es here are disposal cost, transport cost, storage, and sometimes also recovery of phosphorus. Johann Seiwald, managing director of the Großache Nord wastewater association in Tyrol, reports: “We addressed this issue early on, and today we successfully operate an energy-efficient heat pump drying system with sophisticated conveying technology in continuous operation.” The wastewater from three municipalities with approximately 25,000 inhabitants is cleaned at Erpfendorf. The number of people in this popular tourist area almost doubles during the summer and winter seasons. This situation had to be duly reflected in the planning process.

The drying system used today is a belt dryer with two horizontally arranged belts and five heat pump modules (**Figure 3**). The belt speed is adjustable. Sensors monitor the material height on the two belts. The five heat pump modules are directly connected to one another to form a compact system. The belt dryer is designed to process an annual sludge quantity of 2,200 tons. Being modular, the system may be expanded at any time. The entire belt drying system is controlled via an HMI control panel in the control cabinet of the system. The total connected load of the system is 120 kW.

The pioneering project did not run entirely smoothly — challenges arose every now and then. One such challenge involved cellulose fibers contained in the sludge. For uniform drying, it is essential that the sludge lumps are of roughly the same size. The sludge falls onto the belt through a hopper. To achieve a uniform texture, the sludge runs through a shredding mechanism. Cellulose fibres, however, clogged the mechanism and brought the system to a halt. Harter’s designers came up with various ideas, which engineers then tested. The ultimate solution was a purpose-developed paddle unit.

Thanks to the drying process, the Tyrolean wastewater association now saves significantly on operating cost. An added benefit is that drying increases the calorific value of the sludge. The heat pump assisted drying system operates at low temperatures. The dehumidification process takes place at 30 °C to 60 °C, as required by the specific properties of the sludge. The drying process is reliable because it takes place within a closed system. A closed air circuit makes the process reproducible so that maximum reliability is ensured. Once again, the benefit of zero exhaust air plays a key role: it ensures that the drying process is independent of the climate and the seasons.

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Source: Harter

SLUDGE DRYING

Energy-efficient sludge drying with heat pump

Petra Schlachter

The German dryer manufacturer Harter is dedicated to heat pump assisted condensation drying. The company developed and launched this technique over 30 years ago. It is used for drying all types of sludge. Drying sludge, in addition to mechanical dewatering, offers numerous benefits to users in any business.

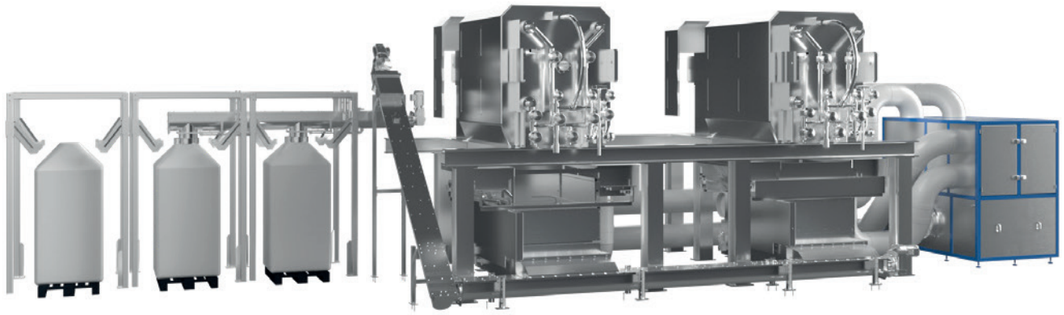
When it comes to sludge drying, the issue is usually cost – operating cost, transport cost, and energy cost.
Pressed sludge still contains 70 to 80 % water. Consequently, 70 to 80 % of disposal cost is essentially spent on water. “It doesn’t matter whether we’re talking about industrial sludge from electroplating processes, for example, or sewage sludge from municipal wastewater treatment”, explains Jonas List of Harter’s technical sales team.

Figure 1: Three tons of sludge per working day are dried to obtain a solids content of approximately 86 % in two drying cabinets with two containers each.

Reducing disposal cost

A company in the etching business wanted to reduce its operating cost related to wastewater treatment. Sludge results from chemical precipitation in their baths. This sludge used to be mechanically dewatered in a chamber filter press, then loaded into transport containers, and taken to a landfill.

