220 KTPA ZINC ROASTER
8.5 MW WHRB
950 TPD SULPHURIC ACID PLANT
Furnace Fabrica is one of the leading providers of Heat transfer and Recovery Solutions for chemical, fertilizer, metallurgical and petrochemical industry. Furnace Fabrica has long term experience and proven know-how in the field of combustion, heat transfer, refractories, corrosion and erosion processes – making Furnace Fabrica a reliable partner for your heat recovery solutions.

Furnace Fabrica has engineered and built numerous such systems for a wide range of industries. With technological support from well-respected industry leaders, today, Furnace Fabrica can engineer, fabricate and construct customized solutions as per today’s challenging process requirements. There are numerous successful turnkey installations to support our expertise in the field of energy recovery.

FF is one of the most tightly integrated turnkey supplier of sulphuric acid plants in the world. FF has vast experience in engineering and building elemental sulphur and off-gas based sulphuric acid plants. With this experience, FF is able to offer an efficient, reliable and one of the best waste heat recovery systems for sulphur based plants.

The sulphur component of various process (or waste) gases can be converted to sulphuric acid using one of the above processes; and the shell & tube type boilers are the most preferred and suitable boiler system for such applications.

The quality of the process gas is determined by the efficiency of the burning and reaction process in the reaction furnace. The burning of the raw material is carried out using multi fuel burners inside the refractory lined furnace.

The furnace is optimally designed taking into consideration various factors, mainly temperature, retention time, flame length, baffles, air-ports, expansion joints etc. These factors also influence the design of the boiler system. Thus the furnace – boiler combination is aptly named “heart of the plant”.

FF provides its proprietary furnace in combination with the shell & tube type waste heat recovery boiler system for elemental sulphur / claus process plants.

Depending upon the volume of gas to be handled, the water tube type boiler wall may alternatively be considered.
DESIGN FEATURES OF THE SHELL & TUBE TYPE BOILER:
Based on decades of experience in designing and manufacturing acid plants, FF has been able to identify the critical components of the WHRB system which contribute to its unique and reliable design.

Tube sheet:
FF uses the traditional tube sheet design and also the thin tube sheet design. The thin tube sheet design offers a lot more flexibility which helps in avoiding excessive stress generated due to differential expansion between the tube and the shell elements. The thin tube sheet also runs a little cooler during operations, thus improving safety and reliability.

Tube - Tubesheet Connection:
FF follows two different types of tube-tubesheet welding system. The traditional welding system as seen in the sketch is used for simpler boiler system which is operating under lower temperature and pressure and serves less critical applications.

The IBW system of welding as seen in the sketch is followed where process is having high inlet gas temperatures. With IBW, the risk of crevice corrosion is eliminated while also helping to run the weld joint cooler as it is in contact with water.

Cold Gas By-pass:
By-pass systems are frequently required in process plants to maintain the temperature of the outlet process gas. Traditionally, the hot by-pass system has been frequently used; but there are many metallurgical and refractory problems associated with the hot by-pass valve, thereby making it an un-economical and maintenance-prone system.

FF solves these problems using the cold by-pass approach, where the hot gases are internally by-passed through the boiler. The gases leaving the internal bypass are at least 35% lower temperature (as compared to the gases leaving the hot-pass valve). Due to these lower temperatures, FF has been able to avoid the frequent repairs and maintenance which affect the hot by-pass systems.

Castables & Ferrules:
Castables and ferrules are installed to insulate the tubes and tubesheet from the direct heat of the process. It is most important to use the right materials as majority of weld failures occur due to refractory damages. The right quality of refractory materials along with consistent maintenance monitoring shows improved campaign life of plants.

In traditional application, the ferrules are embedded in the tubesheet lining. This offers thermal protection at an economical cost. However, this increases the time required for maintenance activities.

A newer approach is to install solid head ferrules. This offers the lowest turnaround time as the complete ferrule can be pulled out and replaced without any surrounding damage or need for any castable dry-out.
Metallurgical process plants for processing of zinc, lead, copper, nickel, tin require different considerations for the design of waste heat recovery systems. The hot and sticky dust laden process gases from variety of metallurgical processes pose a challenge for the gas cooling and heat recovery systems.

