# TECHNICAL PROGRESS REPORT

for the Sixth Quarter
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Engineering Development of Advanced Physical Fine Coal Cleaning for Premium Fuel Applications:

## SUBTASK 3.3 - DEWATERING STUDIES

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## DISCLAIMER

## INTRODUCTION

If successful, the novel Hydrophobic Dewatering (HD) Process being developed in this project will be capable of efficiently removing moisture from fine coal without the expense and other related drawbacks associated with mechanical dewatering or thermal drying. In the HD process, a hydrophobic substance is added to a coal-water slurry to displace water from the surface of coal, while the spent hydrophobic substance is recovered for recycling. For this process to have commercialization potential, the amount of butane lost during the process must be small.

Earlier testing revealed the ability of the hydrophobic dewatering process to reduce the moisture content of fine coal to a very low amount as well as the determination of potential butane losses by the adsorption of butane onto the coal surface. Work in the period covered by this report focuses on the variations in the adsorption amounts and moisture contents due to the oxidation state of the coal sample.

## RESULTS AND DISCUSSIONS

Subtask 3.3.3 Process Development

Subtask 3.3.3.4 *Hydrophobic Substance Recovery and Regeneration*

For commercial application of the hydrophobic dewatering (HD) process, it is essential to maximize the recovery of butane from coal. Since a major potential source of butane loss is its adsorption on coal which in turn is affected by the amount of oxidation on the coal surface,

efforts for the past quarter were centered around studying the effects of coal oxidation on the adsorption of butane on coal.

Both fresh and oxidized coal samples were used to determine the amounts of butane adsorbed. The following method was developed to best determine the amount of butane absorbed by coal. Small bottles containing known weight of dried coal were filled initially with liquid butane in a pressure chamber. After one hour of pressurization, the chamber was depressurized and the weight of the coal sample was monitored as a function of time. A laboratory balance capable of measuring weights down to four decimal points was used. If the weight of a coal sample reaches its original weight, the butane loss to coal would be zero, or the butane recovery is 100% .

**Results**

As shown in Table I, less butane is adsorbed onto oxidized coal than onto fresh or unoxidized coal. Even after 80 minutes of evaporation time, almost double the amount of butane remained on the unoxidized sample compared to the oxidized coal sample. This suggests that the adsorption is due to hydrophobic interaction between butane molecules and the coal surface. While the butane loss due to adsorption may be low with oxidized coal, it would also be expected that it is more difficult to dewater oxidized coal by the hydrophobic dewatering process.

Table I. Amount of Butane Adsorption as a % of Coal Weight

| | Initial | After 80 min. of Evaporation |
|---|---|---|
| Fresh | 1.5 % | 0.17 % |
| Oxidized | 1.0 % | 0.10 % |

Previous testing has shown that several variables such as butane dosage, solids concentration, stirring time, and rate affect the results of the hydrophobic dewatering process. It appears that another major factor in successfully dewatering coal with the hydrophobic method is the amount of oxidation or hydrophobicity of the coal.

If hydrophobicity is a major factor, then the ability to dewater a given coal with the hydrophobic process should vary greatly between an oxidized and an unoxidized coal sample. Using experimental variables that gave the best dewatering results in previous tests, a direct comparison test was run between oxidized and unoxidized coal. The average moisture content for two tests was 40% compared to a moisture content of 1 to 2% for the unoxidized coal sample. This result demonstrates that of all the variables affecting final moisture content from the hydrophobic process, surface property of the coal is the major determining factor. Coals that are heavily oxidized need not be considered for dewatering with this process.

## SUMMARY AND FUTURE WORK

Work performed in this quarter showed that the stated of oxidation affects the amount of butane adsorbed onto the surface of the coal and also affects the final moisture content. The remaining work will involve a preliminary flowsheet of a continuous bench-scale unit and a review of the economics of the system.