UTILITY EXPERIENCE
HANDLING
FINE WASHED COAL

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Understanding the Business of Coal

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INTRODUCTION

In recent years the utility industry has become interested in using low volatile bituminous coals. Several factors have caused this interest including increased pulverizer capacity, increased boiler efficiency and the low sulfur, low fusion characteristics of the Pocahontas #3 seam. The handling characteristics of these coals have caused concern due to their small particle size. These concerns cover both pluggages and fugitive dust. Island Creek has supplied these fuels to over fifteen utility stations. Other coal companies have supplied at least three other stations. The experiences had by these utilities have ranged from normal operation to difficult handling and excessive dust.

These coals come from two seams of coal, 1) Pocahontas #3, located in Virginia and 2) Upper Freeport, located in Northern West Virginia. Both of these coals are ranked low volatile bituminous and because of their high grindability index (approximately 100), and the long wall mining methodology used to mine these coals, they are much finer than coals normally utilized by utilities. The coals are typically 70-90% less than 1/4". These coals are fully washed and utilize froth flotation for the fine cleaning circuit in addition to being thermally dried. It appears that the utilities are in many cases able to handle these coals in spite of their fine sizing. Some coal handling configurations do appear to handle the coal better than others. In addition to flowability of these coals, utility experience in controlling dust is also described.

DESCRIPTION OF COALS

The two coals discussed in this paper are both ranked low volatile bituminous. They have similar organic properties such as oxygen content, carbon to hydrogen ratio and hardgrove grindability. They differ in mineralogy and sulfur content. Table 1 shows typical analysis of both the Upper Freeport seam and the Pocahontas #3 seam. They are both fine sized, as shown in Table 2, and fully washed, using fine coal cleaning circuits and thermal drying. Both coals have an inherent moisture level of approximately two percent.

HANDLING DURING TRANSPORTATION

These coals are delivered using a variety of different types of transportation. The coals are primary shipped by rail from the mine. Utilities have received these coals by rail, barge and self-unloading ship.

Rail Deliveries

The coal delivered by rail generally has about the same moisture as when it was loaded. In a couple of instances the coal routing time was in excess of ten days. This extended transportation time caused an increase of moisture, although not necessarily an excessive amount due to the fact that the rail cars can drain out the bottom.

Bottom Dump With Car Shaker

One utility utilizes a bottom dump system equipped with a car shaker. The cars used were standard carbon steel 100 ton hopper cars with several older 70 ton cars. The moisture level was about six percent and some dust was noticed at the elephant trunk/pile interface. The majority of the coal unloaded from each car within about three minutes. This was about the same as their normal 50 grind coal. On all the 70 ton cars (these are presently being retired from the railroad's fleet) and the majority of the 100 ton cars, about three to seven tons of coal hung up on the slope sheets at the ends of the cars. An additional three to four minutes of continuous shaking was necessary to remove these last few tons. A good potential solution for this extended unloading time would be to use cars with steeper slope sheets or made with a slicker surface than rusted carbon steel.

Although dust was noted during the unloading it was satisfactorily controlled using a proprietary dust control chemical added between the car shaker and the elephant trunk.

Bottom Dump Trestle Unloader

Our first experience with a trestle unloader was disappointing. The trestle unloading system can typically unload a 10,000 ton unit train in about twenty to thirty minutes. The train moves across the trestle without stopping while the doors under the cars open and close sequentially. When the doors opened on the normal steel cars, little if any coal came out. There were no car shakers available and hammering on the sides of the cars was ineffective. These cars were shipped to another station where they were rotary dumped. Two courses of action were taken to improve the unloading. The first was to lower the moisture of the coal. It turns out that the troublesome cars were the first loaded on the shipment day, and the thermal dryer was not up to full temperature. This caused the total coal moisture to be in the eight to nine percent range. The other was to switch to aluminum hopper cars. The combination of these two improvements led to satisfactory unloading. The lower moisture coal did generate more dust, requiring the use of sprays.

Rotary Dumpers

The most common railcar unloading technique employed is the rotary car dumper. These coals have generally performed well in these systems. The railroad piers, where the coal is loaded onto vessels, utilize these systems as well as a majority of the utilities. The use of water sprays to control dust is generally required, and performs adequately.

There was one plant that could not handle these coals. That facility had worn (rough) concrete hoppers below the car dumper. These hoppers also had no vibrators or other mechanical flow aids. Because of the hopper design, the coal had to be gradually fed by slowly pouring the coal out of the car.

The other plants where normal unloading occurred had steel or stainless steel hoppers that had steep sides. Vibrators were available at some stations but not necessarily used.

Barge Unloaders

There are several plants where clam shell barge unloaders are utilized. One plant has no problems. The transit time on the water is about two to three days. These barges have a 7,000 ton capacity which is larger than the 1,500 ton river barges. Another plant located on the river system uses the 1,500 ton equipment and the travel time on the water is 17 to 24 days. This additional travel time on the water (barges do not drain) leads to increased moisture which resulted in some chute pluggages. In one instance, the problem was solved by using covered barges although the additional cost and hassle made this solution unattractive in the long term.

