Happy Independence Day!

Investing Maintenance Dollars Wisely

Storm Technologies, Inc. July 6, 2010

Cost effective maintenance and maximum capacity, reliability, efficiency and environmental performance is every coal plant managers' goal. One good and informative approach to using limited maintenance funds to maximum advantage is to conduct comprehensive boiler performance tests during the high load factor summer months. The reason for doing this is so that the root causes of slagging, fan capacity shortages, high LOI, SCR popcorn ash and other issues can be identified and quantified early, before the final outage work scope is developed. Put another way; use a comprehensive diagnostic test to develop the outage work scope.

Here is an outline of how STORM does it:

SERVICE QUALITY RESULTS STORM

Oxygen Rise Tests: Furnace to Stack

These should be run periodically to monitor boiler air in-leakage, air heater leakage, and duct air in-leakage. These problems can sometimes be corrected online. If not, they can be added to the "outstanding maintenance list" and corrected at the first scheduled (or unscheduled) outage.

The furnace exit must have a slightly oxidizing environment at all points. A reducing environment (no free oxygen) will promote slag formation, high gas temperatures and contribute to high carbon in ash.

We think HVT testing should be conducted at least quarterly. Measuring the oxygen rise from the furnace to the stack is quite useful in quantifying air in-leakage.

In our experience, this is one of the primary problems of balanced draft boilers. Excessive air in leakage is especially significant on 30+ year-old units. The costs of undiscovered and uncorrected air in leakage is among other problems such as limited production capacity due to ID fan limits, high carbon in ash, slagging, fouling, heat rate penalties, catalyst plugging due to cinder carryover from high FEGTs and more.

Quantifying the air in-leakage during the summer high load factor operation provides an opportunity to cost-effectively correct the sources of air in leakage during the fall outage season.

Balancing Fuel Lines

Balancing fuel lines by use of a clean air tests may seem old fashioned, but it works and this is the first step in fuel line balancing.

Figure 1

Combine high load factor operation, with harder or lower HHV coal, lower fusion temperature ash and the fuel fineness and distribution better be close to optimum. If the mills need changes in the fall outages, now is the time to develop that work list and order parts. All mill performance changes and adjustments should be judged by testing all fuel lines. The Storm isokinetic coal sampling kit is time and results proven.

Representative Flyash Sampling

Representative flyash sampling is a must. I said representative flyash sampling, not just flyash sampling. The most practical method to sample flyash is to utilize the STORM near isokinetic, flue inserted flyash sampler. Sampling at least 30 points in each duct requires about 2 hours with interested and motivated test personnel.

It is suggested that permanent brackets be mounted at the test locations to store the probes. We also recommend permanent compressed air supply lines close to the test location. This greatly simplifies the technicians' task of performing the representative flyash sampling tests. The largest effort involved is in getting set up. So, if it is made more convenient to do the testing, then the technicians are more enthusiastic about doing this important test periodically. Weekly tests are a good idea. Not only good reference of the flyash LOI, but flyash sizing and fine/coarse particle LOI is an early indicator of mill and airflow problems.

This is a very cost effective test device, which can reveal much about combustion effectiveness in the furnace.

Sample analyses by sieving and determining the coarse particle, fine particle and composite carbon content is useful in troubleshooting. Again, the key is getting a representative sample of flyash first. Then do the carbon in ash analysis for fine, coarse and composite sizing and LOI.

Airflow measurement device calibrations are important!

Airflow management, that is measurement and control of the primary airflow, secondary airflow and overfire airflows is important. Pulverizer optimization has much to do with the accuracy of the primary airflow measurement and control. Furnace residence time is finite. Therefore, accurate proportioning of the combustion airflows is important. STORM prefers the use of venturis for primary, secondary and overfire airflow measurement. The "secret" to accurate airflow

Figure 1 shows orifice housings installed in the fuel lines to make fixed orifice changes more expeditious. Measuring the fuel line velocities on clean air and then inserting the proper orifice sizes is the first and most important step in fuel line balancing. Later, changes to the classifiers or coal riffles may be required, but the balancing of system resistances, in our experience, is an absolute pre-requisite.

Fuel fineness and distribution

Fuel fineness and distribution is best determined by using the Storm isokinetic coal sampling kit.

Fuel Fineness of at least 75% passing 200 mesh and 0.1% maximum on 50 mesh is important for achieving optimum combustion. Fuel sampling should be conducted in vertical up flow coal piping several diameters from elbows, or orifices.

