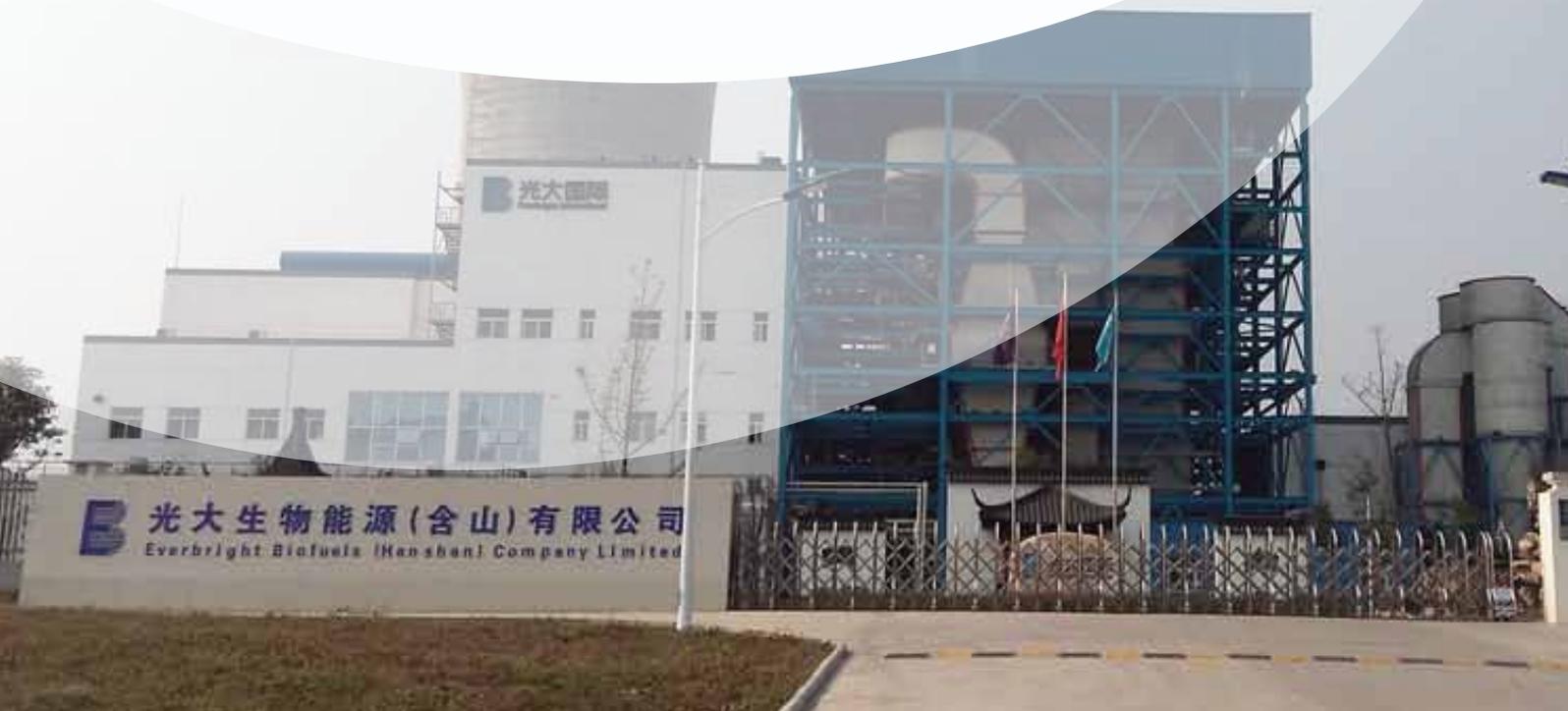




Advanced straw-fired power plant (Rice straw & rice husk)

Hanshan Anhui Province, China



Advanced Straw Fired Power Plant

Hanshan Anhui Province, China

Introduction

- Hanshan project is located in Tongzha Industrial Zone, Hanshan County, Anhui Province; and is the 2nd biomass project investment by Everbright International.
- It was put into operation in 2013.
- The plant has been instrumental in promoting the local rural economy by making good use of agricultural residues. It has helped the local government improve energy structure, protect the environment, and has greatly increased local farmers' income whilst making significant contributions to a low carbon economy.



