Case Study No. 14
Bagasse Fired Boiler Conversion

The Conversion Features

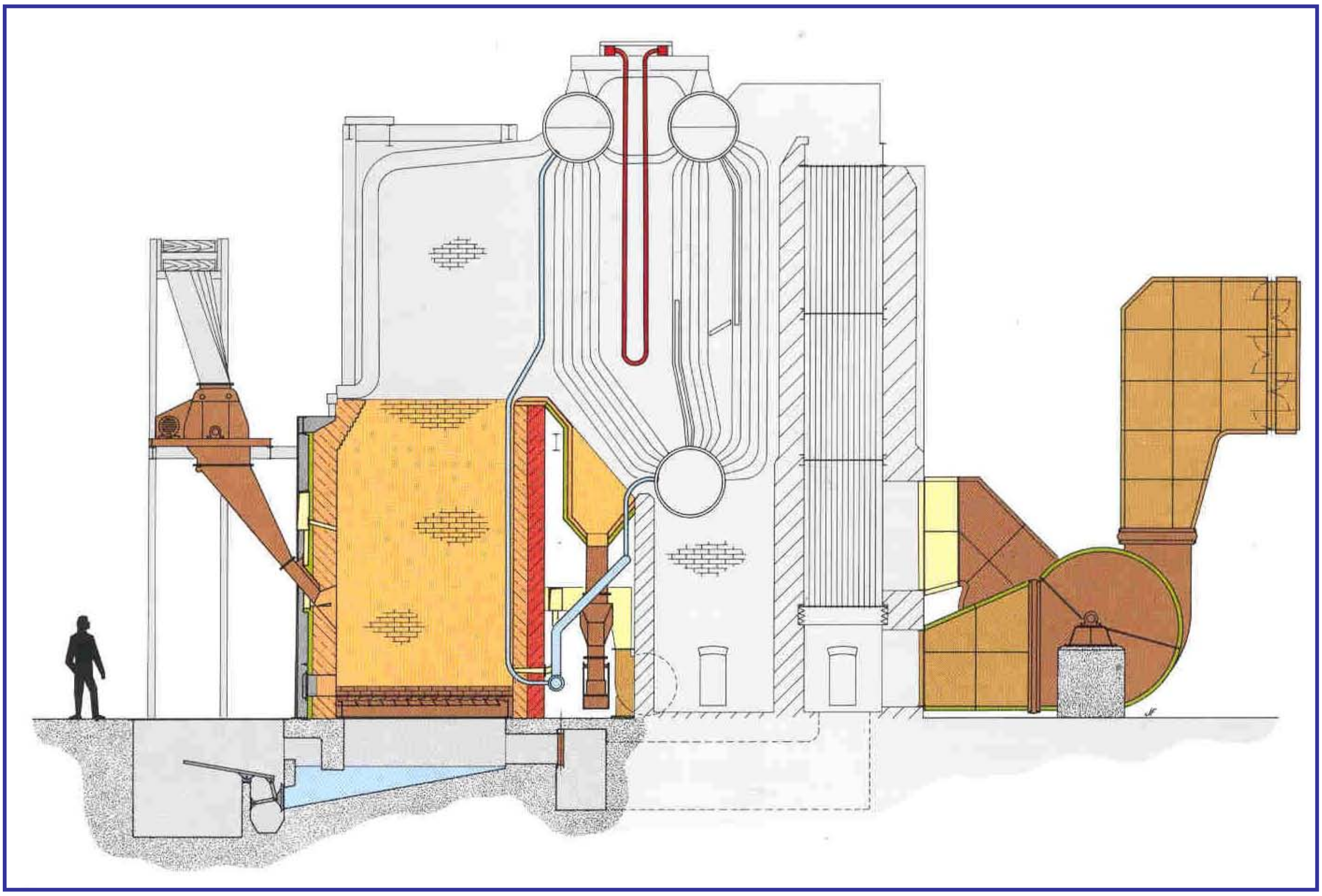
- Increased Output From 30 To 45 t/h
- Spreader Firing
- Mechanical De-Ashing
- Automatic Combustion Control

Design Data

Design Data		Initial	Final
Evaporation	t/h	30	45
Steam Pressure	kPa	2 070	2 070
Steam Temperature	°C	290	290
Feedwater Temperature	°C	80	80
Final Gas Temperature	°C	230	270
Final Gas CO_2 level	%	13	15
GCV Efficiency	%	63	62
NCV Efficiency	%	79	78
Installed Power	kW	135	306
Absorbed Power at MCR	kW	-	175

Fuel (As Fired)

Fuel (As Fired)		Bagasse
Moisture	%	50
Ash	%	2
Brix	%	2
GCV	kJ/kg	9 320
NCV	kJ/kg	7 440



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Boiler and Environmental Solutions

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BACKGROUND

In May 1985 Compagnie de Beau Vallon Limitèe, Mauritius entrusted John Thompson Boilers with a contract for improving the performance of the Stirling Boiler installed in 1958 at their Riche en Eau factory. Management wished to raise the capacity of the boiler to cater for increased throughput and to mechanise de-ashing. Modifications to upgrade the boiler from 30 to 45 t/h included the design, supply and delivery of:

- A modified furnace.
- A dump grate stoker.
- Bagasse feeders, spreaders and chutes.
- Extra furnace heating surface.
- Extra superheater heating surface.
- Larger draught plant.
- Hydraulic ash sluicing system.
- Hydraulically sluiced mud drum hopper
- Automatic combustion controls.

