

# DRYING WITH SUPERHEATED STEAM

For most pellet plants, dryers are a critical component. And although moisture removal from biomass is core business for Swedish Exergy AB, the company with its dryer technology has, until recently, remained something of a dark-horse.

**A SPEAKER AT THE 2020 NORDIC PELLETS CONFERENCE IN UPPSALA, SWEDEN,** Prem Verma, CEO of Swedish Exergy introduced the concept of using superheated steam as drying medium for pelleting plants. Eyebrows were raised when it transpired that neither the concept nor the company are new.

## University spin-out

Svensk Exergiteknik AB, as it was known as back then, was one of the first seed companies spun-out from Chalmers University of Technology (Chalmers) in Gothenburg, Sweden that commercialized the Exergy Superheated Steam Drying technology, developed by the inventor and company founder Claes Münter.

– Over the past forty years, we have developed our technologies and today they are used in a wide range of industries around the world such as energy production, steel manufacturing, automobile manufacturing, pulp and paper, sludge treatment, peat, sugar, tea, mining, tobacco, biofuels and wood pellets to mention a few, said Prem Verma when Bioenergy International visited the company.

Headquartered in Gothenburg, Swedish Exergy has evolved into an international group of four companies in Sweden and India. Apart from various dryer types, the Group's technology portfolio includes evaporators, rotary valves, pneumatic conveying systems, high-pressure pipes and couplings.

– Swedish Exergy is primarily a project design and engineering company that provides complete engineering, turnkey delivery, design and consultancy services. With our well-established network of associated partners, subsidiaries, suppliers, and subcontractors we deliver bespoke plants to our clients in a variety of industries around the world, explained Prem Verma.

## A word on exergy

Exergy is generally defined as the amount of work possible to achieve from a system when it, through reversible processes, reaches thermodynamic equilibrium with the surroundings. Translated into dryer technology, a continuous closed-loop process in which as much as possible of the thermal input energy used to dry the material is recovered and reused so that the total thermal energy used ie losses (aka anergy – energy that cannot be converted to work) is as low as possible.

Rotary drum dryers (high temperature) and belt-dryers (low temperature) are two of the most common dryer technologies used in wood pelleting plants. These are typically installed as linear systems in energy terms. Heat from a direct or indirect source such as flue gas from a burner

or hot water from a boiler is transferred via the dryer to the green material to reduce the moisture content (MC) – from around 50 percent MC to around 10 percent MC, by evaporating the water and releasing it to the atmosphere as water vapour, along with the latent energy contained in it.

Furthermore, in the case of rotary drum dryers there is the added issue of volatile organic compounds (VOCs) emissions with some jurisdictions requiring dryer exhaust treatment using Regenerative Thermal Oxidizers (RTO's) – in essence a high-temperature (≈815 °C to ≈980 °C) thermal treatment that requires additional heat.

## Superheated steam medium

In the case of Swedish Exergy's "Pressurised Super-Heated Steam Dryer" (PSSD), the dryer is indirectly heated and uses superheated steam as the drying and conveying medium in a fully closed-loop process that operates at pressures from 0.5 bar to 4 bar.

– Each project is site specific. The dryer is indirectly heated which means that it is tailored to be integrated with whatever heat source is available – steam, hot water, thermal oil, engine exhaust, flue gas, turbine exhaust or mechanical vapour recompressors (MVR) to name a few. If there is none, then electricity can be used, said Manish Verma, Business Development Manager at Swedish Exergy.

The material is fed into and discharged from the dryer using a Hamacher TroMaxx Conical Rotary Valve. A robust pressure-tight rotary valve, it uses centrifugal forces to feed and discharge bulk material from atmospheric pressure into a pressurized system with differential pressures of up to 6.0 bar and at temperatures up to 250°C. Inside the dryer the residence time is short, about 5 to 30 seconds depending on the material, particle size, incoming MC and outgoing MC.

– The dryer can manage varying particle size up to 5 mm thickness. There are few moving parts. This means that system is easy to start, stop and maintain. In addition, the total amount of material inside the dryer in any given moment is in kilograms, not tonnes, explained Manish Verma adding that the evaporation capacity in a single line ranges from 1 to 70 tonnes per hour – more capacity just add another line.

## Heat recovery key

While the PSSD does require more kW's of electricity (40–60 kW) per tonne dried material compared to the 30-50 kW for conventional belt- or rotary drum dryer technologies, the PSSD has 20 to 30 percent lower thermal

## INCREASED SAFETY WITH CERTIFIED FIRE PREVENTIVE AND PROTECTIVE SOLUTIONS FOR THE PROCESS INDUSTRY





*“For a wood pelleting plant using green feedstock, drying is the single most energy intensive process. Therefore, to reduce the carbon foot print in pellet making, the focus should be on the drying process”*

**PREM VERMA**, CEO of Swedish Exergy AB

energy consumption per tonne – 760 kW/tonne compared to 950 – 1 100 kW/tonne.

