Case study

Biomass Plant, Sangüesa

The Sangüesa Biomass Power Station in Sangüesa (25 MW), in Northern Spain, operates with a single size 21 air preheater. The station was experiencing repeated problems with fouling, and Howden engineers were asked to investigate.

Matching heat exchanger element design to the prevailing conditions of the plant, in particular the fuel used, is essential to efficient performance and increased availability. At Howden, we have developed a range of element profiles, materials and coatings designed to offer optimum longevity and cleanability in every situation.

The challenge

Sangüesa is a biomass power plant, fuelled by burning straw. This tends to leave a high proportion of unburned residue and ash that settles and mixes at the bottom of the boiler, and some of this mixture is inevitably drawn into the air preheater. This leads to clogging of the air channels through the heater elements, and as a result the plant was experiencing reduced availability. The problem was becoming steadily worse, and we were invited to find a way of remedying the situation.

The solution

We found that the air preheater was fitted with DU heating elements profile in both the hot and cold layers. The DU design offers excellent thermal exchange but can be prone to clogging if used with high-residue fuels.

We carried out a full investigation of the conditions and demands at the plant, including an assessment of the combustion processes, and undertook a modelling exercise using our specially created simulation software. This uses the extensive data we have collected during wind tunnel testing of different element profiles, and combines it with specific information about the operating conditions, including the fuels used and the temperatures, pressures and air flow involved. The software allows us to predict, with great accuracy, the behaviour of the equipment under actual operating conditions.

The results demonstrated that by replacing all of the DU profile elements with our HC Element™ design the cleanability of the heater was greatly enhanced and fouling reduced. With the new profile configuration the targeted increase in gas outlet temperature and improved pressure drop was reached (Figure 1). Most importantly, it had a marked effect on availability, allowing the plant to stay operating for much longer periods and delivering the outcomes that the operators sought.

	Gas Outlet Temperature	Pressure Drop Gas Side
Original DU Profile	137°C	1.33 kPa
New HC Element™ profile	142°C	1.12 kPa

Figure 1: Predicted operating condition with HC Element™.

Howden enamelled heating elements manufacturing.

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Air preheater fouling in biomass plants

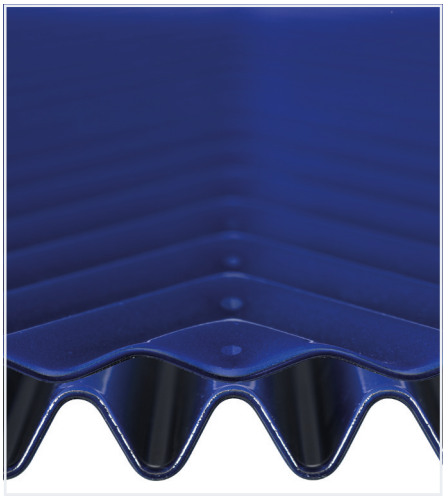
The problem of fouling, always present to some degree in coal or oil-fired power plants, is greatly increased in biomass plants. There are several factors that combine to exacerbate the problem. Condensation causes particulate matter to stick together and results in plugging. The combustion of straw creates large quantities of ash, some of which may form solid deposits on surfaces. Downstream of a Selective Catalytic Reactor, ammonia slip often contributes to the fouling. The consequence is an unacceptable pressure drop across the heater.

HC Element™

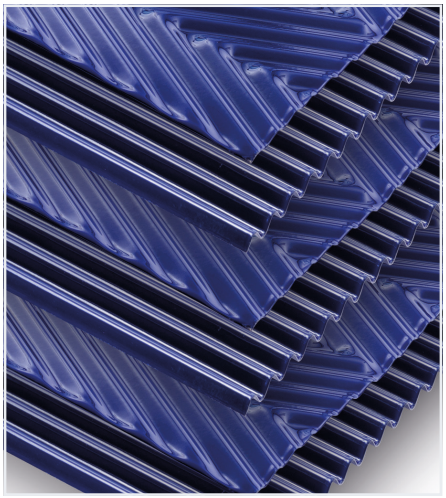
The HC Element™ family of element profiles is the result of extensive laboratory research and testing. The design combines straight and specially shaped corrugations into a herringbone pattern which not only demonstrates a greater resistance to fouling and plugging, but also offers greater cleanability with either steam or high pressure water.

The key features of the HC Element™ design include:

- An advanced symmetrical design that results in all flow channels being equal in area.
- Elimination of skew flow, either within each channel or across the whole unit.
- Reduced fouling due to the uniform velocities across the whole unit and the absence of pinch points.
- A ratio between channel size and corrugation height that produces sufficient turbulence to minimise fouling, optimising the balance between heat transfer and pressure drop.
- High element stiffness, which combines with supported packing to provide exceptional resistance to damage from soot blowing.
- A high-compression element packing arrangement that provides additional support points, to prevent cracking and fatigue and maximise element life.
- A material specification chosen to complement the ease of cleaning while the unit is in normal operation.
- High resistance to corrosion.



HC Element™.



HC Element™.

The new HC Element™ aerodynamically closed design, reduced the fouling and increased the availability of the regenerative rotary heater.