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Getting the Inputs Right

Dick Storm, CEO and Senior Consultant at Storm Technologies, speaks with Mae Kowalke, Neundorfer's Manager of Stories, about the connections between optimized combustion processes and the performance of air pollution control equipment. Get more episodes and join the conversation on iTunes or at www.neundorfer.com/podcast.

Mae: So, Dick, let's start by having you give our listeners a very brief overview of your background and your experience in the industry.

Dick: I've been referred to as the "input guy." I've been focusing on the measurement of air flows and the preparation of coal to be injected into coal-fired furnaces. I've been working at that for about four decades, and our expertise at Storm Technologies for the past twenty years has been in air pollution compliance, largely NO_x, by mechanical tuning of the coal pulverizers and proportioning of airflow into the furnace.

Mae: So, let's get right to our topic. Why should people who are in charge of optimizing air pollution control systems care about what happens with combustion in the boiler?

Dick: Well, what we're finding with every increasing regulations on the emissions of combustion processes, is that all components seem to be inter-related.

Mae: What are some examples of improvement opportunities that inter-relate?

Dick: Primary air, fineness, fuel distribution, air in-leakage are four typical opportunities we've run into that are almost always to be depended on as far as improvement. When you get involved with the combustion process and the air pollution devices, some other things that come into play are carbon in ash, which can impact electrostatic precipitator performance.

And, air in-leakage on the aging fleet of coal-fired boilers can impact the fan loading and the capacity of ID fans and baghouses. Not only do you have the increased gas flow going to the ID fans, the baghouse or the precipitator, but with insufficient oxygen in the furnace carbon in ash becomes an issue. If we have high carbon in ash, that becomes a problem for the electrostatic precipitator.

Carbon is a very conductive material and the precipitator has to be tuned for a very high dielectric strength inert material like silica and alumina. The carbon materials confuse the electrostatic precipitator controls.

That's one reason why our two companies are allied together. A lot of the things you would do to optimize an electrostatic precipitator require as a prerequisite that you get the carbon in ash down to reasonable levels.

Mae: We talk a lot among the alliance companies about the impact of air in-leakage, and how this can cause fuel and air to be unbalanced in the burner belt. Where does air in-leakage or tramp air come from and why does it matter?

Dick: The average age of boilers out there is about 40 years. These old boilers have had a lot of heat-ups and cool-downs, startups and shutdowns, and what you have is hundreds of feet of cracks that are maybe an eighth or a quarter inch wide but end up being real square feet when you take the total aggregate sum of the open areas. An equivalent of ten to twenty percent of the total air for combustion actually leaks in the average boiler setting after the combustion process should be complete.

Because the oxygen analyzers are located at the economizer exit, they can't tell the difference between air that came in through the burners, through the over-fire air ports, or through the places air is supposed to come in, and air that leaks in. The assumption is zero leakage. A lot of people are driven by the manufacturer's design--the boilers were designed to have zero leakage, so they must still be at zero leakage. But the truth it's a different world today. The assumptions of what were used for design are not necessarily relevant in today's typical boiler.

Mae: A lot of what we've talked about so far has to do with particulate matter. What about other pollutants--like, for example, carbon monoxide or CO?

Dick: Well, as you reduce NO_x with in-furnace solutions, if you don't watch out the CO can take off. Everything we do for reduction of NO_x is to control and separate the air and the fuel and allow them to meet together at a controlled rate. As you do that, we're eating up residence time. As we eat up residence time, we have the products of combustion still burning up close to the super-heater. If we don't have it completely balanced all the way across the super-heater, we can get into quenching of the products of combustion before they're completely burned out. Then we end up with CO formations.

CO will still burn down to about 1,300°F. But the gases are moving through the convection pass of the boiler at between 35 and 50 feet per seconds. It's not too long after the products of combustion get quenched in the super-heater and another 50-60 feet and they're quenched down below 1,300°F. Whatever CO remains at that point will never burn out no matter how much air we add to it.

In the new EPA regulations that we're seeing, it appears there are some limits on CO. We had one plant in New York where they were very worried about CO levels that were 500-1,000 parts per million. We put in a fan-boosted over-fire air system, and went after the usual things—burner mechanical tolerances, airflow proportioning—and were able to get into the single digits to 20 parts per million CO.

Now, when CO goes down to reasonable levels, that's the same things you would do to get carbon in ash down to reasonable levels. And those things are both necessary as prerequisites for good electrostatic precipitator performance and for good stack emissions on the CO level.

Mae: What advice would you give someone who is in charge of optimizing air pollution control systems?

Dick: My advice would be: know your boiler, know your combustion system, know what it's doing. You need to know what the leakage is, you need to know what the coal fineness is, you need to know what your fuel balance is, you need to know the atmosphere in the furnace, and you have to be able to identify what the opportunities are to improve performance.

One thing that's worked well for some customers is to do testing of the boiler inputs before an outage and then come up with a list of items that could be improved during the outage. We call that performance-driven maintenance. Rather than doing maintenance on airheater seals and on pulverizers based on hours or years or months of operation, have those be driven more by actual test data. It's relatively inexpensive compared with the millions of dollars spent on boiler maintenance overhauls.