and pressure gradient by using analytical and dimensional analysis approach.

Keywords : Rheology, Hydraulic Transportation, Rotational viscometer, Solids concentration, Particle size distribution, Surface characteristics of solids, Drag reducing agent, Pressure gradient, Apparent viscosity, Data acquisition system, Dimensional analysis.