German mills convert waste into energy

In the face of rising energy and waste disposal costs, two major Germany papermakers are installing energy from waste (EFW) plants, which will generate heat and electricity from mill residues. They are Papierfabrik Palm and Leipa Georg Leinfelder.

Following a USD 244m (RMB 1014m) increase in its energy bill in 2006, Leipa decided to build an EFW plant at the Schwedt Mill in east Brandenburg. Fired by 210,000t/yr of mill waste along with refuse derived fuels (RDF), the new plant will start up in late 2009 and will generate 600,000 megawatts of heat and 110,000 mega-watts of electricity.

The Palm EFW plant, which is based exclusively on mill residues, is being brought on stream this year at Wörth Mill in the Rheinland-Pfalz. It is part of a USD 185m (RMB 1bn) power plant which also includes a combined cycle cogeneration plant, that is to say, a gas- and steam-turbine process.

The combination of a combined cycle plant and a waste-fired steam generator is highly economic. The steam of the waste-fired boiler is used in the steam turbine together with the steam of the heat recovery boiler.

The new power plant will be integrated with Wörth’s gas-fired, shell boiler plant and will supply the paper mill with steam and power, ensuring a 100 per cent external delivery of electrical power in the event of CHP failure.

Waste to energy at Wörth mill

The 52MW Waste to Energy (WtE) boiler will be fired by waste residues from Palm’s three German mills, which together produce 1.4mtpy of paper and board. They are:

One: Aalen-Neukothen, a 320,000t/yr mill which produces recycled newsprint and containerboard (CCM) on three machines. All of the mill’s energy and steam is supplied by its own combined heat and power plant.

Two: Eltmann, a 520,000t/yr mill which produces recycled newsprint on two machines. At the beginning of this year, a USD 79m (RMB 377m) combined heat and power plant started up at Eltmann.

Three: Wörth, a 650,000t/yr mill which produces recycled containerboard on one machine. This is a new mill which came on stream in 2002.

The residues produced at the Wörth are continuously conveyed to the paper mill via two lines of air conveyors with a length of some 200m. The sludge fraction is conveyed directly to the boiler bin and the rejects are carted through the warehouse for treatment – milling and trash separation.
The waste residues from Aalen and Eltmann are transported to Wörth by lorry and stored in the fuel warehouse.

Treating the waste streams

Palm's 1.4m tonnes of paper and board are made entirely from recycled fibre, a process which generates several residues, including the following fractions: Pulper and other rejects; fibre residues; deinking sludge and Bio sludge.

Before their journey to the power plant, these residues are pre-treated at the point of origin. The pulper rejects are shredded and then passed through a ferrous metal separator. The majority of other rejects, which are already shredded at the point of origin, are partly separated from ferrous metals. The fibre residues and the deinking sludge are used without any further sorting treatment.

The management of residues centres on the fuel warehouse into which the waste from Aalen and Eltmann is dumped along with the rejects from the Wörth process.

The fuel warehouse is divided into two storage areas and is managed by two automatic gantry cranes, which dump onto moving floors inside the warehouse. The moving floors run all rejects over a shredder, after which they are again run over a ferrous metal and nonferrous metal separator.

The other external residues are transported over a “police” ferrous metal separator and are then conveyed to the boiler bins of the residue boiler together with the rejects on two redundant lines.

The WE boiler

A bubbling fluidised bed (BFB) combustion system was chosen for the incineration of waste, because of: i) the variety of waste fuels used; ii) the lower heat value (LHV) of the sludge fraction; and iii) the flexibility required with regard to individual fuel fractions and their impact on overall combustion heat.

Taking into account the local constraints at Wörth, a bespoke combustion and boiler system was developed. For example, to cope with the ash and trash in the system, the BFB boiler has an open nozzle floor through which ash and trash can be drawn off. Coarse particles are separated from the bed material, before it is returned to the combustion chamber, if it is reusable. The latest tools are used to measure ash-salt proportions and analyse ash coating.

For temperature control, the combustion chamber has cooled walls and low-wear lining; and, the heating surfaces are designed and positioned to reduce high temperature corrosion.

The supply of combustion air is staged. Primary air comes into the combustion chamber through the nozzle floor and secondary air comes in on two levels. Flue gas is recirculated at low velocities to regulate the temperature of the chamber.
Energy from waste

and to adjust to different heating values. There is a generously
dimensioned empty path behind the combustion chamber. The
heating surfaces are cleaned by water jet blowers in the empty
path and by steam jet blowers in the convection paths.

NOx-reduction is affected by a SNCR System and a dry
process is used for flue gas cleaning. Some of the flue dust is
removed from the flue gas in a dust separator before entering
the economiser of the boiler; and, after the boiler, lime hydrate
and activated carbon are dosed. The reaction products, including
flue dust, are deposited in a baghouse filter.

If the emissions limit values rise significantly, a quench may
also be integrated. This enables the mill to comply with the
emissions limit values safely.

The WTE boiler is one component of the new power plant
which comprises:

- A two circuit bypass heat recovery boiler of 95 t/h of
which 20 t/h is by auxiliary firing; plus approximately 4MW
hot water
- A gas turbine set of 44 MW/1. This is a Siemens SGT-800
unit with a Dry Low Emissions (DLE) combustion system for
maximum environmental compatibility
- A steam turbine of 17 MW
- 1hc 52 MW WTE boiler 52 MW of 60 t/h, 76 bar, 440 °C
with flue gas cleaning plant

A fast moving project

Palm got official approval for the new power plant in
less then five months – a notable achievement since waste
incineration plants often run into not-in-my-backyard (NIMBY)
opposition. The speed for the approval process is attributed
to Palm’s openness with the local population and authority and
to the fact that the WTE plant uses only Palm’s own mill residues.

There were other potential obstacles to fast completion. In
the first place, the European power station market is undergoing
structural change; and, at a time of takeovers and mergers, the
lead time required for tenders, bids and negotiations is extended.
This has created a supplier’s market at manufacturing and
subcontracts level, a market characterised by shortages of
manufacturing capacity of qualified personnel, of raw materials
and of semi-finished products, such as piping materials.

As a result, some potential suppliers did not bid for the work,
and those who did quoted high prices and rising delivery times.
The original intention was to procure the plant within the scope
of a few large lots, such as the gas turbine, heat recovery steam
generator, steam turbine, residue boiler and piping.

However, in the course of the project the components
sometimes had to be separated from the lots and procured
separately so that the tight schedule could be met. For instance
the piping lot had to be divided into four individual lots to ensure
that the HD fittings and the HD piping were available in time.
This pragmatic approach kept the project on the fast track, and overall planning and site supervision was provided by Eproplan Consulting Engineers of Stuttgart.

Design contracts were awarded in December 2005 the design engineering was completed within 15 weeks. The combined cycle plant was built within 12 months and came into commercial operation in December 2007. The WTE plant started trial run on 1 July 2008.

The new power plant will underpin the economic and environmental viability of Wörth, by minimising its exposure to soaring energy costs and by turning waste residues into an energy source. By minimising the amount of electricity purchased, the mill's dependence on the development of electricity prices is minimised. With the startup of the WTE plant, exposure to gas price trends is reduced and the disposal costs for waste residues are slashed. And finally, the mill's dependence on the CO₂ emission allowances market is also reduced.

Based on a presentation by: Dipl.-Ing. Josef Thalheimer, Eproplan GmbH - Consulting Engineers, Stuttgart; and Dr.-Ing. Andreas Haas, Papierfabrik Palm GmbH & Co. KG, Aalen

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