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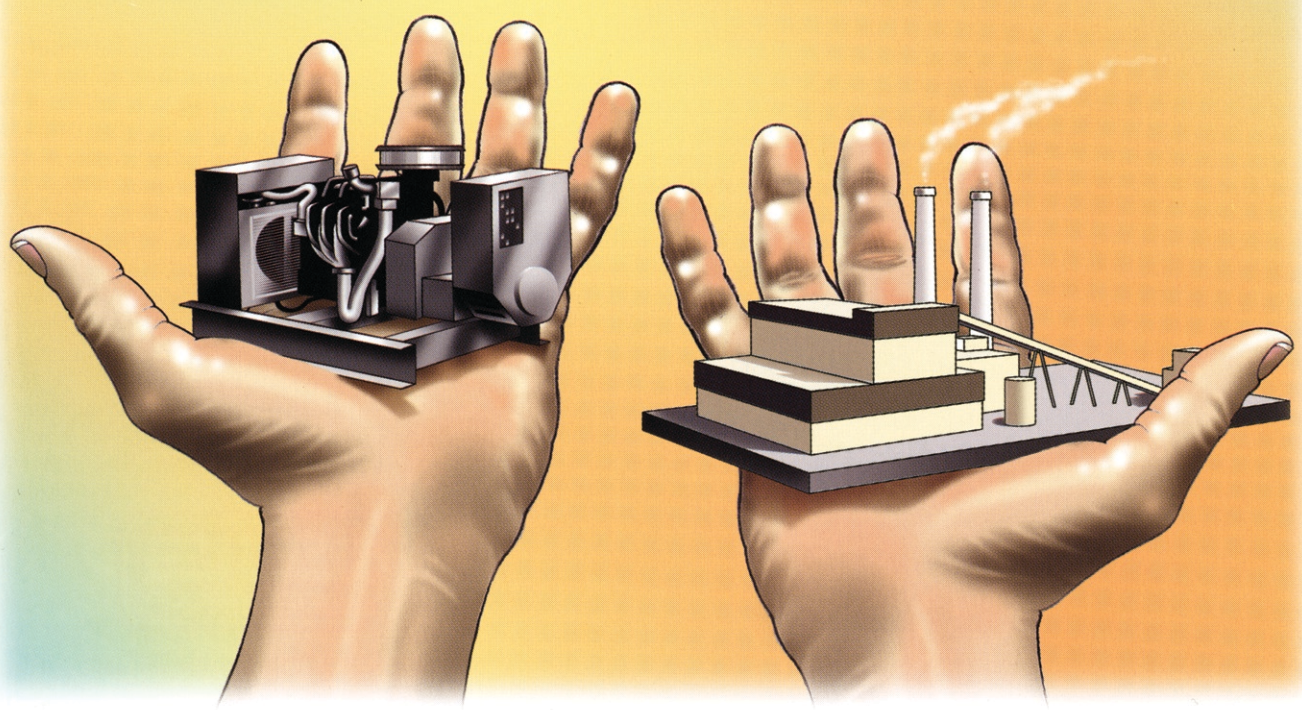
Reducing Airheater Leakage Boosts Output and Availability



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UPDATE

REDUCING AIRHEATER LEAKAGE BOOSTS OUTPUT AND AVAILABILITY

Even the most seasoned power plant managers may not fully appreciate the extent to which air preheater function affects power plant performance. Nor do they likely realize how many elements of a power plant are affected by poor preheater performance.

Even though many plants record air heater leakage through their performance monitoring systems, the recorded leakage rates are usually grossly underestimated.

The very nature of seal leakage results in most leakage occurring very close to the ductwork walls, a place where O_2 monitors and flow and temperature sensors are rarely located. These instruments, although critical for assessing air heater leakage, are generally installed in the central areas of the ductwork, a place where leakage will not be detected unless the instruments are located 6 to 10 duct diameters downstream from the source of the leak.

