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DEVELOPMENT OF A GAS-PROMOTED OIL AGGLOMERATION PROCESS

Technical Progress Report

September 1, 1993 - November 30, 1993

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DEVELOPMENT OF A GAS-PROMOTED OIL AGGLOMERATION PROCESS

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PURPOSE

The overall purpose of this research project is to carry out the preliminary laboratory-scale development of a gas-promoted, oil agglomeration process for cleaning coal using model mixing systems.

INTRODUCTION

Previous research showed that having a gas present in an agitated system used for the agglomeration of an aqueous suspension of coal particles with oil would reduce greatly the required mixing shear rate and power input. To take advantage of this discovery, the present research project was initiated. The project will involve building and testing two model mixing systems which differ in scale but are representative of standard industrial mixing systems used for mixing solid particles, liquid, and gas. These systems will be tested by conducting oil agglomeration tests under various conditions and measuring agitator torque and power as well as agglomeration performance. Special attention will be given to the effects produced by having gas present in the system.

WORK PERFORMED

During the past quarter the first model mixing system was designed and constructed. This system is the smaller of the two systems which will be utilized eventually. A cross

section view of the system is shown in Figure 1. The system includes a tank, an agitator driven by a variable speed motor, the controller for the motor, and a photometric dispersion analyzer for measuring the turbidity of the coal particle suspension.

The tank has an inside diameter of 15.24 cm (6.0 in.) and height of 15.24 cm (6.0 in.). The tank has four vertical baffles which project inward a distance of 1.27 cm (0.50 in.). The walls of the tank and baffles are made of Plexiglas, whereas the top and bottom are made of stainless steel. The top and bottom are slightly concave to facilitate drainage of liquid from the bottom and of gas from the top. A cooling coil is attached to the bottom to remove heat generated by the agitator and thereby to control the temperature of the system. The top and bottom are easily removed to facilitate cleaning and to allow for increasing the height of the tank by replacing the cylindrical body with a longer piece of Plexiglas tubing.

A six-blade, Rushton-type impeller will be used for agitation. The impeller which will be used initially has a diameter of 5.08 cm (2.0 in.) and is made of stainless steel. The impeller will be driven initially by a variable speed motor which is rated to deliver 41 watts (1/18 hp). The motor is controllable over a speed range of 20 to 2500 rpm. The electronic motor control indicates both motor speed and torque. This drive unit will be used initially because it was on hand. After the agglomeration system has been thoroughly tested, a larger drive system may need to be purchased.

The photometric dispersion analyzer is a PDA 2000 instrument manufactured by Rank Brothers Ltd. This instrument was also on hand.

Figure 1. Mixing system designed for oil agglomeration tests.

PLANS FOR NEXT QUARTER

A preliminary series of shakedown tests will be conducted with the newly constructed mixing system. For these preliminary tests, coal which is on hand will be utilized. One objective of the tests will be to evaluate the capabilities and some of the important characteristics of the mixing system. The system will be tested over a wide range of agitator speed with particle concentrations which vary widely to determine the effect on agitator torque and power requirements. Also several oil agglomeration tests will be conducted to observe the changing torque and power requirements which take place as the particles are agglomerated. The results will show whether the present agitator drive unit is adequate or whether a more powerful agitator drive unit will be required. These tests will also show whether the cooling coil attached to the bottom of the tank is adequate for controlling the temperature of the system. In addition, the tests will indicate the minimum agitator speed required to maintain an adequate flow of material through the external loop of tubing connecting the mixing system and the photometric dispersion analyzer.

Additional tests will be conducted without coal in which oil and/or air are introduced to observe the effect of agitator speed on the dispersion of these materials in water. In some cases the oil or air will be introduced below the impeller, whereas in other cases these materials will be introduced at or near the upper surface of the liquid to see how the point of introduction affects the dispersion of oil or air. Different oils may be utilized to see how the viscosity and other properties of the oil affect the rate of dispersion as indicated by changes in the turbidity of the system.

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