Coping with Coal Quality Impacts on Power Plant Operation and Maintenance

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Introduction

The electric power industry is rapidly changing due to deregulation. The author was present one hot day in June of this year, when a southeastern utility company was selling electricity for $5,000.00 per megawatt with $85.00 cost. Typical power cost range from the mid teens at night to about $30.00 on a normal day. The free market place will challenge the power industry in many ways. Fuel is the major cost in electric power. In a regulated industry the cost of fuel was passed on to the customers. Fuels were chosen to minimize problems such as handling, combustion, ash deposits and other operational and maintenance concerns. Tight specifications were used to eliminate or minimize coals that caused problems. These tight specifications raised the price of fuel by minimizing competition. Deregulation is on its way. As the power stations become individual profit centers, plant management must take a more proactive role in fuel selection. When the plant starts to take a more active role in the selection process, it develops improved communication with fuel purchasing as well as a more accurate overall understanding of coal quality. Fuel cost is always a major production cost. Understanding how coal quality impacts plant performance and cost, allows better fuel selection decisions. The plants need to become more aware of the nature of coal and implement creative solutions for problems arising from differing coal quality. The potential of lowering fuel cost is so significant that most utilities will at least explore their options. How well plants take advantage of their knowledge, may determine, whether they will be able to compete in a free market place. The coal industry Itself can provide many insights on how to survive in this type of market. Coal mines today must remain competitive or be shut down. The consolidation of the coal industry indicates the trends that can occur in a competitive market These trends have already started, and will continue in the utility industry. This paper will discuss several common situations concerning coal quality and potential solutions for the plant to consider. All these examples have mill maintenance and performance issues in common. This is indicative of how important pulverizers are to the successful operation of a power plant

Mill Capacity

The ability of a power plant to pulverize coal for combustion is directly related to the load produced and indirectly impacts other areas such as slagging, ash sales and opacity. One measure of the grinding nature of a coal is the Hardgrove Grindability Index (HGI). This index is used to calculate the variation in tonnage throughput from one coal to another, generally using a set of curves provided from the mill manufacturer. Emphasis is placed on this number by many utilities, but it is only part of the mill capacity equation. Surface moisture, inlet and outlet coals sizing and heating value all play a significant role in determining mill capacity. More utilities are incorporating a heating value adjustment to the HGI. Higher Btu coals can have a lower HGI than the HGI required by lower Btu coals. This has opened up the market place for several utilities that never considered low HGI coals. This Btu adjusted capacity method does allow a greater range of coals to be considered,

but does not change the fundamental capacity of the mills. To do this a plant must consider the outlet sizing, at the coal from the mill, and what impacts it has on other boiler and plant components. Obtaining mill fineness samples is hard, noisy and tedious work that does pose some safety concerns.

Consider this, one eastern plant decided that it would emphasize knowledge of coal sizing and its impacts on plant performance. They assigned personnel to perform, almost exclusively, coal fineness testing. These results were compared to changes in mill parameters such as spring tension, bowl clearance, and primary air flow to quantify the performance of the mill. This knowledge led to the expansion of the HGI specification by more than 20 points. The maintenance to keep these mills in shape is influenced significantly by the results of the fineness testing. At a time when many plants are reducing their mill maintenance budget to control costs, one plant is increasing theirs to be able to burn harder to grind coals. The fuel cost savings this mill capacity increase provided amounted to millions of dollars a year. It has been the authors experience that power plants vary in a large degree in the emphasis they place on mill performance. This example shows some of the potential savings from this type of work and should lead to utilities becoming more aware of the wide variety of options to expand coal specifications.

Slagging with Bituminous Type of Ashes

This example will show how a utility was able to lower its ash fusion specification by understanding how different coals behave in the boiler. Typically utilities have specifications for total ash (in percent) and a fixed fusion temperature spec. Published accounts of utilities experience in this area have led many slag specialists to consider the amount of ash loading to be important. When ash levels are expressed in pounds per million Btus, they more closely reflect the levels seen by the boiler. The author has also proposed that the Iron loading level is an important consideration. In several boiler slagging events worked on by the author, the problematic coal had elevated iron loading levels. Using this information several utilities have conducted test burns of coals with lower fusion characteristics. Their strategy was to limit the iron loading by considering lower ash, higher iron coals. These coals had lower than design fusion temperatures but it was suggested that the lower ash levels would offset this. The results of the test confirmed that the iron loading levels more accurately predicted the slagging behavior of the coal than the fusion temperature of the coal.

Coal fineness also plays an important role in being able to utilize coals with elevated iron levels. Many slagging problems associated with high sulfur-low fusion coals can be traced back to poor grinding (fineness) of the coal. Large pyrite particles escape from the mill and do not completely oxidize in the flame. The molten particles contain unoxidized iron that can flux the aluminosilicate materials in the ash into low melting type glasses. This effect is most dramatically seen in the difference between the oxidizing and reducing fusion temperatures. The spread between these fusion temps can be several hundred degrees in high iron coals. Again maintaining mill performance can significantly impact the use of lower fusion eastern type coal.

Opacity

The opacity of a unit was running particularly high. The unit was burning a western coal and used S03 injection to lower the resistivity of the ash. In the past, the unit was able to maintain opacity below 10 percent. On the day in question, it was close to 20 percent. The ESP control showed poor performance with low power levels and high rates of sparking. This was the type of behavior the ESP showed when trying to collect unconditioned ash, yet all indications showed that the 803 system was operating. A sample of the ash was taken and it appeared black. Further testing revealed that one of the mills was producing poor fineness, causing the high carbon content in the ash. This elevated carbon content was causing the opacity problems. By bringing the mill performance up to spec, the problem was solved.

Conclusion

This paper was brief, but hopefully has shown the importance of one aspect, mill performance, on many coal quality related issues. At first glance one might not consider the influence mill fineness has on mill capacity, slagging and opacity; this paper has shown that it does indeed, and mill performance is only one of many areas of consideration. The plant personnel of the future will have to integrate their knowledge and experience into the fuel selection process. They should also be more willing to make suggestions and improvements in what they do to accommodate a wider fuel selection. By allowing plant management more access to the nature of coal mining and coal quality, better decisions ran be made concerning fuel choice.