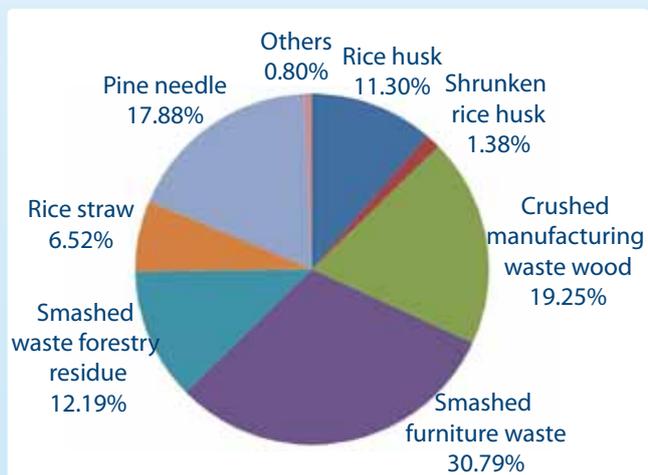
Performance Data

The 30 MWe Hanshan plant, together with the plant at Dangshan is one of the most advanced biomass plants in China. It consumes about 250,000 ton of agricultural residue per annum. In 2015, Hanshan's gross power generation reached 241.282Mkwh, of which 221.618Mkwh was connected to the grid. Total fuel consumption was 269,226 tons. The annual availability was 8042.73 hours. The plant consists of a High Pressure High Temperature Water Cooled Vibrating Grate boiler and a condensed steam turbine. This combination of technology enables very high overall plant efficiency (33%). In addition, the superior design and manufactured quality of the equipment ensures high reliability, and corrosion & fouling resistance.

Design Data

Fuel	Rice Straw, Rice Husk
Fuel Consumption	32tph
Plant Efficiency	>33%
Boiler Efficiency	>91%
Annual Operation Hours	>8000h
Main Steam Flow	130t/h
Main Steam Pressure	92 bar
Main Steam Temp	540 °C
Parasitic Load	10%

Fuel Types (sample from April, 2016)



The plant was designed for rice crop residues, but the quality and flexibility of the technology has enabled the use of other waste products.