“The high cost of transport and disposal had been a thorn in the company’s side for quite some time”, says List. “The operations manager had realized that drying the sludge offered much potential for savings.” The company also received government funding for using heat pump technology. Harter’s technique stands out by using very dry air. This unsaturated air quickly absorbs the moisture from



Source: Harter

Figure 2: Fully automatic sludge drying system, including the heat pump module for conditioning the required process air

the sludge. The process air is circulated in a closed system – with no exhaust air and no energy loss. Harter always follows the same procedure for its projects: First, drying tests are conducted in the company's in-house technical center. So, the etching company also had a sludge sample tested by Harter. The test showed that the sludge weight could be reduced by 71 %. Larger-scale tests using a rental drying system verified this test result. An economic evaluation also promised a favorable payback period.

Ultimately, the leader in etching technology invested in two sludge dryers. These are two standard Drymex M5 dryers, each with two drying containers. The containers have a usable volume of 1.5 m^3 each. The current sequence of operations is as follows: After pressing in the chamber filter press, the sludge is emptied into one of the two drying containers, which is transported to the dryer using a forklift and inserted in the sludge dryer. The doors of the compact system are closed, and the drying process is started. In the meantime, the second container is positioned under the chamber filter press to be filled with more pressed sludge.
About three tons of sludge with a solids content of 26 % accumulate each working day. Its solids content rises to about

Source: Harter

Figure 3: A belt dryer composed of five units dries sewage sludge from three municipalities in Tyrol. After drying, the sludge has a residual moisture content of only about 15 %. This significantly reduces both its weight and volume.

86 % after 20 to 24 hours of drying **(Figure 1)**. The water removal rate of the M5 dryers is approximately 800 liters per 24 hours. 0.4 kWh is required to remove one liter of water. When the desired level of dry air is reached, the system automatically shuts down via a humidity sensor. For subsequent unloading, the drying containers are equipped with a tipping mechanism that allows the dried sludge to be emptied completely and easily into a transport container to be disposed of. The rated power of an M5 sludge dryer is 13.3 kW.

Sludge drying including conveyance technology

A significantly larger-scale project was implemented by Harter for a Swiss waste management company. This company purchases sludge containing precious metals, recycles and refines these metals, and then sells them to the electronics industry. The company wanted a comprehensive solution including pre-dewatering, drying, conveyance, and filling into big bags. The current fully automated sludge drying system consists of two special stainless steel containers with a cross conveyor belt, a heat pump module, a screw conveyor system, and an unloading station for three big bags. The stainless steel containers are equipped with a multifunctional intermediate floor with rotating vanes and a PLC system. The operation of the entire system is controlled by a purpose-developed program. The customer replaced the two previous chamber filter presses with new automatic ones and installed them on a steel support frame some two meters above the floor. Two drying containers are placed below the presses, waiting to be filled with sludge (**Figure 2**).

When a chamber filter press is full, the sludge is discharged into the drying container. This happens three to four times a day. The rotating vanes open to a defined angle to allow the required process air to flow through the container from the bottom up. The drying process is designed such that the lowest portion of sludge in the container is always dried first. It reaches the desired dry matter content long before the next batch of sludge is discharged from the filter press into the container from above. Before that, the container is partially emptied from below. The PLC system defines how much sludge must first be released from the container so that there is enough space available at the top to accommodate the next batch. The rotating vanes at the bottom open to discharge the sludge. It falls onto the cross-conveyor system and is then transported directly into the auger conveyor.

Energy-efficient drying
Pressed sludge still contains 70 to 80 % water. Subsequent drying reduces the residual moisture content of sludge to about 15 %. If the drying process is also energy-efficient operators may achieve savings of up to 60 %.

Dry air from the heat pump module

The air dehumidification system developed by Harter using integrated heat pump technology is inherently very efficient. As wet sludge is periodically fed into the container from above, there is always sufficient moisture available for absorption by the dry process air to ensure optimized process operation. The fresh, wet sludge also safely prevents dust from forming at the heat pump module side of the container. The containers are connected to the heat pump module via insulated air piping. This heat pump module provides the very dry process air required for drying and is also responsible for the condensation process.

From the cross conveyor belt of the containers, the sludge now enters the spiral conveyor system, which transports the dried substance upwards to the opening of the big bags for emptying. Pneumatic flaps control the selection of the big bag to be filled, sensors monitor the fill level, and a signal indicates when the maximum fill level is reached. The auger conveyor is fully enclosed to safely preclude any dust pollution. Humans or the environment are not affected. The drying temperature is about 50 °C. The drying time in sludge drying systems is typically 24 hours. This is the period normally required to dry the filter cake pieces throughout.

Pioneering project with sewage sludge

After more than 30 years of experience in industrial sludge drying, Harter was given the opportunity to realize a municipal sewage sludge drying pilot project last year. "This breaks the ground for successfully establishing our energy-saving heat pump drying technology in this sector as well", says Specht, managing partner at Harter. Sewage sludge must no longer be spread on farmland. The issu-