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RHEOLOGICAL PROPERTIES ESSENTIAL FOR THE ATOMIZATION OF
COAL WATER SLURRIES (CWS).

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Quarterly Progress Report
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OVERALL OBJECTIVE:

The overall objective of this project is to perform experiments to understand the effect of high shear and extensional properties on the atomization of coal-water slurries (CWS). In the atomization studies, the mean drop size of the CWS sprays will be determined at various air-to CWS. A correlation between the extensional and high shear properties, particle size distributions and the atomization will be made in order to determine the influence of these parameters on the atomization of CWS.

WORK DONE

A theoretical relationship between the sauter mean diameter, (SMD), the Air/Fuel ratio and the viscosity was derived during the previous quarter. The established relationship was modified to account for the high shear viscosity data.

Thus the expression:

$$SMD/L = 1/3 \rho_A/\rho_F (We^{-1} + KRe^{-1}) (1 + M_F/M_A) \quad (1)$$

derived in the previous quarter report, was modified as follows:
using the definition of Reynolds number:

$$Re = \text{Reynolds number} = \rho_F VD_F/\mu$$

equation (1) can be written as:

$$SMD/L = 1/3 \rho_A/\rho_F (We^{-1} + C\mu) (1 + M_F/M_A) \quad (2)$$

where C is a constant and μ is the viscosity.

The viscosity term in equation (2) is replaced by a power law expression to account for the non-Newtonian behavior rheology of CWS and the glycerine-polymeric fluids.

$$\mu = K\dot{\gamma}^n \quad (3)$$

Where K=Consistency index

n=flow behavior index

γ = shear rate

$$\text{SMD}/L = 1/3 \rho_A/\rho_F \text{We}^{-1}(1+M_F/M_A) + 1/3 \rho_A/\rho_F CK \gamma^n (1+M_F/M_A) \quad (4)$$

This gives a term dependent on viscosity and a term independent on viscosity.

Based on this relationship, several rheological evaluations on CWS and glycerine-polymeric fluids have been performed. Atomization studies as a function of surface tension, injection pressure, M_F/M_A and density is currently being performed and these data will be used to fit the model equation (4). The results of this study will be reported in the next quarter.

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