However, a key feature of the PSSD is easy integration with other processes for energy optimization. As the dryer can operate at pressures from 0.5 bar to 4 bar gauge, the vaporised moisture from the wet material can be used as secondary steam. By utilising this steam, over 95 percent of the drying energy can be recovered and used in other processes such as process heating, evaporation/distillation, electricity production or district heating.

– This is why every project is unique. It is not just a question of installing a dryer but of energy integration and optimisation to reap the full economic potential and environmental benefits of the technology, Manish Verma emphasised.

**Zero emissions and zero fire hazard**

The short residence time in an oxygen free environment together with the low pressure closed-loop system ensures there are no emissions to the atmosphere. As a result, there is no need to install an RTO or bag filter. There is also the option of treating the steam condensate separately.

– As we’re using superheated steam as the drying media, the atmosphere within our closed-loop system is essentially oxygen-free. Practically all the air is displaced with steam thus eliminating the risk of fire or explosions creating a safer work environment. Our dryers do not require any ATEX 94/9/EC certification which drastically lowers the client’s insurance premiums, explained Manish Verma adding that there is no need for ancillary fire detection and suppression systems such as spark detectors and sprinklers for the dryer.

– To date, we have not had a single reported fire or explosion incident in our steam dryers. The oldest one, our very first installation which was built in 1979 at Rockhammars Bruk pulp mill, is still in use, said Prem Verma.

He clarified that although pressure is used, the process is not a steam explosion.

– There is no dramatic pressure loss and the cells in the material are not altered or ruptured. Instead the result is a completely sterilised non-oxidised product homogeneously dried to the required moisture content, said Prem Verma

As a result, the dried fibre does not need intermediate storage for conditioning before pelleting but can be pelleted directly. While guaranteeing sterilisation of the wood fibre is perhaps not an issue for pellets, it is for other materials and industries such as sewage sludge, biogas digestate or the grain ethanol industry’s dried distillers’ grains and solubles (DDGS).

**Pellet industry applications**

Swedish Exergy has completed over 50 projects in a variety of industries around the world, including wood pellets. In Sweden, it has supplied its PSSD systems to Härjeåns Energi AB (previously known as Härjedalens Miljöbränsle - HMAB) integrated combined heat, power and pellets (CHPP) plant in Sveg and to Skellefteå Kraft AB’s Hedensbyn CHPP plant in Skellefteå. These were installed in 1988 and 1997 respectively and both plants are still operational each producing around 100 000 tonnes-per-annum of pellets along with district heating and electricity.

– In both these installations, the VOC’s in the steam generated by the

PSSD are separated in a condenser/reboiler and piped to the CHP boiler for destruction, explained Prem Verma.

In more recent pellet projects it seems that the company has been somewhat unlucky. Inaugurated in 2008 by HM King Carl XVI Gustaf of Sweden, Skellefteå Kraft’s Biostor CHPP plant in Storuman was shuttered in 2013 before closing on account of low pellet and energy prices. Much of the plant has since been dismantled with pelleting equipment sold to Bosnien-Herzegovina and the biomass boiler and turbine sold to Turkey. In Norway, Swedish Exergy supplied the BioWood Norway AS project in Averøy that was commissioned in 2010. It too was closed by the owners, energy utility Hafslund ASA during 2013 and the site was sold to Wahlberg AS.

– Storuman and BioWood were unfortunately closed, however, the closures were not attributed to our dryer technology, said Manish Verma.

**North American opportunities**

Looking ahead, the company sees that much has happened over the last number of years in the pellet industry. With an ever-increasing public focus on carbon footprint, it feels the time is right to increase its reach. In particular, Swedish Exergy is vying the industrial pellet sector in North America where it has partners and references in the corn ethanol industry.

– It seems that the industrial pellet industry is becoming more mature and more process oriented. With large annual production capacities and medium-to-long term off-take contracts, every reduction of kW’s needed per tonne has a positive impact on the carbon footprint and the bottom-line. By integrating our dryer system there is an opportunity to radically reduce the kW’s per tonne and do away with RTO’s which translates into lower OPEX, lower total life-cycle cost of ownership, a safer workplace and lower environmental and climate impact. That ought to be of interest to pellet plant investors, owners and project planners, ended Prem Verma.

*Text & photos: Alan Sherrard  
PS66531/AS*



Christoffer Glavander (left) Sales Manager and Manish Verma, Business Development Manager at Swedish Exergy.