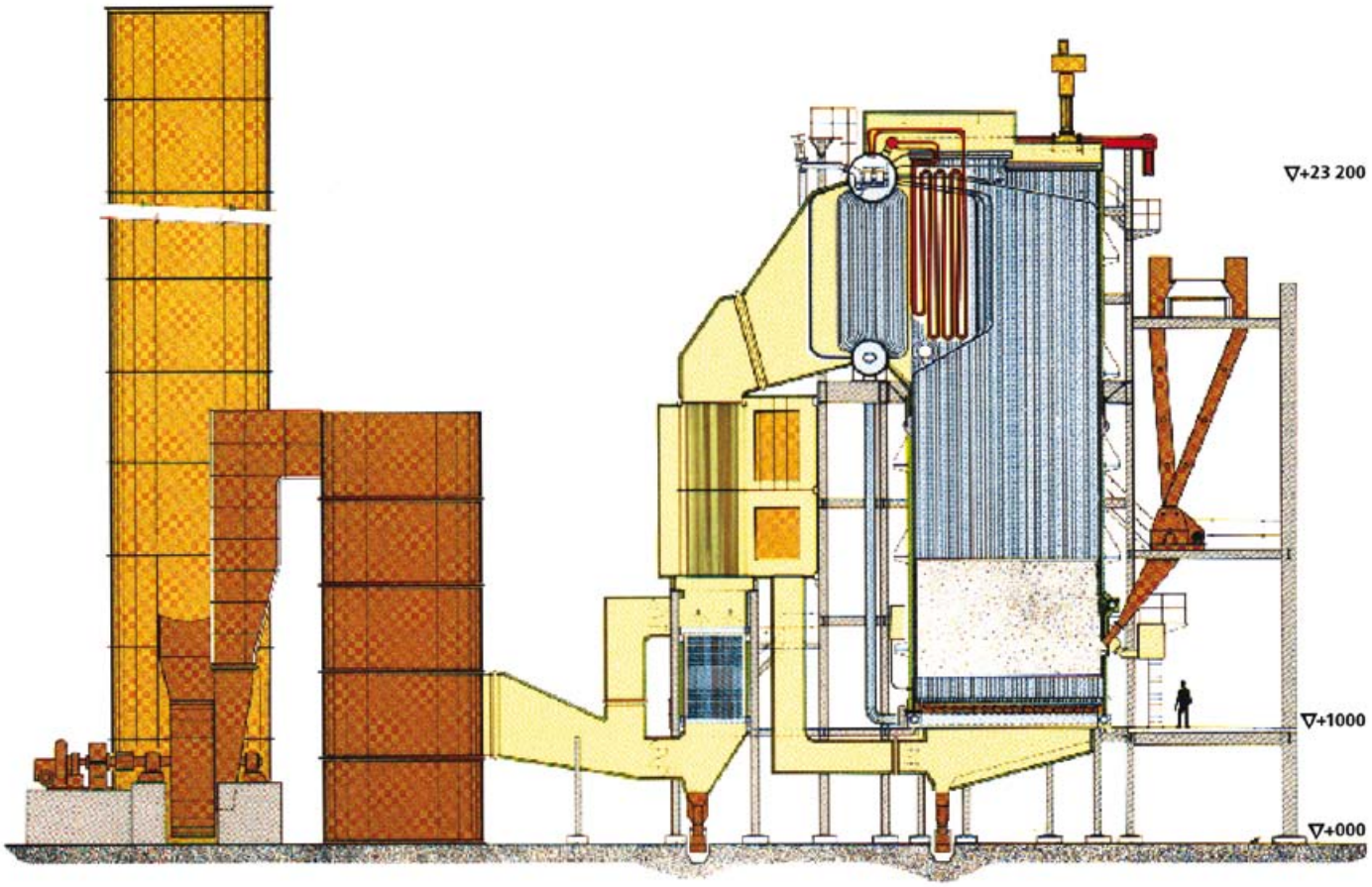

Features

- Welded Wall Combustion Chamber
- Dump Grate Stoker
- Single Pass Mainbank
- Pendant Superheater
- Girth Support
- Parallel Flow Airheater
- Mild Steel Bare Tube Economiser

Design Data

Evaporation	t/h	204
Steam Pressure	kPa	3 100
Steam Temperature	°C	400
Feedwater Temperature	°C	110
Final Gas Temperature	°C	200
GCV Efficiency	%	65,0
NCV Efficiency	%	83,6
Installed Power	kW	2 534
Absorbed Power at MCR	kW	1 345

Fuel (As Fired)

		Bagasse
Moisture	%	53
Ash	%	3,1
Brix	%	1,85
GCV	kJ/kg	8 550
NCV	kJ/kg	6 640

CASE STUDY No.12
204 t/h Single-pass Bagasse-fired Boiler

John Thompson

ACTOM

JOHN THOMPSON
204 t/h Single-pass Bagasse-fired Boiler

Background

In 1981 Tate & Lyle Agri-business Limited, acting on behalf of the Transvaalse Suikerkorporasie Beperk placed an order with John Thompson Boilers for the supply of boilerplant and ancillary equipment as part of a programme to rationalize the production capacity of the Malelane Sugar Factory. When commissioned in 1983 the 204 t/h unit was the largest of its type in South Africa.

