ETSI Coal Evaluation Plant

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Summary

The objectives and testwork results of ETSI's Coal Evaluation Plant are summarized and a description of the principal components for preparation, dewatering, handling and storing as well as water treatment are given.

1. Introduction

ETSI Pipeline Project (EPP) is in the final stages of operating its Coal Evaluation Plant (CEP). The CEP facilities are located at the White Bluff power plant, Arkansas Power & Light's 1,500 MW coal burning electric generating plant, 30 miles south of Little Rock.

The Powder River coal fueling the White Bluff power plant comes from Kerr McGee's Jacobs Ranch mine in Wyoming, which is also the origin of the ETSI transportation system. Other coals transported by ETSI would come from ARCO's Black Thunder mine, Peabody's North Antelope mine and Carter's North Rawhide mine. Although the geographically dispersed coals are very similar, the sensitivity of grinding and dewatering processes to certain coal characteristics spurred EPP's decision to evaluate the behavior of these coals in laboratory tests, pilot plant tests and finally in full scale equipment tests.

The CEP throughput capacity was dictated by the largest commercially proven dewatering equipment, i.e., a 50 short ton per hour (TPH) 44-inch diameter by 132-inch long screenbowl centrifuge followed by a five foot wide by forty-foot long vibrating bed drier. This was to represent a typical module in the commercial dewatering plant. The upstream grinding circuit, slurry storage tanks and test loop, and the downstream secondary dewatering, water treatment and coal handling facilities were also sized for continuous production at 50 TPH.

In addition to assessing the impact of varying coals in the preparation and dewatering processes of the coal slurry transport system, objectives in the CEP were:

1.1 Preparation

- Demonstrate that the cage mill/rod mill grinding circuit, which has proven so successful for the Black Mesa coal slurry pipeline, can produce pipeline specification product on Powder River Basin coals.

1.2 Dewatering

- Demonstrate that the full scale screenbowl centrifuge and vibrating bed dryer can reproduce the successful results obtained in a 4 TPH pilot plant, constructed and operated by ETSI in 1979.
- Test the solid bowl centrifuge and alternate filtration-type equipment to determine the most effective approach to deal with the effluent from the screenbowl centrifuge.
- Test and select types and dosages of flocculants and other chemicals needed in the various steps of the dewatering process.
- Determine the solids carry-over in the vibrating bed dryer and assess the effectiveness of dust control equipment in meeting environmental standards and regulatory limitation.
- Demonstrate that the dewatering circuit can be closed, i.e., no fines are rejected.

1.3 Water Treatment

- Demonstrate to the satisfaction of the EPA and State agencies that Biochemical Oxygen Demand is potentially the only constituent to be treated and determine the level of reduction that can be achieved using best practical technology.

1.4 Coal Handling, Storage and Burning

- Demonstrate that dried pipeline coal can be handled with conventional equipment and stockpiled successfully under adverse climatic conditions.

- Demonstrate that the pipeline stockpiled coal can be reclaimed, processed through White Bluff's existing facilities, including its day-bunkers and combusted, without adverse effects, in one of its 750 MW boilers.

In addition to the above objectives, optimizations would be conducted to refine process variables and data would be collected to establish criteria for commercial design.

