

## BENEFITS OF COAL CLEANING UPON THE PERFORMANCE OF COAL-WATER SLURRIES

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### Introduction

Coal preparation as described in "days gone-by" functioned around the one word - "TIPPLE". This word, tipple, is rapidly losing its identification within the coal industry except for those we admire so much who have devoted their entire industrial life to this coal industry. Now, through the modern coal industry, we hear such terms as coal washing, coal preparation, coal cleaning, coal beneficiation, which also in themselves create confusion about what is meant.

As you drive along the Appalachian roads today, remnants of the tipples of "days gone-by" can be seen. Long chutes can be seen coming down the mountainside to the loading truck ramps. These wooden structures remind us of the technology of that day and they are now left only to the imagination of the artist to describe those days.

Today's coal preparation facility looks more like a massive industrial complex with long belt lines coming in and out of a preparation facility and ancillary facilities such as dewatering and refuse handling systems. An aerial view of one of our preparation plants is shown in Figure 1. This plant, located at one of our operations near Grundy, Virginia, processes in excess of 700 TPH of feed coal in both coarse and fine coal cleaning circuits. It is true that the coal industry is now directed more by the characteristics and quality of coal than if it were just a black versus gray color used years ago. Even in a few years from now, this preparation plant will be obsolete. One will see a complex which looks similar to an oil refinery. Various grades of coal products will be produced and tank cars will be used to carry the liquid coal product away from the plant. The coal industry is becoming more concerned with the needs of the customer than ever before. Oil has replaced coal in many markets because it is a liquid that can be pumped, stored and burned much easier and cleaner than coal. With the development of new technology to convert coal into a liquid fuel form through coal-oil mixing, coal-water mixing and even with some new technology still on the horizon, coal can be placed into a converted liquid form similar to oil. However, one major technology gap remains and that is the need to remove the non-carbon products of ash and sulfur from the coal to a level equivalent to that required for burning oil. Now I did not say the same ash and sulfur levels must be achieved. No, one must look at the burning, off-gas systems, and regulations and then decide what the ash and sulfur levels of any liquid coal product must be.

### Coal Preparation & Impact on Utilization

The steel industry has generally benefitted from coal preparation from production of metallurgical grade coal with desirable coking coal through optimum blending of seams of coals and reduced ash, sulfur, and moisture of coal. Today, almost 100% of metallurgical coal is processed in preparation plants. Whereas, less than 25% of the coal burned by industry for utility generation is cleaned before combustion.

What coal preparation can do.

- Reduce ash - and sulfur oxide - forming components from coal before combustion.
- Produce consistent quality fuel.
- Upgrade the heat value of fuel.
- Optimize the size consist of fuel.
- Produce multigrade fuel with varied levels of ash, sulfur, and heat content.

The coal producer benefits from the coal preparation through production of improved and premium fuel with broad market acceptability. With our recent emphasis to utilize the low ash and low sulfur coal, the premium quality coal in the ground is depleting. Coal preparation is the only technology available to producers to increase the utilization of low-grade coals. The continuous mining operations are producing more fine size and higher ash coal which can only be upgraded through proper coal preparation. However, dewatering of the fine size coal is still problematic which not only affects the fuel value but also is a major problem in handling and transportation due to freezing in winter months.

Coal users for industrial applications have been motivated in the past primarily by the lowest price coal. Not until the last decade have many of the more modern utility companies started to appreciate that just because coal is black does not mean it is all the same. To date, compliance of air quality standards has been the prime incentive for using beneficiated coal. However, a number of recent studies by the utilities, Electric Power Research Institute and the U. S. Department of Energy have shown the benefits of coal preparation on overall systems and significant reduction on the cost of electricity production. (1,2,3,4,5)

These benefits include:

- Reduced transportation cost through more Btu per ton.
- Improved boiler efficiency and boiler availability due to consistent and high quality fuel.
- Reduced operating costs of pulverization, ash-handling systems, flue-gas clean-up, and ash-disposal systems.
- Reduced capital cost of boiler and flue gas clean-up equipment.