Typical problems to be overcome in the design of these WHRBs are: high gas volume, high temperatures, high dust content, sticky dust conditions, variable gas compositions etc.

FF is able to provide (a) natural circulation systems, (b) forced circulation systems, and (c) combined natural – forced circulation systems. Wherever possible, natural and natural /forced circulation is provided to reduce power consumption and maintenance efforts. Finally, the choice of WHRB and its circulation system depends on the process and geometry of the furnaces.

FF designs and manufactures:
1) Membrane wall panels
2) Evaporator, Superheater and Economiser bundles
3) Rapping and Hammering systems
4) Steam drum, Feed water tank, De-aerator
5) Preheaters, Economisers, Superheaters equipment

Design Features of Water Tube Type Boiler:
This type of design is considered when the process calls for handling of high gas flow rates. This type of boiler offers all design opportunities to provide control of the gas outlet and steam temperatures.

These boilers feature (1) external by-pass (with and without refractory), (2) internal by-pass (straight through and with heating surface), (3) temperature control by waterside by-pass.

Case Study: FTB for 500TPD SAP at KCM, ZAMBIA

Gas Volume: 40,500 Nm³/h
Inlet Temperature: 1000-1050°C
Outlet Temperature: 380-425°C
Steam Generation: 25.5 T/h
Steam Pressure: 29 bar (g)
Steam Temperature: 400°C
Power Generation: 1.43 MW

A wide range of WHRB designs and systems are available from FF which meet the various process requirement of the non-ferrous industry – zinc, copper, lead pyrites etc.
SMELTING OF COPPER, LEAD ORES:

Smelting technology is a preferred route for the recovery of metals like copper, lead, etc. The temperature in this process is much higher in the range of 1000–1200°C. The gas generated is then sucked into the WHRB and cooled to the required temperature.

As per the requirement of the process, the cooling of the gases is achieved in a two stage channel – commonly called the uptake and downtake channel followed by a horizontal boiler.

As this is a pyro-metallurgical process, special considerations have to be given for dust handling. The dust generated in this process is molten at 1200°C, and as the gas cools, the dust starts solidifying and accumulation along the panel walls. Omega tubes are also used to prevent dust accumulation at the uptake mouth. Several hammering units are installed along the panel surfaces to dislodge the accretion on a periodic basis.

The flash smelting furnaces and the converting furnaces require horizontal type WHRB design. The geometry is similar to that of roaster boilers. This arrangement effectively prevents dust agglomeration as the reduced gas velocity allows the dust to fall freely.

ROASTING OF ZINC, PYRITE ORES:

Roasting of sulphidic ores of zinc, pyrites ores are done in fluidised bed roasters. FF has built numerous such roasters for zinc, pyrite ores. The WHRB is located downstream of the roaster. A sketch for typical arrangement is shown.

The hot roaster gases of 900-1050°C and with unusually high dust content are pushed into the WHRB and are cooled to 350-400°C.

The gases are cooled by the membrane panels and a series of evaporator and superheater bundles. The dust content in these gases are managed by the rapping and hammering system installed onto the panels / bundles.

FF supplies for such WHRB include (a) Cooling coils inside the roaster, (b) WHRB panels, (c) Evaporator and superheater bundles, (d) Steamdrum, (e)Economiser, (f) High-pressure piping, (g) Refractory lining.

Similar membrane wall WHR systems have been successfully implemented in numerous metallurgical, chemical and fertilizer plants.