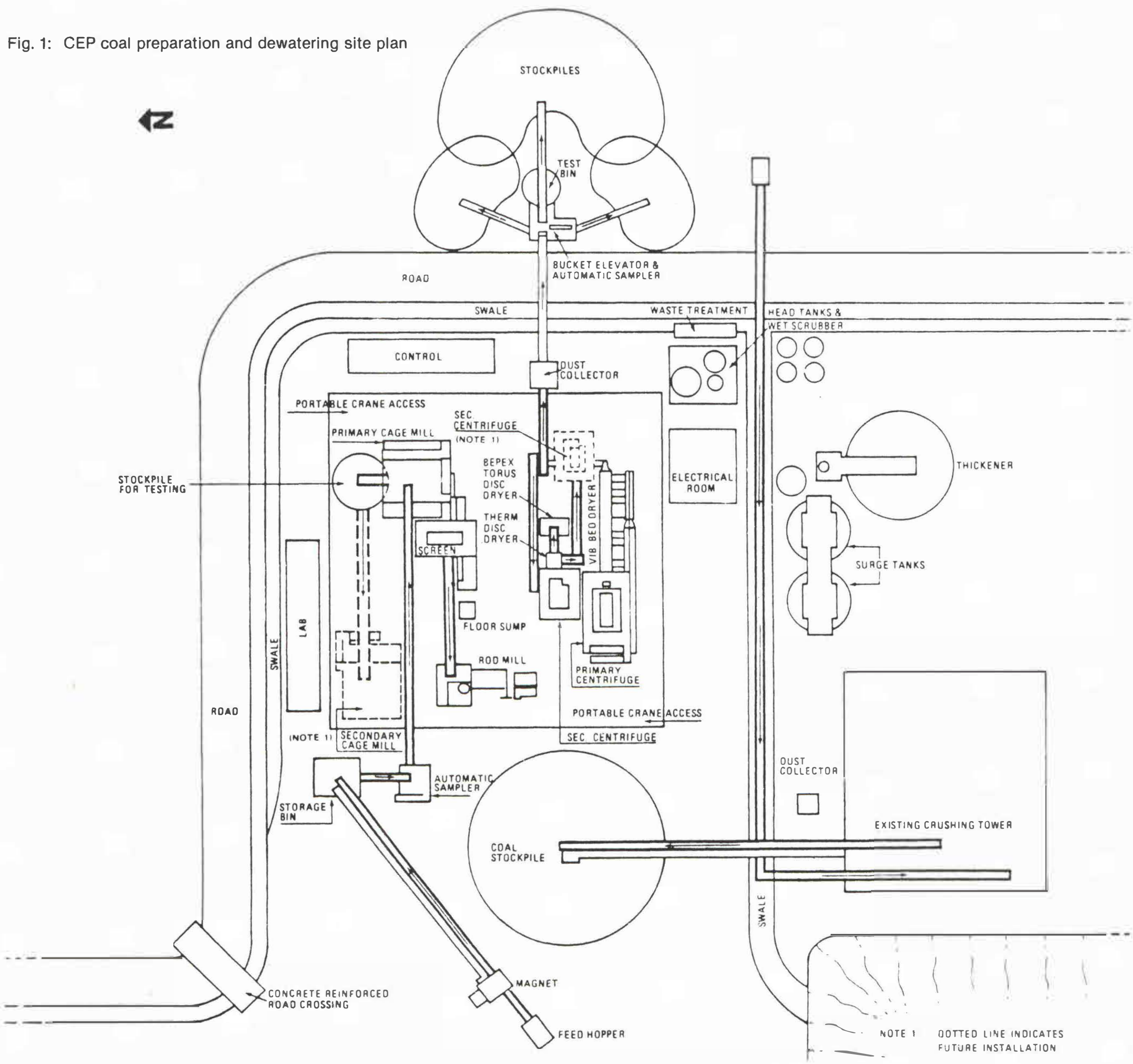
2. Testwork Results

After several months of effective testwork we can conclude that most of these objectives have been met. With a little more than one month of testwork remaining we will conclude our program with the demonstration of the handleability of pipeline dried coal and the 48-hour burn test.

To date, (March 24, 1982) however, after approximately 600 hours of running the results of the CEP testwork have been most encouraging:

- Pipeline specification coal can be produced with the cage mill/rod mill equipment and at energy requirements closely correlating the Black Mesa commercial experience.
- The commercial screenbowl centrifuge and the vibrating bed dryer have confirmed previous projections of performance. Specification material with surface moistures adjustable between 7 and 11 % can be produced consistently and with the reliability required for commercial acceptance.
- The solids carry-over in the vibrating bed dryer is minimal and the nature of the material is such that dust collection equipment operates more efficiently than predicted.
- Air emissions and wastewater discharge are well within environmental standards.
- Solids recovery in the dewatering process is complete with the screen-bowl effluent being filtered in a continuous belt press and the filtrate from the belt press being recirculated to its feed via a thickener. The overflow from the thickener contains no more than 30 ppm suspended solids.

