

# PLANT ENGINEERING WITH A TWIST

**A tough nut for plant constructors: This is how it is possible to extract heat from the burning of nutshells** — When it comes to complicated raw materials that tend to form slag or vitrify, conventional burners reach their limits. Now, a new technology brings movement into this seemingly stuck subject—in case of the rotary kiln quite literally...



Sources: Werkstätten

**Boiler with a twist:** The constant rotation of the furnace tube allows to use difficult feedstock materials.

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**N**ot only squirrels are keen on nuts: Cosmetics and pharmaceutical companies have long since discovered the benefits of these fat-rich tree fruits with their valuable ingredients. Especially sought after is the African Shea nut, which provides the precious shea butter when ground. However, the production of the yellowish fatty mass also results in huge amounts of nut peels and

pulp residues. This biomass waste with its fluctuating composition and increased ash content seems to be a classic case for disposal at a composting plant—or isn't it?

In fact, there is a different way, as the example of a Danish oil mill shows: No longer content with disposing off the remaining nutshells at an expensive price, the Scandinavians looked for a way to utilize the residues for energy production—and found what they were looking for in a rotary kiln from the German engineering experts of the Werkstätten-Group. The technology utilizes a revolving vortex of combustion air and burning gases

inside a rotating tub to generate homogeneous temperatures throughout the firing area. Feedstock that enters the burner is heated up by the approximately 800 °C concrete lining and the rising gases are caught and burned in the vortex. The resulting up to five megawatts of electricity and saturated steam generated this way are used to replace a part of the energy previously generated by fossil fuels, the Danes state.

Initial experiences confirm the concept's viability—thus, the plant

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operator plans to build further units to site's cater the whole energy demand with shea material.

Nevertheless, there were some tough nuts to crack for the plant engineers: The high mineral content of the biomass raw material with its fluctuating calorific value is not well suited for thermal utilization in conventional incinerator units for mono-combustion. As the material tends to vitrify and form slags in the kiln, the combustion chamber must be constantly cooled and moved.

A win on points for the rotary kiln boiler, which boasts both a stable concrete lining and water cooling. The material is first briquetted, as the burner technology is designed for structured material flows with a dry matter content of > 85 %.

The rotary tube itself helps to avoid slagging without needing any internal parts, even when using fast-melting fuels. It is lined only with refractory concrete and equipped with a cylindrical jacket with water cooling, to reduce the lining and the ember bed temperature before the dreaded vitrification can happen.

This is followed by an afterburner unit, a heat exchanger and a steam turbine.

The plant itself was planned, designed and delivered by the Werkstätten-Group, an engineering company and component manufacturer from Lower Saxony. The boiler making and control technology specialists have long evolved from their roots as a supplier of the local textile industry to experts in stainless steel solutions—but also other heat and wear-resistant materials pose no problem for the engineers. The workshop specialists support their customers “from the idea to the assembly” and develop tailor-made new solutions. This unique focus on special equipment construction is characteristic for the group, confirms Werkstätten Heating-Systems' managing director Nils Moggert. Although the

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WERKSTÄTTEN

company produces small series of e.g. biomass boilers, tailor made solutions and individual designs account for the bulk of its orders. The Werkstätten portfolio also includes far more than ‘just’ boilers

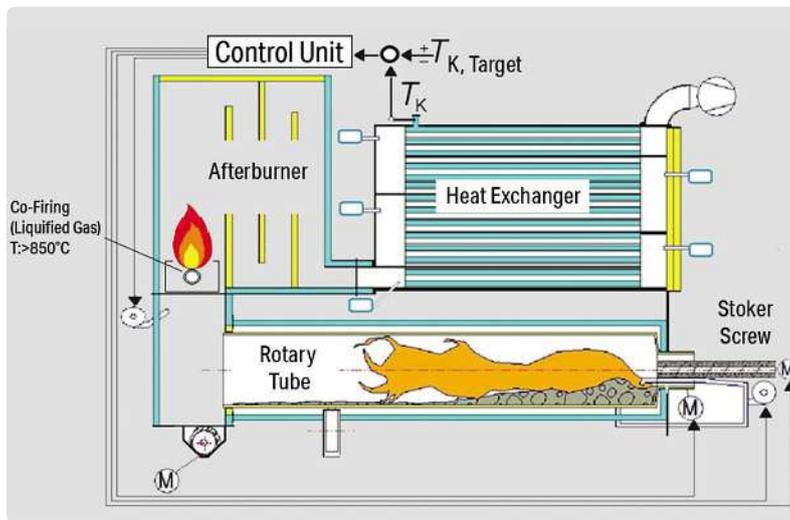
and furnaces: “We offer the entire process engineering design right down to vibration dampeners or silencers,” Moggert explains. When it comes to engineering and designing for a new plant project, the company sees itself well positioned with its ability to calculate and simulate complex components using FEM analysis and state-of-the-art 3D CAD systems. Thus, the operator is to be offered a high degree of flexibility already at the project stage, Moggert assures.

One important focus of the Werkstätten activities is on renewable energies—and here in particular on decentralized biomass combustion. Technologies like the rotary kiln boiler can be used for agricultural residues, such as straw, digestate and chicken manure or industrial by-products and waste materials such as old wood or plastic residues. Even dried sewage sludge could be recycled this way.

But the engineers think even further: In about five years, the technology could be ready for use in the combustion of residues from the phosphorus precipitation and recovery in sewage treatment

plants. By allowing the production of a uniform mono ash, such residues could be processed for safe intermediate storage—a major advantage over the “co-incineration” with sewage sludge. “The boiler can relatively easily be used for a wide variety of feedstock without major changes or adjustments. This is controlled by the PLC control alone,” says Moggert.

Until then, there are still some tough nuts to crack—but the Werkstätten Group is ideally positioned for the job. Through the cooperation under one roof, the companies of the group bundle the complete expertise from the drawing board to the industrial service. The result: Turnkey plants made to measure. This often pays off quickly through the use of a cheap fuel, which would otherwise often disposal costs, and the production of continuous energy very quickly—if the boiler has the special twist.



Energy from the nut: The Danish plant, consisting of a rotary kiln furnace, afterburner unit and heat exchanger provides up to five MW of electric power as well as saturated steam.

#### PROCESS-Tip

- More about **thermal processes and waste heat recovery** on [www.process-worldwide.com](http://www.process-worldwide.com)!
- Discover additional **information about the technology** – also in Danish – on [www.Drehrohrkessel.de](http://www.Drehrohrkessel.de)

#### Technology Focus

## GOOD REASONS FOR THE ROTARY KILN BOILER

- ✓ Reliable recovery of agricultural / industrial by-products
- ✓ No slagging despite the most difficult fuels
- ✓ Very good emission levels due to two-stage combustion
- ✓ Highest efficiency through maximum energy use
- ✓ Generation of mono ash for phosphorus recovery
- ✓ No direct contact of the flames with the cooling surface
- ✓ No wear due to movement or sticking of the slag
- ✓ Constant optimum combustion eliminates additional inspection or cleaning work