

Fuel management

By Cate Jones, Contributing Editor

Firing PRB? Control of coal dust is a must



Market economics and the Clean Air Act of 1990 have made the low-sulfur sub-bituminous coals of the Powder River Basin (PRB) in Wyoming a popular choice for existing coal-fired power stations. However, considerable re-engineering of the power station systems must occur along with the switch.

One of these systems is the coal-dust collection system. Just as combustion modifications are required, so too are modifications required in the coal delivery system to ensure the safety of personnel as well as to minimize maintenance, and insure continuous environmental compliance. Here are some recommendations based on material presented by Michael Harris, Air-Cure Inc, Minneapolis, Minn, at the American Society of Mechanical Engineers (ASME) 1998 *International Joint Power Generation Conference*. (For information on this year's meeting, see p 57).

Auto-ignites

The higher propensity for spontaneous combustion of PRB coal, compared to eastern and midwestern bituminous coals, represents the greatest threat to coal-handling-system—and personnel—safety. A combination of high moisture and high volatiles content results in this condition and affects the collection system in three areas: collector housing design, dust disposal, and duct design.

First, the collector housing must be vented to handle a rapid rise in internal pressure. The National Fire Protection Assn (NFPA) Guide 68-1994 provides vent-sizing criteria. Air-Cure has used a

round, high-strength enclosure for the dust collector as defined by NFPA. The explosion vents have a frangible material holding a metal door to withstand the system fan suction, but that bursts open at the appropriate internal design pressure. This type of door provides a stable burst characteristic over time, and thus a higher reliability, than a design using mechanical means for securing the door.

The use of these pressure relief vents assumes the collector is located outdoors; however, many dust collectors on existing powerplants are not. Indoor pressure vents must be ducted to the exterior of the plant. But this may be impractical if the pressure-vent duct distance is greater than 3 meters, because most existing dust collector housings cannot withstand the backpressure during venting.

A fire protection and suppression system that meets NFPA Standard 13-1996 should be incorporated into the housing design. A dry-pipe precaution deluge system with fusible links on the sprinkler heads, as defined in the standard, has been one choice. Damage to a properly designed collector housing should be minimal during a rapid pressure rise, but the heat from a fire will distort metal. The sprinkler system will minimize overheating. In Air-Cure's experience, all cases of PRB-dust-collector housings damaged beyond repair by fires were caused from lack of fire water.

Another important dust-collector feature is complete static electrical grounding of the housing, particularly the filter media and its wire supports. The passing of air-borne coal dust over polyester filter media

Shown above: Associated Electric Co-op's Thomas Hill station

has sufficient triboelectric gradient to induce a charge.

Coal dust accumulations in the hopper are the most frequent cause of dust collector fires. Storage of coal dust in the hopper is not recommended. In addition to promoting spontaneous combustion, it also increases the available fuel if a fire from another source occurs.

The NFPA Standard 120 requires a minimum acceptable duct design velocity of 4500 ft/min. Most existing systems do not meet this standard. Lower velocities will result in potential accumulations, especially when moisture is present and the dust becomes "sticky." In addition to velocity, any transitions or tapers, clean outs, dead-end caps, or hoods which allow coal dust to accumulate should be re-engineered.

Only a small amount of dust in the right conditions is required for spontaneous combustion. A fire in the ductwork will eventually propagate to the dust collector where the fire system monitor will detect problems via the thermal sensor. A CO monitor can provide a means of early detection which can alert plant personnel before a fire occurs.

Moisture

In general, PRB coal has between 20 and 30% water compared to 10% for a midwestern bituminous coal. The presence of water in vapor form will not pose problems in the dust collection system until the dew point is reached. Dew points in the dust collection airstream generally occur

because of changing weather conditions, space heating of coal handling structures, or differences in temperature of the coal versus the ambient air.

Virtually every collection system the company has encountered has experienced some problems. First, filter media, including filtering velocities, are affected by moisture. Next, if the outdoor temperature is below freezing, ice will form on the collector walls and hopper slopes. Sublimation from air movement will remove ice from the walls if the dust filter remains operational. Ice on the hopper slopes will impede flow and cause duct accumulations. We recommend enclosing all outdoor hopper surfaces and indirectly heating the hopper slope by heating the space around the hopper.

Ductwork is also affected by the presence of moisture. The ductwork routing should be designed to be self-draining towards the hoods or dust collector.

More fines

PRB coal is characterized by the quantity of fine dust which impacts the dust collector, duct design, and dust disposal method. The dust collector must handle a continuous load of 10 grains/ft³ and a peak of 20 grains/ft³. Air-Cure has used a

cyclone to route air to the filter media which directly impacts the filtering velocity. A low concentration of dust may permit a velocity of 6 ft/min through the media while a high concentration would require a velocity in the range of 4 ft/min.

The type, placement, and size of hoods is critical to collecting high quantities of coal dust. While NFPA standards require a hood area of not less than four times the duct area, in many instances a hood area of eight times the duct area is appropriate for capturing "float" dust.

Removal of dust from the filter, and subsequent disposal, will determine the amount of re-entrainment which occurs at the next

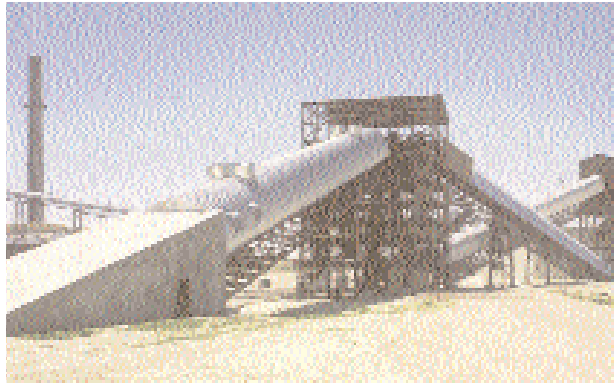
transfer point in the coal handling system. There are two good techniques for controlling dust from conveyor transfers. Pneumatic transfer avoids re-entrainment because dust does not return to the belt. The conveying of fine dust down a 4- to 6-in. pipe up to 1000 ft long allows removal of dust from the collection system and separate conveying of the dust to a plant silo, yard silo, or crusher surge bin. There, a mechanical separator deposits dust and vents the conveying air to a local dust collector.

De-dusting the fine coal dust is another method of disposal. Fine coal dust does not mix readily with water, so a high-speed pin mixer is used to accomplish the de-dusting.

No additional chemicals are used. This agglomeration process can be used below one filter or in combination with pneumatic transport so one unit can serve several dust collectors to reduce the airborne dust concentration in the silo receiving the coal dust.

The agglomerated dust should not be placed on an empty conveyor belt, as it can be very sticky, nor in a conventional screw conveyor. Agglomerated coal dust must be placed on top of coal on the belt.

Edited by Cate Jones



Coal conveyor shown is at the Pawnee station in Colorado