Fig. 1: CEP coal preparation and dewatering site plan



3. Facilities Description and Performance

The facilities and test program can be divided in four principal components:

- Preparation: crushing and grinding of the two-inch by 0-inch coal and addition of water to produce a representative slurry.
- Dewatering centrifuging and drying to produce the desired cake moisture under closed circuit conditions.
- Handling and storing: transporting the dewatered and dried pipeline coal by belt conveyor, handling by front-end loader, bunkering, stockpiling and reclaiming.
- Water treatment: treat the effluent from the dewatering process to permit its discharge into nearby streams within constraints of EPA and State standards.

A layout of the facilities is shown in Fig. 1 and a photograph of the plant building in Fig. 2.

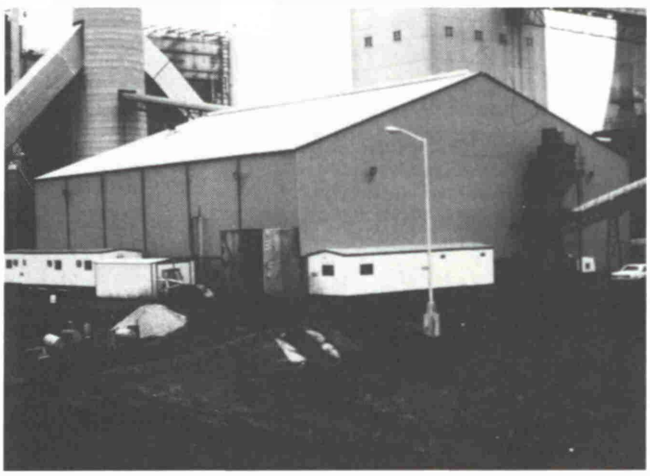


Fig. 2: Plant building

3.1 Preparation

A flowsheet of the preparation process is shown in Fig. 3. The two-inch by 0-inch coal is intercepted in AP & L's crushing tower and stockpiled. This coal is crushed in a 450 HP, 50-inch diameter cage mill (Fig. 4) to minus one-fourth inch. The cages in the mill rotate at approximately 700 rpm and consume in the order of 5.8 HP-hour per ton with new cages. This compares with 6.3 HP-hour per ton at Black