Self Unloading Vessels

A self unloading oceangoing vessel has been used to deliver both of the coals discussed in this paper. The hoppers in the vessel are lined with the plastic that is becoming more popular as a chute liner. There has been good performance with this unloading system. When the coal is loaded with a moisture level less than six percent, a dusting problem can arise. This is particularly true when the wind velocity exceeds 25 miles per hour. The boom is not equipped with an elephant trunk which would help considerably. A satisfactory solution has been to treat the coal with water and a proprietary chemical as it is being unloaded. It is also important to keep the boom close to the top of the pile to eliminate excessive freefall.

COAL HANDLING - COAL YARD

Coal handling in the coal yard is influenced by many factors. These would include the pile design, mobile equipment types, reclaim system and yard personnel attitude and morale. Several examples of how these may influence the coal handling are described here.

Pile Design

The shape and location of the pile, and methodology for storing and reclaiming coal can greatly influence the amount of moisture gain and dust generation of a coal. One utility had severe wet coal problems and had to eliminate the use of high grind coals at considerable cost and decreased plant performance. One glance at the pile told the story. The plant had about 160,000 tons of inventory spread out over several acres. The drainage within the pile was nonexistent. Dozer operators had to push the coal hundreds of yards through puddles of water, thoroughly saturating the coal. This plant could have eliminated many wet coal problems by using a well groomed, sloped pile with proper drainage around the perimeter.

Several of the plants that have had good performance with these fine washed coals use a crater styled pile. These piles are built up with step sides to minimize the exposed surfaces. These sides are treated with a binder-like chemical or organic product that can harden. These hard treated sides shed water readily and have no appreciable dust. The active portion of the pile lays within these walls that also act as a wind break. Water can be sprayed regularly to control dust on the interior and due to the low surface to weight ratio, water gain from rain can be minimized.

Not all plants can have a crater styled pile due to the system layout. An alternate pile design also uses the "minimize the surface to weight ratio." These piles are again built with three steep sides and one gradually sloping active side. The drainage system around the reclaim hopper must be sufficient to remove any standing water that may gather between it and the active slope. If it is necessary, the first few inches of wet coal should be scraped off and the dryer coal below used.

In some cases it may be possible to plant grass on the sides of piles rather than to use chemicals.

Reclaim Hopper Design

The design of the reclaim hopper or hoppers can significantly affect the flow of coal. Two utilities have had problems and both have similar designs. One of the calculated flowability criteria is the critical arching diameter. This number estimates the chute diameter where the coal will start to arch over. This diameter represents the maximum so it would be the diagonal on square or rectangular chutes, or the actual on circular hoppers. It is due to this maximum diameter effect that slot or elongated hoppers are so effective. The reclaim system that has had the most difficulty with flowability has had multiple (18, 24, 48) smaller reclaim hoppers rather than one or two large ones. These systems offer greater flexibility in terms of blending or reliability due to mechanical failures, but do not have very large diameters so they are more sensitive to coals with larger critical arching diameters. Possible solutions to hang-ups with these types of hoppers may involve individual vibrators or air puffers.

The systems with larger reclaim hoppers that do not have significant problems range from those with hopper vibrators and vibrating feeders to these with no vibrators and gravity feed.

Chutes

The chutes in the coal handling system can also plug. The larger chutes and those lined with stainless and especially plastic do not have many problems. The problem areas have been where chutes are internally cluttered with supports, handles and other foot holds where the coal can start to back up. Another poor design is where the chutes have a shallow incline. The lumpy coal can roll down these chutes but the fine coal can back up. Liners, both stainless and plastic, vibrators, air puffers and air cannons can all help the flow of coal in chutes. Hammering on the sides may help as a quick fix, but not when hammered so much as to constrict the size of the chute. Regular inspection of the chutes to clear out build-ups is recommended before they cause problems.

COAL BLENDING

Particular attention must be paid to handling characteristics when blending coals. The fine washed, thermally dried coals described in this paper have been successfully handled due to the removal of extraneous mineral matter and surface moisture. When blended with other fine washed coals, no significant deterioration in handling has been observed. However, there are several instances where the coal has been blended with a raw coal. The combination of the fine sizing mixed with the mineral matter in the raw coal has caused considerable flowability problems. This phenomenon is being studied by the EPRI coal handleability project but the preliminary results have not been included here.

CONCLUSION

It appears that fine washed coals can be satisfactorily handled in many utility coal systems. The predictive techniques are not well developed so we are still using the "try some and see what happens" techniques. It is obvious that simply stating a maximum percent passing some sieve does not protect the plant from all handling problems and may eliminate several potential coal sources. It was not possible to describe all the experiences and equipment encountered in this paper, but the author hopes that some usefulness is derived by the readership.

TABLE 1 -- AS RECEIVED TYPICAL ANALYSIS OF COALS

	Upper Freeport	Pocahontas #3
Total Moisture:	7.0	6.0
Equilibrium Moisture:	2.0	2.0
Ash:	10.0	5.0
Volatile:	18.5	17.0
Sulfur:	1.5	0.7
Btu/lb.:	13,000	14,200
HGI:	95	100
Slagging Index:	0.35	0.35

TABLE 2 -- TYPICAL SIZING OF HIGH GRIND COAL

Screen Size	% Passing by Weight
2"	100
1 1/4"	100
1"	99
3/4"	98
1/2"	96
3/8"	91
1/4"	89
1/8"	81
14M	67
20M	37
28M	31
35M	24
60M	10
100M	7