View from the Penthouse

The DNFM Technical News Letter

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Awareness on the environmental effects of burning fossil fuels began in 1960 with implementation of emission controls in industrial and utility boilers. Congress established the Clean Air Act, which is more comprehensive, in 1970. There were several amendments since then. Congress extensively amended the Clean Air Act in 1990. The use of Powder River Basin (PRB) coal has tremendously increased since the mid-90s due to stringent restrictions on pollution control. PRB coal gained a tremendous amount of interest for its lower sulfur content, resulting in lower SOx emissions, lower cost and abundance of availability. Lower sulfur content in the PRB coal is due to fresh water exposure during its formation. Although PRB coal offers lower heating value (≈8000 BTU/lb) due to higher moisture content (from it's porous structure), it has economical advantages over high sulfur bituminous coals (≈13,000 BTU/lb). The economical advantages are low fuel cost and low capital investment. The environment-friendly (low SOx) characteristics of PRB coal and its relatively low cost make it attractive for the power industry. However, there has been substantial debate about the economic advantages of switching to PRB coal. The other major differences between the PRB and bituminous coals are concentrations of ash, CaO and MgO. The concentration of these oxides in PRB coal is much higher than in the bituminous coals, which affects the ash melting temperature and radiant heat absorption capacity in the furnace area. Reduced radiant heat absorption capacity in the furnace area is due to the higher reflectivity of the deposit, which contains higher oxides of calcium and magnesium. This reduced heat transfer capacity in the furnace impairs the thermal efficiency by raising the furnace gas exit temperature.

Slagging may be elevated in the high temperature superheater/reheater areas due to higher furnace gas exit temperature, **Fig. 1**. This situation is further exacerbated by low-NOx burners and over-fired air (OFA). **Figures 2 and 3** illustrate the coal ash corrosion on a reheater tube after switching to PRB coal. Using blends of high-chlorine and PRB coals also promotes fireside corrosion. High levels of chlorine react with minerals in the PRB coal, resulting in the formation of a corrosive environment. Improper mixing of blends may cause load swings due to variable heat content in the coal pockets. An "intelligent" cleaning system is required in the furnace area to attain the designed thermal efficiency by reducing the furnace gas exit temperatures (care must be taken to avoid thermal fatigue cracking due to increased sootblower/water lance usage). The effective cleaning of furnace tubes solves many secondary problems such as slagging/fouling, high furnace exit temperature and excessive usage of superheater/reheater sprays. Although PRB coal contains lower ash content, it requires higher throughput to meet full load conditions. Therefore, erosion problems may be increased due to the lower heating value when switching from bituminous coal.

Low-sulfur coals such as PRB coal increase the fly ash resistivity, resulting in lower electrostatic precipitator (ESP) performance. One way to overcome this is by increasing the size of the ESP, but this approach is expensive and time consuming, requiring longer outage periods. Alternatively, chemicals such as ammonia can be injected into the flue gas stream to reduce the resistivity, improving the overall performance of the ESP. The fine particulates make PRB coal very volatile, which increases the risk of spontaneous combustion. This risk can be mitigated by the use of proper dust collecting systems and cleaning equipment.

Figure 1. Thick slag build-up on a reheater tube after switching to PRB coal.

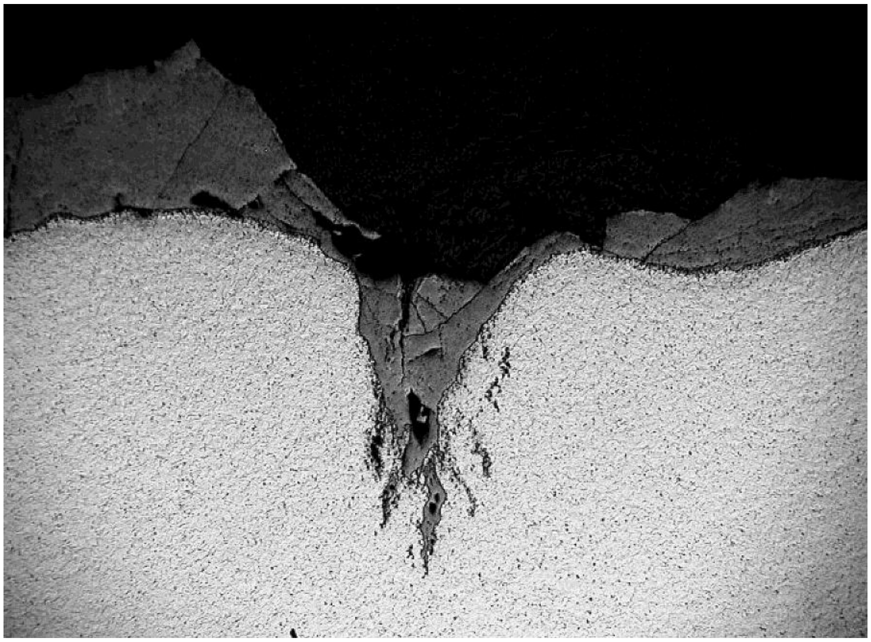

Figure 2. Tube wastage and creep damage, reheater T22 tube, OD. 80x.

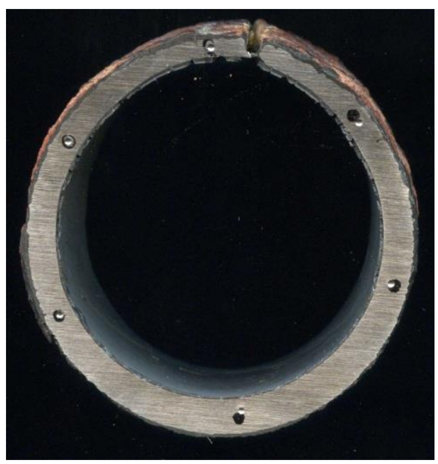

Figure 3. Ring section from the tube in **Fig. 1**. Note the severe wastage at the 12:00 orientation of the tube due to coal ash corrosion.