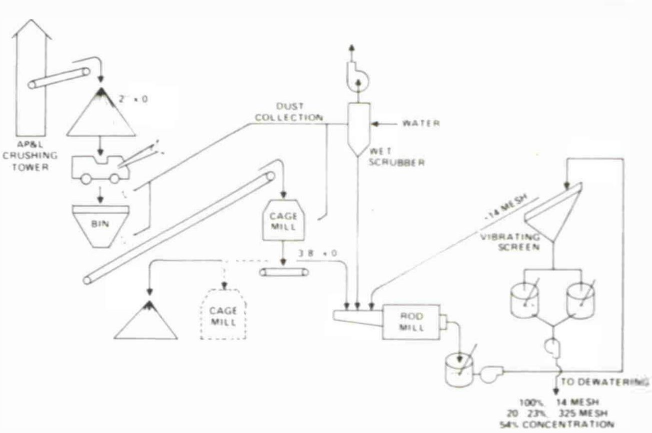


Fig. 3: Flowsheet of coal slurry preparation

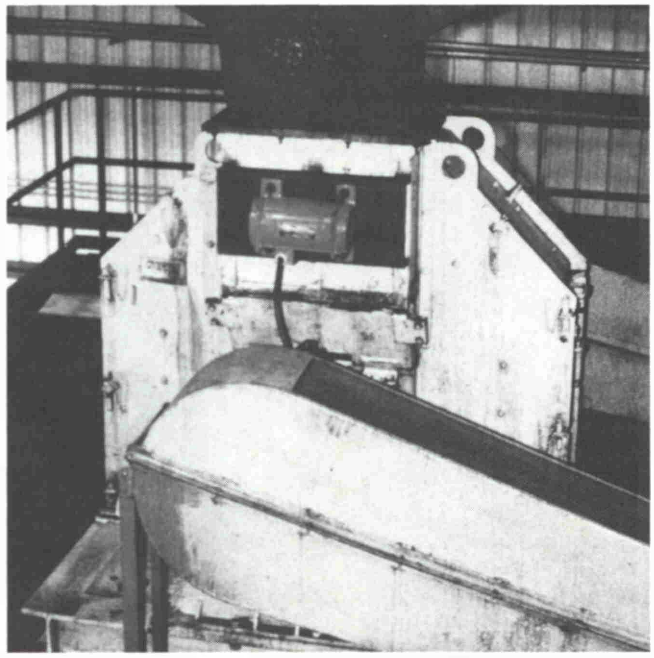


Fig. 4: Cage mill for coal crushing

Mesa when operating with new cages. The testwork has further shown that the rpm of the cages is a strong determinant of size reduction and horsepower consumption. At the 700 rpm speed the typical size consist is 13 % plus 14 Mesh and 14 % minus 325 Mesh.

Whereas at Black Mesa the cage mill product is conveyed by belt to its dedicated rod mill, the CEP has demonstrated the successful use of hydraulic conveying of the cage mill product. The cage mill crushed coal discharges directly into a sump (Fig. 5). During its fall the coal crosses water sprays which wet the coal and enhance rapid slurrying. This new approach has two major advantages: first, it reduces dust emissions considerably and, second, it decouples cage mills from rod mills in the commercial arrangement which permits a steady feed to each rod mill and enhances the plant availability factor.

The rod mill (Fig. 6) is 7.5 ft in diameter by 12 ft long and is driven by a 300 HP motor. To date the rod mill has only operated at 19 % rod charge which accounts for the 1 to 1.5 % plus 14 Mesh material in its product. The optimization of this circuit has not yet been accomplished, but it is projected that this mill's capacity as well as that of the cage mill may be in the order of 70—80 TPH and that the rod charge should be increased for optimum operation. Under current conditions the rod mill draws approximately 4.2 HP-hour per ton. This is very close to the Black Mesa commercial rod mill energy consumption.

3.2 Dewatering

The flowsheet of the dewatering process is shown in Fig. 7. Pipeline slurry is heated using condensation heat from the extraction steam supplied by White Bluff. The first centrifuge tested was a KHD 44-inch by 132-inch screenbowl with a 500 HP motor. The following conditions were tested:

- Temperature: ambient — 200 °F
- Bowl speed: 800—1100 rpm
- Feed rate: 25—45 TPH
- Pool depth: 2.5—5.0 inches
- Scrowl differential speed: 25:1 and 40:1