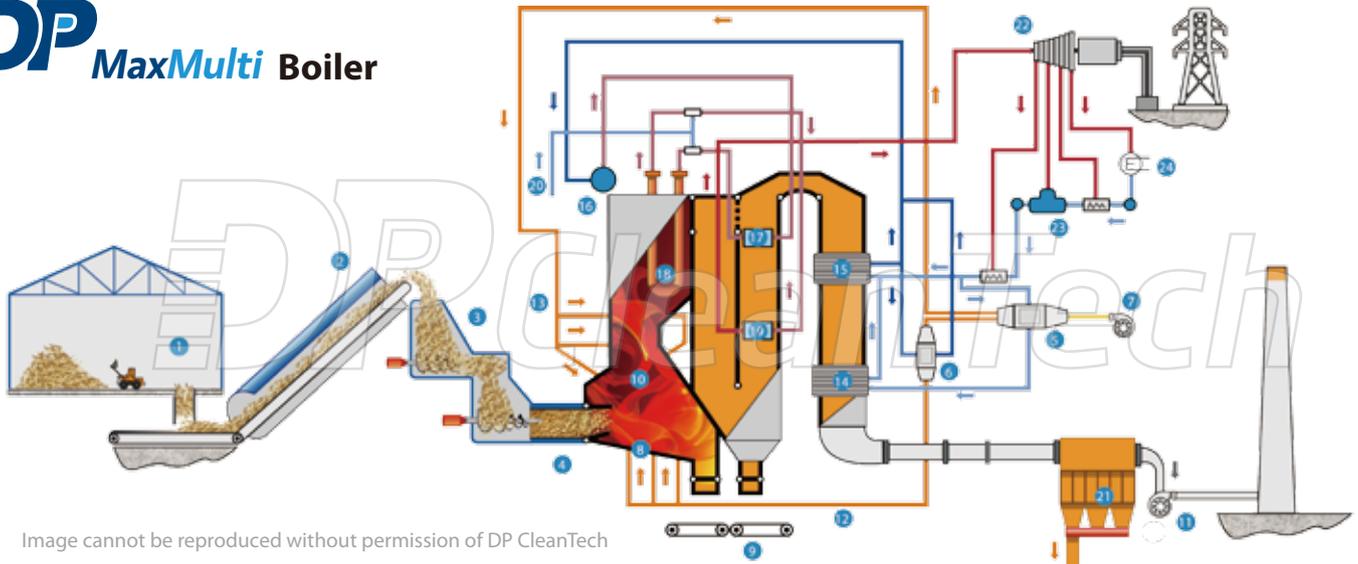


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- | | | | |
|----------------------------------|-----------------------|--------------------|---------------------------|
| 1 Fuel storage | 7 FD fan | 13 Secondary air | 19 Superheater 3 |
| 2 Belt conveyer | 8 Vibrating grate | 14 Flue gas cooler | 20 Water for atemperators |
| 3 Dosing silo | 9 Slag conveyor | 15 Economizer | 21 Bag filter |
| 4 Stoker | 10 Combustion chamber | 16 Steam drum | 22 Turbine |
| 5 Low temperature air preheater | 11 ID fan | 17 Superheater 1 | 23 Deaerator |
| 6 High temperature air preheater | 12 Primary air | 18 Superheater 2 | 24 Condenser |

Key Technology

The Water-Cooled Vibrating Grate is a feature unique to DP CleanTech. Originally from Denmark, this system was specifically designed for the efficient combustion of biomass fuels. The grate vibrates periodically during biomass combustion, thus ensuring full burnout and automatically controlling fuel combustion time in order to prevent slagging on the grate segments. For the Hanshan project, the grate length was extended to cater for woodier type waste, and the staging of air was modified accordingly.



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Boiler

High efficiency and durability are key features of all DP CleanTech products. The design of the boiler and the materials used are fundamental to ensuring long term performance. The boiler itself is supported from the bottom, and the centre of gravity and guiding devices ensures uniform expansion in all dimensions. In addition, the boiler is designed to resist earthquakes. In the event of seismic activity, any horizontal force that might affect the body of the boiler would be transmitted to its main and auxiliary steel frames, and from there to the foundations, thus preventing damage to the boiler itself. The boiler is manufactured using high grade materials to resist corrosion and extend the product life cycle.

External Air Preheater and Proprietary Technology for Handling Corrosive Fuels

Biomass fuels are significantly different from coal, having a higher content of chlorine and alkali metals, and lower sulfur content – all of which can heavily corrode heating surfaces. Rice straw is particularly corrosive. DP CleanTech uses proven, proprietary technology to reduce flue gas temperature and prevent low temperature corrosion. In essence, using a patented combination of an external Air Preheater and recirculated feedwater, the temperatures of flue gas can be regulated to maximize the efficiency of the boiler. At the same time, low temperature corrosion is reduced because the cold end average temperature $\left[\frac{(130+90)}{2} = 110^{\circ}\text{C} \right]$ is higher than dew point. Using DP's patented system for the Air Preheater also avoids problems of ash blockage and abrasion of the Air Preheater.



Superheaters

DP CleanTech's Superheaters have a special structural design and use high grade materials to resist the common problems of corrosion and coking. The structure consists of vertical tube panels and ASME SA-213TP347H extra thick pipe stainless steel materials, which together help to avoid high temperature oxidation (steam side); and to significantly reduce coking and high temperature corrosion (flue gas side).

DP Project References in China