Fuel fineness and distribution is absolutely essential to achieve optimum performance with the environmental restrictions in place these days. Low NO_X operation affects nearly every customer that we have worked for. Fuel changes to the most economical and environmentally friendly coals are also the norm.

measurement on boilers where the ductwork is not arranged like an aircraft-testing wind tunnel, is to perform hot calibration traverses. Storm prefers the use of our own design venturis and calibration by STORM designed forward-reverse pitot tubes.

Storm Technologies, Inc. takes great pride in being results oriented. Doing so, in our experience, is best done by taking a comprehensive approach to boiler performance optimization, from the raw coal supply to the stack.

Applying the 13 Essentials is a great start in minimizing forced outages, capacity limitations or environmental stress on management.

Our products and services have evolved over the years based on getting results and by providing the best field services that we are capable of performing. If you would like a copy of our catalog of products and services let us know or visit our web page at www.stormeng.com.

Dick Storm - Senior Consultant

The first step in applying scarce maintenance dollars is to identify the most benefit multiplying opportunities for improvement. We often refer to these as the "low hanging fruit". In our experience there are three major recurring "opportunities" that almost any pulverized coal plant suffers from in penalties of slagging, heat rate, reliability, fuel flexibility and comfortable environmental emissions compliance. These are:

- Air in leakage
- Fuel fineness and distribution
- Combustion airflow measurement inaccuracies

Take air in-leakage as the first example. Please refer to Figure 2 which shows an old-timey "triangular combustion chart". These were commonly used by results engineers and testing and results technicians who used orsat's to measure flue gas constituents as opposed to electro-chemical cell based analyzers commonly used today. We used to measure CO_2 and O_2 chemically by volume by extracting a 100 Ml sample and passing that sample through absorbent chemicals. The individual constituents of carbon dioxide and oxygen were then noted on a data sheet and the points plotted for CO_2 and O_2 This chart is redrawn on our Figure 2 and can be enlarged by drawn from the pivot point to the hydrogen/carbon ratio of the fuel fired. It is usually about 15-16 % for most commonly fired coals. Therefore, a stack carbon dioxide reading of 10% would correspond to a stack excess oxygen level of about 8.8%. This is equivalent to an excess air level of about 70% (assuming all the air went through the burners). Excess tramp air that infiltrates the system is a common, yet serious problem in our aging fleet of coal fueled boilers. This also represents a considerable amount of ID fan power to force this extra tramp air through the electrostatic precipitators, baghouses, SCR's and the sulfur scrubber. Our first "opportunities" bullet is air in leakage. Air drawn into the convection pass of the boiler post combustion is measured as excess combustion oxygen by the oxygen sensors mounted at the ductwork immediately before the air preheaters. The stack oxygen content is a first tip off that significant air in leakage may be occurring.

The use of the triangular combustion chart can help to put stack flue gas constituents into perspective as to just how much air in leakage there may be. Doing this at full and steady load is the best time to identify the levels of opportunity for reducing air in leakage.

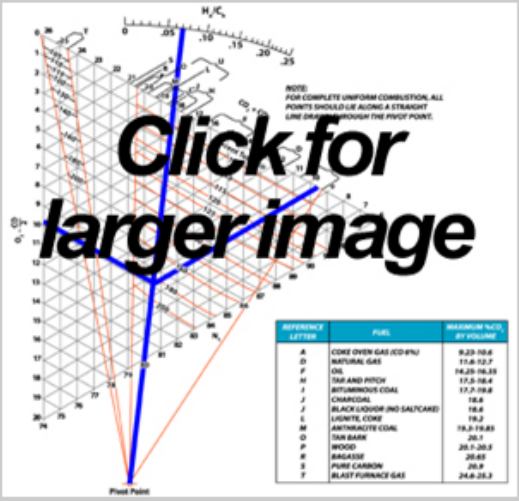

Figure 2

Airflow measurement inaccuracies continue to be a problem as well, especially primary airflows and over-fire airflows that are not accurately measured and controlled. High primary airflows can produce poor fineness, poor fuel balance and can contribute to superheater slagging all from this one O&M variable.

If you have questions or concerns about any of these or other factors, contact us at Storm Technologies. We will be pleased to discuss the specifics of how we can help you achieve the best possible performance, reliability and efficiency from your coal fueled boilers. Optimization by the Storm approach is what we refer to as "**PERFORMANCE DRIVE MAINTENANCE.**"

Conducting boiler tests at full load during the summer peak load periods is a great time to prepare the work scope for the fall outage season. Remember what Ben Franklin said, "a problem identified is a problem half solved."

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