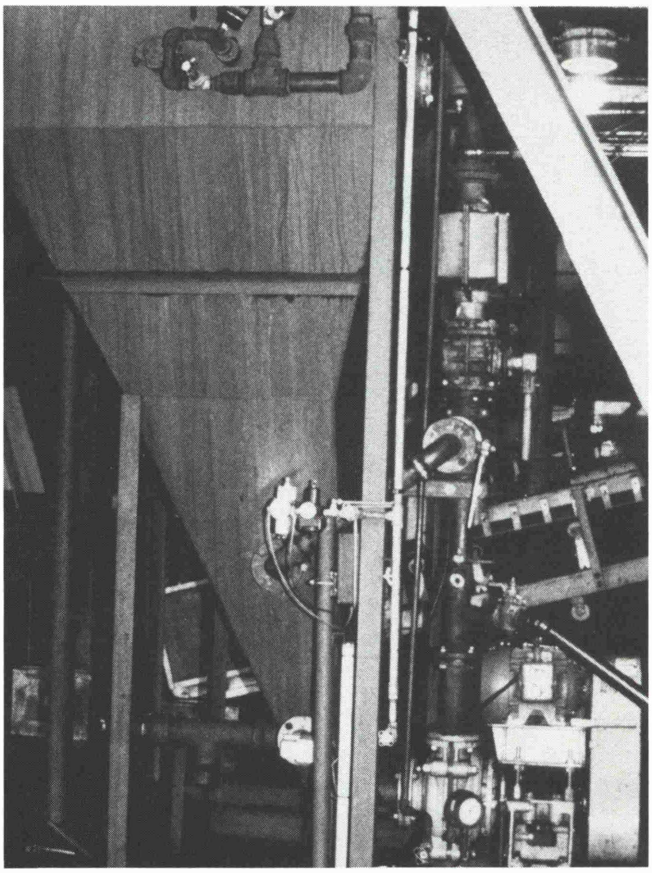


Fig. 5: Cage mill coal discharge

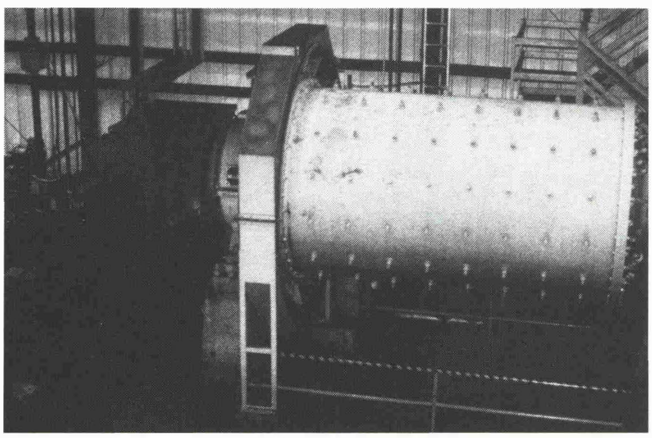


Fig. 6: Rod mill

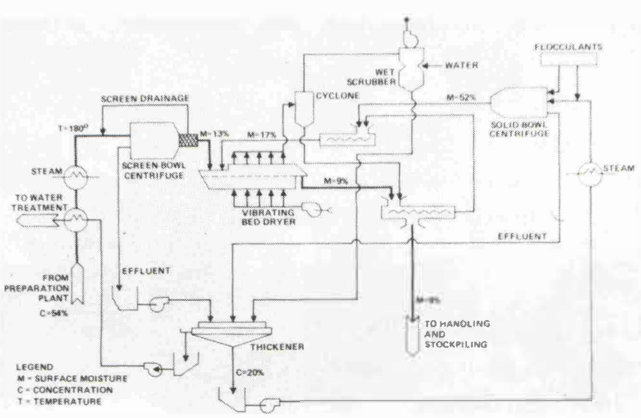


Fig. 7: Flowsheet of dewatering process

Performance data within the above settings were as follows:

- Primary cake surface moisture: 11—15 %
- Recovery with screen drainage recycled: 90—95 %
- Recovery without screen drainage recycled: 77—87 %

A significant variable in the combined performance of primary and secondary dewatering is the processing of the screen drainage. The majority of the test work was done under screen drainage recycling conditions, i.e., return to centrifuge feed. However, combining screen drainage and effluent has proven effective, particularly when the secondary dewatering is performed by the continuous belt press. The latter will produce a cake of about 50 % surface moisture on effluent only and 30 % or less when screen drainage is combined with the effluent.

The continuous belt press (Fig. 8) has produced dryer cake (5 to 15 points lower in moisture) than the solid bowl centrifuge (Fig. 9). Because of encouraging results on the one meter wide Andritz continuous belt press test unit, ETSI air freighted a commercial 2.2 m wide belt press from Switzerland. Testing on this commercial unit commenced in late March 1982. Primary and secondary cakes are fed to the vibrating bed dryer (Fig. 10). Their combined surface moisture is in the 15—20 % range. The vibrating bed dryer has been an effective device to dry the dewatered cakes to approximately 9—10 % surface moisture. Although some predictions of 16 % and higher solids carry-over in the dryer had been made, actual measurements indicate carry-overs of not more than 2.5 % of the feed. This can be explained in that pipeline coal is not dusty above 5 % surface moisture and that the fines agglomerate and do not behave as discrete particles. This phenomenon also explains the excellent efficiencies in the cyclone (95 % plus) and wet scrubber (99.6 % plus) dust collectors.

