

Effective burner design reduces emissions to a minimum

Low NOx firing for Germany's largest flame-tube boiler

Something has been achieved that even experts at first thought impossible : thanks to ingenious internal flue gas recirculation, combustion equipment manufacturer Pillard has brought the NOx emissions of the burners of a large-water-space boiler clearly below 100mg/m³.

Pillard Feuerungen GmbH of Taunusstein in Germany was able to secure a contract of a special sort last year. In May Omnical GmbH of Diethöhlzthal commissioned the combustion equipment manufacturer to deliver a burner system to fire a two-pass double-fired flame-tube boiler. This large-water-space boiler with a thermal output of 34.5MW is the first and largest built in Germany to meet the EU's new pressure equipment directive.

The two-pass double-fired flame-tube boiler, with a downstream economiser and exhaust gas noise damper, replaces a forty-year old boiler, and supplies process steam for the two fine paper machines and a corrugated board machine at the Schöllershammer paper mill in Düren. The new boiler is designed to have a steam generating capacity of 50t/h at a working pressure of 10 barg. The fuel used is natural gas with a calorific value of 9.29 kWh/Nm³.

The timetable for producing the burner installation was as much a challenge to Pillard as the technical parameters. The firm was given only ten weeks for the preparatory work and manufacture of the combustion equipment. But the combustion specialists stayed cool despite the time pressure. Staff were able to set up the burner installation by the date agreed, in July 2000 - and in less than three days.



Automatic internal flue gas recirculation



The contract covered manufacture, erection, commissioning and service trials for the installation. Its principal components are :

- two GRC LONox Flam type third-generation burners
- a natural gas armature rack
- a combustion air fan
- a frequency converter
- the combustion management system, and
- natural gas and combustion air connecting conduits.

The GRC LONox Flam third generation burner developed by Pillard is a low NOx gas burner which is specially appropriate for use in flame tube boilers because of its low flame dimensions. With this type of burner the use of the kinetic energy of the incoming combustion gas creates an automatic internal recirculation of flue gas. This concept allows the achievement of extremely low NOx emissions. The kinetic energy of the combustion gas streaming through lances and nozzles into the combustion chamber creates internal flue gas recirculation; combustion is in consequence smooth while the partial pressure of oxygen remains low. Swirl and impulse are determined by the choice of burner head. Combustion gas passes through the gas distribution ring to the gas lances and is led from there to the ejection system. To achieve the interaction of the flow of flue gas with the greatest possible surface of the individual flames, the gas nozzles are arranged so that alternate nozzles have differing outputs.

The flame is stabilised by a central gas lance

The recirculation ports positioned on the air guide ring suck in flue gases on the injection principle. The gas impulse of the gas lances carries the flue gases back to burn again. The combustion air divides into a primary and a secondary component. Primary air is taken into the combustion chamber through a perforated jacket and the flame stabiliser. Secondary air is ejected through nozzles, with a high impulse.

The way the ejection system is constructed, and the differing ejection impulses of the gas and air components create an intense mixing of air and gas. This flammable mixture is lit by the pilot burner. A central gas lance, located at the heart of the burner, stabilises the flame in all load ranges. This special construction feature, taken with the well tried GRC ejection system, guarantees reliable ignition at all load levels, even under the most extreme combustion chamber conditions.

The two Pillard burners face-mounted on the boiler described are run in parallel, with the same output. Gas is supplied via a common safety armature rack with flow measurement. A speed-controlled radial fan supplies the burners with combustion air via a Y-tube. A furnace management system (FMS) tested by TÜV (Germany's Technischer Überwachungsverein - Technical Supervision Association) controls the burner and manages adjustments in the fuel/air mixture.

The GRC LONox Flam burners, with their low emissions, are persuasive. Under all load conditions measurements show less than 80mg/m³ NOx and 10mg/m³ CO₂ for an oxygen content of 3%.

This outcome is safely under the maximum emission value of 100mg/m³ NOx to which the manufacturer was committed. Pillard has proved with these values that plant built in this way with internal recirculation makes low-emission operation possible.