Plant and equipment was delivered in January 1986. This allowed the modifications to be installed by the Mill personnel in time for the new season, which commenced in June 1986. A John Thompson erection supervisor visited the site three times during the construction period to advise on erection methods and procedures. John Thompson personnel also supervised the commissioning.

COMBUSTION EQUIPMENT

An existing slat conveyor feeds bagasse to four John Thompson three drum, fibrous fuel feeders driven by 2.2kW motors through hydraulic variable speed couplings. Aircooled 316 stainless steel distributors with adjustable deflector plates distribute the fuel evenly over the grate surface. The chutes between the feeders and distributors are of 430 stainless steel.

The dump grate stoker is divided into four sections. While most of the bagasse burns in suspension the larger particles burn on the grate. Each grate section is dumped periodically to remove sand and ash deposited on it. Full load can be carried while sections are dumped.

Hydraulic power cylinders are used to dump the grate. Four trim dampers regulate the distribution of hot primary air to the underside of the grate.

FURNACE

The hearth furnace in Figure 1 was removed and a new refractory furnace was constructed in its stead to accommodate the dump grate stoker. Anti-slagging carborundum tiles and four large cast iron access doors were fitted at grate level.

The front of the furnace is double cased to provide a plenum chamber from which cold secondary air is supplied to the distributors and to a set of cast iron front wall secondary air nozzles. A further set of cast iron secondary air nozzles are contained in the furnace rear wall.

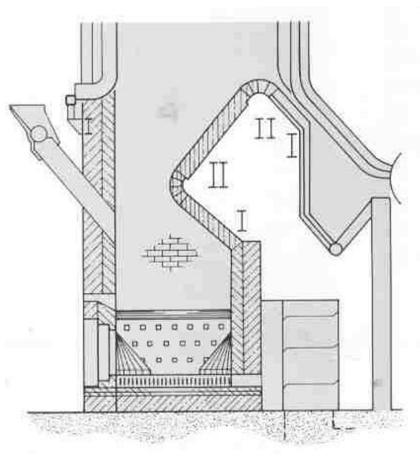

FIG 1: Hearth type Furnace prior to conversion.

PRESSURE PART MODIFICATIONS

Furnace rear wall heating surface was added to enable the unit to steam at the higher load. This was done by removing the first row of mainbank tubes and replacing them with a set of furnace tubes and replacing them with a set of furnace tubes running from a header located at grate level to the steam drum. Tubes from the mud drum were incorporated to feed the header. The new tubing and feeders made use of the tube holes which became available when the first row of mainbank tubes were removed.

Additional superheater tubes were added to maintain the required steam temperature. In addition a further superheater safety valve as well as a larger mainsteam stop valve were provided.

DRAUGHT PLANT

A single damper controlled 75kW direct driven, backward bladed forced draught fan blows combustion air through the existing airheater to the stoker plenum chamber. A damper controlled 18.5kW direct driven, radially tipped secondary air fan feeds cold high pressure air to the secondary air nozzles and bagasse distributors.

Gas is exhausted from the system by means of a 200kW turbine driven forward curved radially tipped variable speed induced draught fan. The fan is located after the airheater.

AUTOMATIC COMBUSTION CONTROLS

The master pressure controller senses deviations for the set pressure. A pneumatic signal from the pressure controller adjusts the amount of fuel and air fed to the boiler by varying the speed of the bagasse feeders and the induced draught fan turbine drive. The furnace pressure control loop adjusts the position of the forced draught fan damper to maintain constant furnace pressure.

MECHANICAL DE-ASHING EQUIPMENT

The furnace is fitted with a John Thompson hydraulic ash sluicing system. Ash is discharged into the water-filled sluice hopers by dumping each grate section consecutively. On de-ashing the grate, ash and water from each of the hoppers discharges into a concrete sluice through specially designed sluice gates. Dust and grit collected in the mud drum hopper is sluiced continuously through a special discharge basket into the main sluiceway. This de-ashing and sluicing system has proven to be highly effective.

OPERATING CHARACTERISTICS

The plant was commissioned as planned and has since steamed at 45 to 52 t/h. Steam pressure is maintained at ±3% of design. Steam temperature at MCR is within 10°C of design. Figure 2 shows a typical steam flow/pressure chart.

When re-evaluating the performance of the boiler a conservative view was taken of the effect which uprating from 30 to 45t/h would have on efficiency. This was calculated to drop from 79% to 78%. In practice less fouling takes place than was anticipated with the result that nearly 2% more steam is generated per kg of bagasse even though output was increased by 50%.

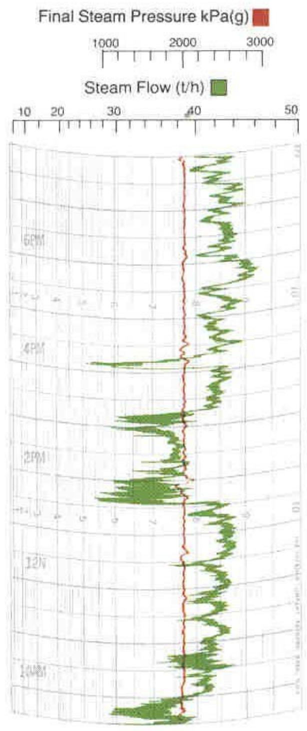

FIG2: Chart recorded during commissioning in June 1986 showing large load swings with constant pressure holding capability.

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