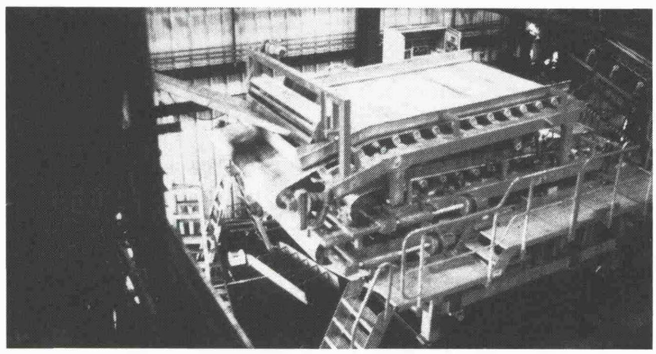


Fig. 8: Continuous belt press

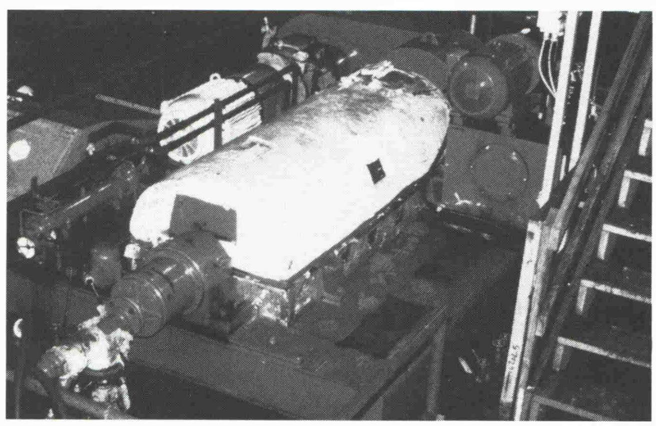


Fig. 9: Solid bowl centrifuge

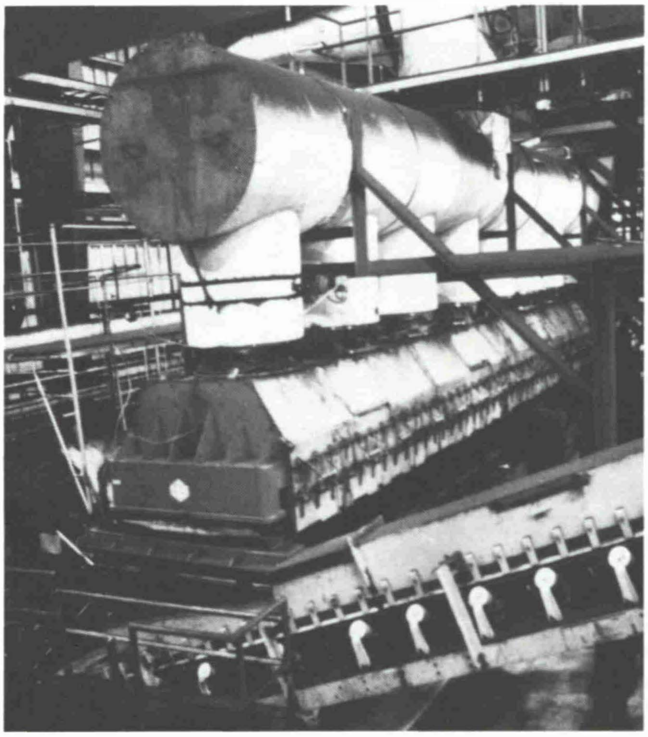


Fig. 10: Vibrating bed dryer

Flocculant optimization in the thickener and secondary dewatering is still under way but already significant achievements have been made. To date American Cyanamid and Dow Chemical products have been tested in conjunction with Alum dosages and costs have been reduced from over $1/per ton of primary feed at the beginning of the program to approximately 50 cents per ton today.

A Bird screenbowl centrifuge, (Fig. 11), specifically designed to meet ETSI requirements, has recently replaced the KHD centrifuge for testing.