Case Study: Copper WHRB at Sterlite, India
- Gas Volume: 90,000 Nm3/h
- Inlet Temperature: 1270°C
- Outlet Temperature: 375°C
- Steam Generation: 76 T/h
- Steam Pressure: 65 bar(g)
- Steam Temperature: 485°C
- Power Generation: 11.2 MW

Case Study: Zinc Roaster WHRB at HZL, India
- Gas Volume: 97,322 Nm3/h
- Inlet Temperature: 900 – 1000°C
- Outlet Temperature: 350 - 375°C
- Steam Generation: 52 T/h
- Steam Pressure: 40 bar(g)
- Steam Temperature: 400°C
- Power Generation: 8.5 MW
HEAT TRANSFER UNITS

ECONOMISER:
The economiser is an equipment which is used to remove excess heat of flue / process gases & preheat the water entering into the boiler system to improve the boiler efficiency.

The boiler feed water flows through the tubes & flue gases pass around the outside of the tubes - shell side. The cross flow between gas & water causes heat transfer. The economizer coils are high pressure equipments manufactured as per ASME and IBR standards.

SUPERHEATER:
A superheater is used to convert saturated steam or wet steam into dry steam to be used in steam engines or in processes such as steam reforming. FF has experience in fabricating coil type superheaters and stand-alone fired type superheaters as well.

HEAT EXCHANGER:
FF has long experience in the fabrication of heat exchangers. We have significant expertise in all types of heat exchangers – Gas/Gas type, Liquid/Gas type and Liquid/Liquid type heat exchangers. Most of our heat exchangers are used in highly corrosive processes like sulphuric acid.

PREHEATER:
FF is one of the leaders in design and supply of process gas preheaters. FF designed preheaters have been successfully commissioned in zinc, lead and copper plants.

FF has two special designs for the preheater based on plant process and layout. There is a traditional design with heater and exchanger combination (a) - requiring more space, while the other design is meant for very quick heat-up and has a smaller footprint.

The quick startup design (b) is very popular where the equipment is to be situated upstream in an off-gas based sulphuric acid plant. This type of preheater is also used when process may require frequent heat-up of the feed gas.
RENOVATION AND MODERNIZATION

We understand that the boiler system is the heart of any industrial plant. At FF we consider it our core responsibility to support the systems built and supplied by us for its entire lifespan. Regular checks and maintenance of the systems reduce the risk of sudden failure, thereby increasing the campaign life of the system.

Our in-house teams support our clients to resolve any difficulties on a SOS basis. The core responsibilities of our service business are:

**Maintenance:** FF team is keen to support the client with a maintenance plan and schedule tailored to the plant. Our service range from boiler casing checks, thickness measurements, corrosion checks, welding checks and weakspots in general which may require immediate attention.

**Modifications:** We understand that there are continuous changes in the operating conditions of the plants. Very often, new equipment are added to a system, which then necessitate that the old components of the system complement the new. Such changes require modifications, addition or deletion to the old components. FF is fully geared to understand the changes and make such modifications to improve the efficiencies of the overall system.

**Replacements:** It is a well-known fact that efficiency of equipment reduces with age and increased usage. We are well organized to support your emergency requirements as well as your replacement parts for the purpose of inventory management.

We provide the following equipment and spares on a regular basis:

- Membrane panels.
- Economiser and Superheater bundles.
- High pressure piping and fittings as spools.
- Mechanical and Pneumatic Hammering systems.
- Refractory (bricks, castables, ferrules, ceramic blankets) supply and application services.

FABRICATION FACILITY

**IBR | U | U2 | S | R | PED**

FF has been producing high pressure vessels since 1994. In 2008, FF established a state-of-the-art modern facility dedicated to the manufacturing of boiler equipment and systems in Gujarat, India. This workshop is located in the Kandla Special Economic Zone (SEZ), roughly 500 km north of Mumbai.

Kandla offers major geographical advantage for material sourcing, manufacturing & transportation. The workshop is located in close vicinity to two of the major sea-ports of the western sea coast of India – Kandla and Mundra; providing ideal logistical conditions.

The workshop has 4 well-equipped bays with total production area of 30000m² (7500m²-covered; 2500m²-open).

As required by facilities of such standard, the workshop is accredited by the Indian Boiler Regulation (IBR) and ASME (U, U2, S, R).

FF has also fabricated and supplied process equipments and pressure vessels under the Pressure Equipment Directive (PED) and is fully geared to obtain the CE mark for its manufactured products.