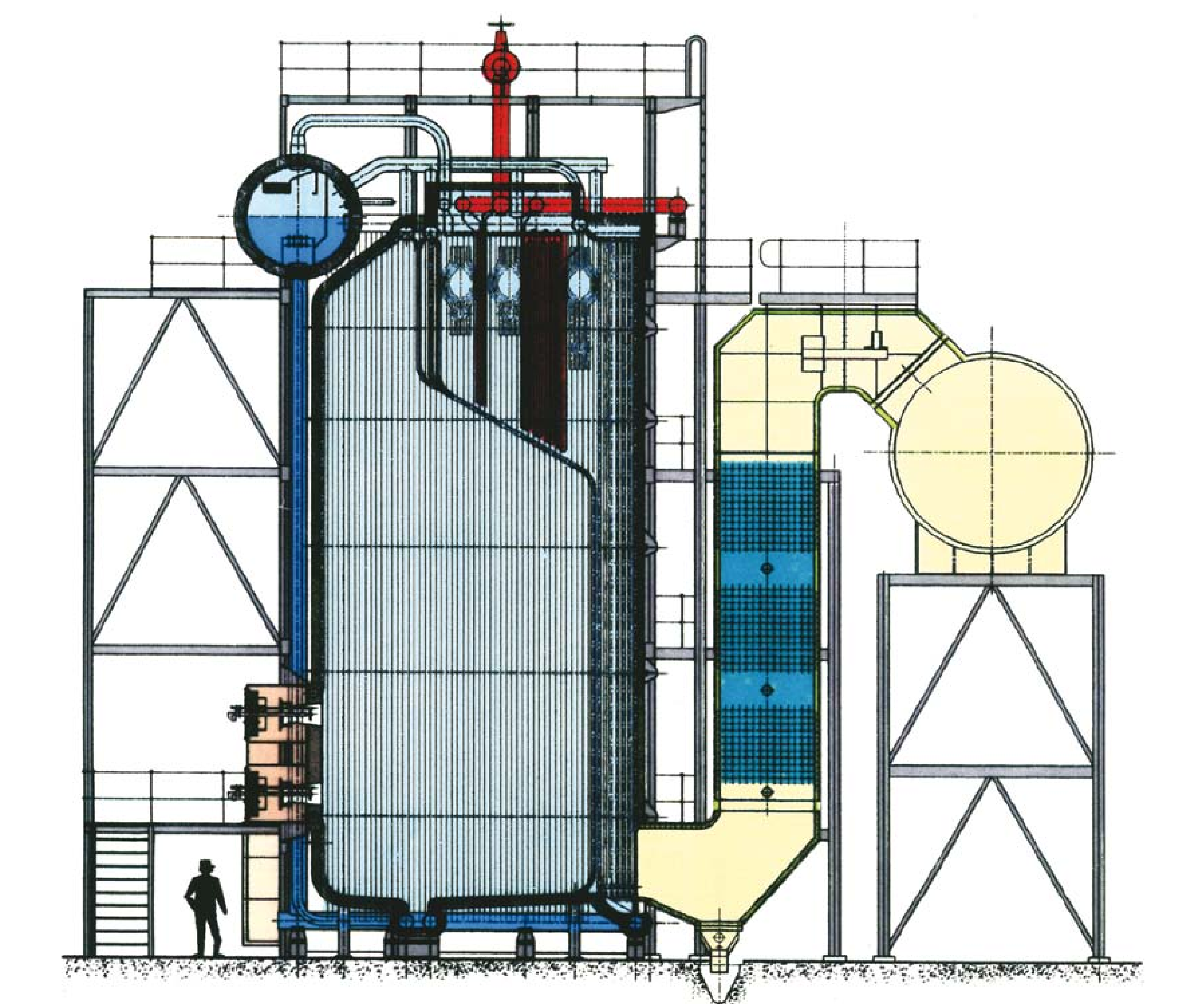

Features

- Welded wall combustion chamber
- Vertical generating bank to accommodate dirty fuels
- Rigid pipeframe support – no external steelwork
- 2-Stage controlled superheater
- Pre-separation of water & steam
- High steam purity
- Single drum with few penetrations
- Rapid start-up and load changes
- Extended surface economiser
- Drum type feedwater heater

Design Data		Oil	Gas
Evaporation - MCR	t/h	100	100
Evaporation - 4 h peak	t/h	120	120
Steam Pressure	kPa	4 150	4 150
Steam Temperature	°C	400	400
Feedwater Temperature	°C	145	145
Final Gas Temperature	°C	202	208
GCV Efficiency	%	86,0	82,9
NCV Efficiency	%	91,2	90,5

Fuel (as fired)		Oil	Gas
Molecular Mass		N/A	23,4
Viscosity @ 60 °C (fob)	cSt	180	N/A
Viscosity @ 80 °C (fob)	cSt	50	N/A
Viscosity @ 80 °C (vis res)	cSt	12 000	N/A
Viscosity @ 100 °C (vis res)	cSt	2 600	N/A
GCV	kJ/kg	41 200	44 400
NCV	kJ/kg	39 150	40 650

CASE STUDY No.26
120 t/h Corner-tube Refinery Oil- / Gas-fired Boiler

john thompson

ACTOM

JOHN THOMPSON
120 t/h Corner-tube Refinery Oil- / Gas-fired Boiler

Background

John Thompson is a member of the Echrohr boiler group which consists of a limited world wide circle of renowned and selected boiler manufacturers. Through the close co-operation of the members of the group, directed and advised from the Eckrohr centre in Berlin, a natural circulation boiler has been developed which enjoys wide popularity. This popularity is a direct result of the technical advantages of the boiler, and of the advantages offered by the Echrohr boiler group itself. Echrohr boiler development is continuously advancing and incorporates the latest innovation in boiler design, construction and environmental technology.