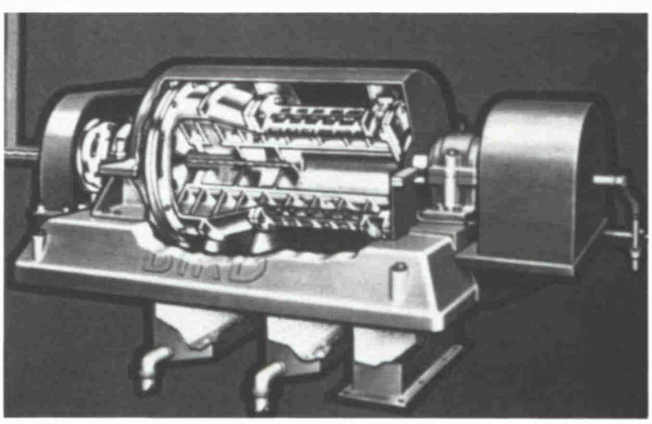


Fig. 11: Bird screenbowl centrifuge

3.3 Handling and Storing

Although to date 14,000 tons of coal have been processed through the CEP and stockpiled successfully, the program for this facility is now starting in earnest. Bunkering (Fig. 12) tests are being conducted to determine the flow characteristics of dried pipeline coal as a function of moisture, temperature and fines level.

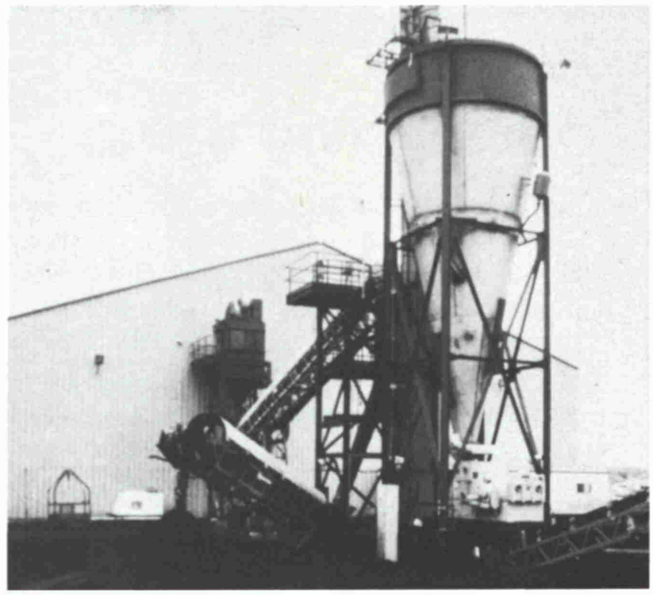


Fig. 12: Handling and storing of processed coal

Stockpiles are being sprayed with various types of chemicals to assess effect on dusting prevention and rain erosion. Temperature and moisture levels are being monitored in these stockpiles to determine potential combustion problems and determine moisture migrations respectively.

Presently pipeline coal is easily handled by conventional equipment currently used by White Bluff personnel in handling of rail delivered coal. The high degree of compaction readily achieved on pipeline coal by standard stockpile construction techniques provides good stability of the stockpiles. Torrential rains (over one-inch overnight) have severely tested the CEP's dried coal stockpile for erosion. It was found that due to the high degree of compaction, the stockpile withstood these conditions very well although otherwise unprotected. Only minimal erosion was detected when certain protective chemical coatings were used.

A special 30,000-ton stockpile is presently being produced dedicated for a 48-hour burn test where pipeline coal will be used as sole fuel for one of White Bluff's boilers.

3.4 Water Treatment

Overflow from the clariflocculator has averaged less than 30 ppm total suspended solids once operations stabilized. Treatment has not been necessary to meet state and federal water quality standards.

While laboratory simulation work predicted Biochemical Oxygen Demand (BOD) levels in the effluent ranging from 60 to 120 ppm, measurements of BOD levels at the CEP have been consistently lower than 30 ppm.

The Arkansas Department of Ecology and pollution control has stipulated that BOD levels are not to exceed 30 ppm. Metals and EPA priority pollutants were measured extensively in early simulation work and at the CEP and always found to be well below discharge limitations.

Therefore, data from the CEP indicate that biological treatments are not required and that the clariflocculator overflow meets environmental constraints for discharge in public streams.