The project was handled on a turnkey basis with John Thompson supplying the boiler and boilerhouse, fuel handling system, pre-boiler plant, gas clean-up equipment and stack.

Bagasse Handling Equipment

Bagasse is fed from the Mill direct to a 1260 ton capacity store. A scratcher conveyor reclaims bagasse from the store after which it is elevated on an inclined belt conveyor to the 18,3 m level from where pneumatically operated ploughs direct it into eight 5m long chutes. Sensors in the chutes regulate the position of the ploughs. A low level sensor in each chute trips its respective bagasse feeder if the bagasse in the chute falls below a pre-determined level. This ensures that an air seal is maintained at all times.

Pre-Boiler System

Condensate and soft water are stored in an elevated 170 ton feedwater tank. Water from this tank is pumped to a 400 m^3/h John Thompson pressure deaerator operating at 110 °C. The deaerator is mounted on a 170 ton capacity storage vessel. A 450 kW electrically driven feedpump supplies water to the boiler. Space is available to install a second electrically driven pump to cater for a future boiler. A turbine driven feedpump which starts automatically in the event of low feedline pressure provides standby capacity.

Combustion Equipment

Eight 3 drum John Thompson variable speed, 2.2 kW DC driven, biomass feeders meter the bagasse to the boiler. Pneumatic distributors with adjustable deflector plates distribute the bagasse evenly over the grate surface.

The dump grate stoker is divided into 8 dumping sections. While most of the bagasse burns in suspension, the larger particles burn on the grate.

Each grate section is dumped periodically to remove the sand and ash deposited on it. Full load can be carried while sections are dumped consecutively.

The Boiler

The boiler is a single pass unit. The steam drum is 23 m above ground level.

The furnace panel walls are made of finned tubes welded together to form a gas tight enclosure. A non-structural refractory band is spragged onto the lower section of the furnace to stabilize combustion of wet bagasse.

Secondary air is introduced into the furnace at strategic levels to promote turbulence. The "furnace nose" acts as a baffle to provide further turbulence.

The grate is supported from ground level and the boiler is girth supported at mud drum level. The boiler expands downwards towards the grate where a combination of mechanical and fabric seals complete the enclosure. The upper portion of the furnace and convection bank are free to expand upwards. The girth support system carries the furnace mass. This load is transferred to the system through a series of pre-tensioned disc springs and hanger rods attached to the brackets welded to the panel walls at regular intervals around the periphery of the furnace.

Galleries and ladders are cantilevered off torsionally rigid box girders which form part of the main structural framework.

Superheater

Steam is dried in cyclone separators before flowing to a pendant non-drainable superheater, the high temperature elements of which are made of 1% Cr ½% Mo alloy tubing. Thermocouples are attached to the superheater tubes to monitor metal temperature during start-up and transient conditions.

Convection Bank

Gas velocities are kept below 15 m/s to reduce erosion in the single pass main bank. Tubing is swaged to improve drum ligament efficiencies whilst optimizing the heating surface.

Heat Recovery Equipment

The boiler is fitted with a parallel flow mild steel tubular airheater and a mild steel bare tube economizer. In both units operating metal temperatures are above the acid dew point. The economizer is fitted with on-load water washing equipment. A gas by-pass system allows the unit to operate in an incinerating mode.

ANCILLARY EQUIPMENT

Draught Plant

A single damper controlled 250 kW direct driven backward bladed forced draught fan blows combustion air through the airheater to the stoker plenum chamber. A damper controlled 110 kW direct driven radially tipped secondary air fan feeds cold high pressure air to the secondary air nozzles and the bagasse distributors.

Gas is exhausted from the system by means of a 1255 kW turbine driven forward curved, radially tipped, variable speed, ID fan. The fan is located after the wet gas clean-up plant which protects the impeller from erosion. The exhaust gases are discharged to atmosphere through a 40 m high gunnite lined self-supporting mild steel stack.

Gas Clean-Up Plant

The exhaust gases are cleaned up by twin venturi throat type scrubbers made of 430 stainless steel. The venturi throats are gunnite lined to minimize erosion. Automatically controlled adjustable dampers maintain constant pressure differentials in the venturi throats irrespective of load. Grit emission from the plant is below 150mg/m^3 at STP and 12% CO_2.

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

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