CHAPTER 5

CONCLUSION AND RECOMMENDATION

The characterization of the fundamental properties of COM is essential for the proper interpretation of COM utilization (storage, pumping, atomization, combustion, etc.) data. The basic question is how to achieve the highest possible coal concentration at a given slurry viscosity level while maintaining slurry stability. Given the variability in the properties of coal and fuel oil and the myriad of commercially additives, the diversity in COM formulations and properties are vast.

This study emphasizes the following COM properties : rheology, stability and combustion by using coal and fuel cil in Thailand. The main conclusions may be as follows :

1. The rheology of COM used in this study is described either by a Newtonian fluid model at low concentrations or by Bingham plastic model for higher concentrations. The COM yield stress increases with increasing coal concentration and has different values for various types of coal and fuel oil types. In summary, the onset of non-Newtonian behavior and the maximum yield stress are as follows:

COM	Onset of non-Newtonian behavior	Ty_{max} (dynes/cm^2)
Ban Pu coal + HFO	40 %	149.41
Ban Pu coal + LFO	40 %	169.91
Mae Moh coal + HFO	20 %	327.06
Nong Ya Plong coal + HFO	20 %	4165.84

2. The viscosity of COM increases rapidly with coal loading, particularly at high concentrations, and rises dramatically as the saturation percentage of coal in oil is approached. The COM viscosity increases with decreasing temperature, increasing fuel oil viscosity and coal fineness.

3. The general effect that occurs when powder coal and oil are mixed is aggregation and network formation so that a stable COM is a loosely dispersed flocculated network of coal in oil. The interparticle attraction and hence the fluidity of the slurry and also the stability is extremely sensitives to small amounts of additives.

4. The screening of additives for COM using sedimentation column and measured in form SR showes that the cationic additives as a group are the most effectiveness additives which give the lowest SR values. Ethomeen C-20 is the most effectiveness additive which gives SR values for Ban Pu coal, Mae Moh coal and Nong Ya Plong coal in HFO 0.49, 0.54, 0.46 repectively and Ban Pu coal in LFO 0.61. The mechanism of stability improvment is that the additive which has positive charge is adsorbed to the negative charge of polar group on the coal surface and improves the dispersion. Therefore, the additives enhance aggregation. For the addition of additive in COM , very small coal particles have a spontaneous tendency to aggregate and form flocculated network, but at large coal particles, it have tendency to subsidence due to the greater settling rate. Adding small amount of additives improves dispersion.

5. Burning profile by DTG curves of COM presents the two temperature ranges for combustion phenomena; around 260-290 $^{\circ}$C and around 400-440 $^{\circ}$C. Around 260-290 $^{\circ}$C shows the rate of weight loss of fuel oil concerned with gas phase combustion and

around 400-440 °C shows the rate of weight loss of coal concerned with solid phase combustion. Thermogravimetry appears to be a technique for investigating the combustion phenomena of COM but its limitation is the heterogeneous phase of COM which makes the rate equation unable to simplify to find combustibility value , i.e. activation energy.

Using COM as fuel, generally, 30-50 wt% coal concentrations of -75 microns of coal in heavy fuel oil are employed. PSD less than 75 microns of coal increases viscosity, but improves stability and combustion characterization. In summary, PSD less than 75 microns of coal yields the best properties for COM, but require high size reduction cost. Heavy fuel oil is cheaper than light fuel oil, therefore, the suitable COM would compose of -75 microns of coal in heavy fuel oil. Additives such as Ethomeen C-20 can be used to improve COM stability. The suitable COM formulation could be achieved by the feasibility study. At present, a temperature of 40 °C is used to storage COM while temperature of 70 °C is used to transport COM in pipeline.

RECOMMENDATION

Further studies should be carried on as follows:

1) Study various types of coal-oil mixtures to provide a better understanding of the COM properties due to the different coal types in Thailand.
2) Use fineness coal or other techniques to study the mechanisms that enhance stability.
3) The combustion test by observing the burning charateristics such as combustibility and ash accumulation can be used to study the effective utilization.