The American Electric Power Company has been one of the prime advocates of benefits of coal preparation of utility application. Mr. Gerald Blackmore, the Vice President of AEP, has spent almost his entire life in the coal industry and advocating the benefits of coal preparation. He has been referred to many times as the "Patron Saint of Coal Washing". To prove his point, he points out that AEP's

average price to all its customers in 1979 was 2.86 cents against an estimated national average of 3.94 cents.(6)

#### Benefits of Coal Cleaning Upon Performance of Coal-Water Mixtures

One of the major problems that has hampered coal utilization for industrial use is the materials handling problems associated with bulky coal. With the advent of new technologies associated with coal-oil, coal-water, and coal-methanol mixtures, it is becoming possible to put coal into a liquid form where it can be stored in tankers, shipped by pipeline and fed into boilers without the manual labor associated with coal handling as it is today.

This type of developing market encourages coal preparation of fine size coal and mixing of the coal into a stabilized solution even at the preparation plant and shipped directly to boilers through pipeline and fed into boilers without even being touched.

If this market does develop, as it is expected to do, the utilities then will be able to replace oil with liquid coal as well as develop new boilers designed specifically for this liquid coal form. However, much of the development depends upon cleaning the coal to very low ash and sulfur levels. United Coal has been pursuing this development for the past several years. In fact, UCC has now developed and optimized a commercial coal preparation plant to produce up to 300 TPH of 2% ash coal. Currently, no customers are beating our door down for this super-clean coal primarily because the market for replacing oil with a liquid coal has not developed. The prime purpose of developing this super-clean coal is to optimize the coal feed to make a premium coal-water mixture fuel for testing purposes.

To date, United Coal Company has produced 300 tons of this super-clean coal in our commercial plant to optimize our processing conditions, establish economics of the process and prepare test samples for combustion tests by various organizations. A preliminary report on the Department of Energy's tests on our coals is given below. A comprehensive detailed report on these tests is currently under preparation at DOE.

#### Coal-Water Combustion Tests on Beneficiated Coal

The Department of Energy has conducted several combustion tests on coal-water mixture fuel prepared with beneficiated coals. These tests were conducted at DOE's Pittsburgh Energy Technology Center 700 HP combustion test facility. United Coal Company supplied the beneficiated coals from their commercial process and advanced beneficiation process.

The primary purpose of the tests was to evaluate the particulate emissions and furnace ash deposits as a function of ash content in the coal. The Department of Energy's combustion test conditions were set at excess air of 15 weight %, combustion air temperature of 500°C, with a steam output of about 24,000 lbs/hr. Significant test results are listed in Table I.

TABLE I. TEST RESULTS OF DOE COMBUSTION TESTS  
ON COAL-WATER MIXTURE WITH BENEFICIATED COALS

<u>Coal Type</u>	<u>Ash%</u>	<u>Particulate Emission, lb/hr</u>	<u>Furnace Ash Deposit, lb/hr</u>	<u>Carbon Conversion Efficiency</u>
UCC Commercial Coal	~ 8	120	8.9	97.5
UCC Super-Clean Coal	~ 2	79	2.3	97.4

These test results show that even though the carbon conversion efficiency remains about the same, there is significant decrease in particulate emissions and furnace ash deposits. The composition of furnace ash deposits from the low-ash coal was primarily aluminum silicate and is highly friable and non-sticky and thus can be blown off with blower action.

These results indicate that by cleaning the coals to low levels of ash, the most serious problem of furnace ash deposits can be solved thus making coal-water mixture fuel compatible with boilers designed for firing low-ash fuel oil.

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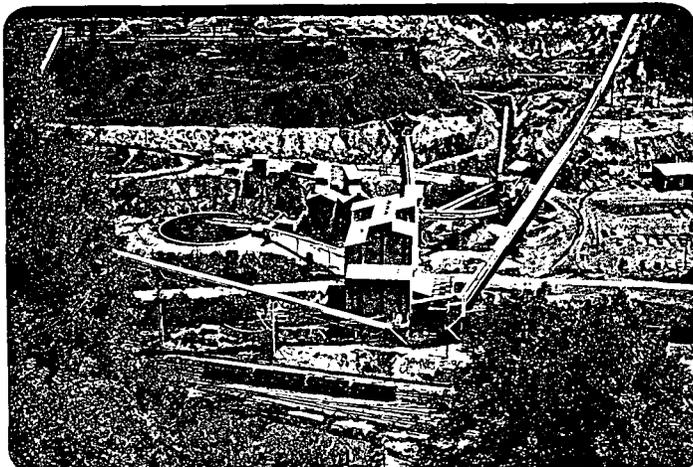


FIG. 1: COAL PREPARATION PLANT (WELLMORE NO. 7)  
OF UNITED COAL COMPANY AT  
GRUNDY, VIRGINIA