In 1996, Caltex Refinery, Milnerton, RSA placed an order with John Thompson for the supply and installation of an Oil and Gas Fired Watertube Boiler as part of the Refinery upgrade project. During negotiations much emphasis was placed on the environmental aspects and the boiler was designed to comply with European standards. The unit was commissioned in 1998 and successfully attained all performance and environmental guarantees.

Water Circulation System

The Corner-tube Boiler differs from the usual natural circulation boiler due to its characteristic water/steam circulation. This circulation takes place partly through the drum and its downcomers and partly through the recirculation tubes to the lower headers, with a pre-separation of steam occurring in the upper headers.

Erection of furnace front module.

The mixture of steam and water rising in the heated tubes enters the horizontal headers in which the water and steam is pre-separated. The steam flows to the drum, primarily through the discharge tubes, and also to some extent through the longitudinal headers.

However, only part of the water circulates through the drum, the other part is supplied directly to the distributors, through the return flow tubes, to enter the heating surfaces positioned some distance from the drum, providing a high degree of flexibility in design particularly when positioning convection heating surfaces.

Furthermore, due to the pre-separation of steam and water, a better steam quality can be attained, because only 40–60% of the boiler water circulates through the drum. Due to the lower quantity of water circulating via the drum and the pre-separation of steam, the separation of steam in the drum is easier and hence steam quality is increased.

Since all the horizontal collectors are connected to the drum at the normal operating level, and since there are no riser tubes ending above that level, the water circulation, when starting up the boiler, is very intensive. The separation of the steam from the water before entering the drum contributes decisively towards a reliable and rapid water circulation.

The large diameter unheated downcomers ensure a reliable water circulation. In cases of heavy load fluctuations, accompanied by sudden decrease in pressure, the downward flow through these downcomers is not disturbed by the upward flow of steam bubbles which would normally result from these pressure variations.

Because of the pre-separation of steam in the corner-tube system and a generously proportioned steam drum, a very high steam quality is achieved with only simple internals.

An extremely important safety feature of the boiler is that the steam drum is totally unheated so that should a low water condition occur, there is no danger of overheating the drum.

Combustion Equipment

Nitrogen Oxides (NOx), arise from two sources in fossil fuel fired combustion systems. These are the nitrogen contained in the fuel and the nitrogen in the air required for combustion of the fuel.

The atmospheric nitrogen reactions are strongly temperature dependent and can be minimised by keeping the flame temperatures below 1500 °C.

The fuel nitrogen NOx formation reactions are dependent on the Nitrogen level in the fuel and the stoichiometry of the combustion system. Reaction time is also an important factor and hence combustion chamber sizing is an important consideration.

By controlling the rate of mixing of the fuel and combustion air, the burner design is adapted to minimise the formation of NOx.

In order to reduce the NOx levels, frontwall burners were selected which feature controlled mixing techniques usually described as staged combustion. This design produces fuel-rich zones, which inhibit NOx production from nitrogen contained in the fuel and also reduces peak combustion temperatures which diminishes NOx production from nitrogen in the air.

The Boiler Construction

Efficient heat transfer is achieved entirely without baffles which would otherwise lead to a build up of deposits and consequent maintenance problems.

One of the main features of the Corner-tube Boiler is the 100% welded construction. This gives an extremely rugged and reliable construction without the problems associated with large number of expanded tube connections in conventional boilers.

Overly quick load changes on conventional boilers lead to very high thermal and mechanical stresses on these expanded joints and hence to the well known cracking of the ligaments. Having an all welded construction allows close pitched tube walls throughout thereby reducing refractories to a minimum. This considerably reduces the maintenance requirements on the boiler.

The Furnace

The furnace is designed as a tall fully watercooled unit of welded wall construction from seamless tube. The panel configuration is 76,2 mm OD tubes on 100 mm pitch. The furnace wall construction incorporates buckstays at several levels.

Heating Surfaces

In order to obtain a high boiler efficiency throughout the load range and over extended periods, the heating surfaces are designed for moderate velocities and draught loss. To this end well spaced tubes are used to avoid any appreciable reduction in heat transfer due to normal soot or ash accumulation. The superheater chamber is inclined downwards at 30° in order to facilitate cleaning. Soot that does form on the tube banks is easily removed by the sootblowers provided.

The generating bank is of the parallel flow longitudinal tube design which is much less prone to soot and ash accumulation than cross flow designs, and can also be easily cleaned.

The bottom headers of the generating bank are configured in a staggered arrangement to facilitate any soot removal.

Superheater

The Superheater is a pendant non-drainable design of two stage configuration. It is located in a separate inclined pass at the furnace exit behind the screen, which shields the superheater elements from direct furnace radiation and thereby minimises metal temperatures.

Heat Recovery Equipment

In order to meet the required high thermal efficiency, the unit is fitted with a three bank extended surface economiser. The performance was optimised by arranging the economiser with two banks in parallel flow and one bank in counter flow. Corrosion in the economiser is minimised by pre heating the incoming feedwater by means of a drum type feedwater heater.

The finished product.

John Thompson a division of ACTOM (Pty) Ltd.

Cape Town (Head Office)	info@johnthompson.co.za	Tel: +27 (0)21 959-8400
Johannesburg	infojhb@johnthompson.co.za	Tel: +27 (0)11 392-0900
Durban	infodbn@johnthompson.co.za	Tel: +27 (0)31 408-9700
Cresta (Air Pollution Control)	infoapc@johnthompson.co.za	Tel: +27 (0)11 478-0456

www.johnthompson.co.za