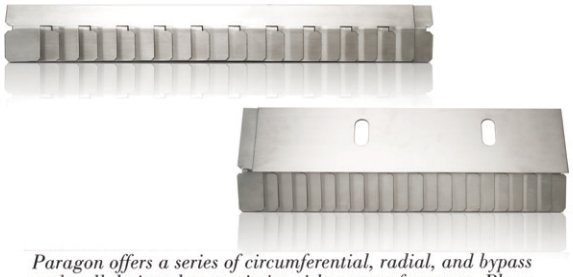
Air preheaters are used in virtually all gas, oil and coal-fired utility-scale power plants (except combined-cycle units). By far, the most common type of air preheater used in power plants today is the rotary regenerative air preheater. The rotary regenerative air preheater is essentially a rotating heat exchanger that captures heat from flue gases exhausted from the boiler, then rotates the heated portion of the heat exchanger into the inlet (cold) side of the boiler air stream where the captured heat is released to warm (preheat) the incoming combustion air. This process increases the overall efficiency of the power plant by about 10 percent.

An often neglected part of air heater performance is gas leakage that occurs through the sealing system dividing the hot and cold sides as the airheater rotates at 1 to 3 rpm. The rotating wheels on air heaters are subject to huge differential temperatures from hot side to cold side, in the range of 400 F with each rotation. This end-to-end differential temperature causes the wheel to actually bend during rotation. Considering that air heaters in modern boilers exceed 50 feet in diameter, these large differential temperatures can cause the wheel to deflect as much as an inch, up or down, with each rotation.

Optimal air preheater performance requires that the hot and cold sides of the air heater be properly sealed to prevent cross-air leakage that negatively affects performance. The existence of the cyclical thermal deflection that occurs in rotary air heaters, however, makes sealing especially difficult. In fact, many plant operators have learned to live with leakage rates greater than 20 percent of the total air moved by the fans.

For the most part, plant operators tend to focus on the deterioration and plugging of the heat exchange element in air preheaters, which leads to increased pressure drop and increased demand on forced draft and ID fans. In many cases, the pressure drop can become so great that the fans cannot move enough air through the preheater to sustain full load. This is especially common during summer months when warm ambient temperatures thin the incoming air, placing a greater demand on boiler fans.

What is often overlooked, however, is the effect of air preheater leakage on overall power plant performance. In today's power environment, this problem is worsened by the addition of SCRs, baghouses, ESPs and scrubbers, all of which increase overall pressure drop through the system.



Paragon offers a series of circumferential, radial, and bypass seals, all designed to maximize airheater performance. Photo Courtesy of Paragon Airheater.

Reducing leakage from preheaters can lead to dramatic increases in unit efficiencies and increases in output. John Guffre, lead engineer for Paragon Airheater, has seen one plant go from 25 percent airheater leakage with standard seals to 12 percent airheater leakage with Paragon's Duramax seals. In another instance, seal replacement restored 20 MW of lost generating capacity to a 175 MW plant.

"There is nothing wrong with preheater designs," says Guffre. "Air heaters generally leak about 20 percent due to the nature of their rotary regenerative design and because they are so large in today's typical power plant. Better seals, however, can boost performance significantly."

Paragon makes replacement parts for heaters and preheaters and manufactures seals for pre-heaters. "Improved seals are the best way to control and minimize leakage," says Guffre. In addition to emission control equipment, issues that impair preheater performance include fuel switching, blending of lower grade fuels, such as PRB, and the demands of today's power marketplace that force units to run in different modes than those for which they were originally designed.

For units that burn higher sulfur coals, less cold air leaking into the exhaust stream keeps the exhaust ductwork from cooling below the sulfur dew point, thus keeping this part of the plant out of the "corrosion zone." Western coals demand greater primary airflow. Burning them in a plant designed for eastern coal can exceed the existing fan capacity. Any reduction in airheater leakage is effectively an increase in fan capacity. In some cases, a plant may be able to avoid the heavy cost of replacing fans, or installing booster fans, when switching to PRB coal.

Spring season cycling puts a great deal of stress and wear on seals, leading to reduced efficiency during the summer peak generating months. Paragon's spring-like seal design is much better suited to maintaining a tight seal even after prolonged cycling.

"Five MW lost due to leakage is 5 MW less to sell," says Guffre. "In the summer, when you can get $100 to $200 per MWh and your plant is running 20 to 25 MW short, this could equate to $1 million to $1.5 million per year for a 600 MW coal-fired plant, either in terms of lost sales or additional fuel costs or a combination of both. Even if you don't lose the sales opportunity, you could still be using a significant amount of power to operate fans at a higher level, thereby eating up more net power due to extra auxiliary power use." PE

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