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SPECIAL PRINT

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More and more countries enact distinct regulations concerning the drying and incineration of sewage sludge. Decentralised, individual solutions for self-sufficient drying make local authorities more independent. Costs for transport sink considerably. This is illustrated by a pilot project in Austria with a heat pump technology.

Austria's Federal Waste Management Scheme of 2017 stipulates that up to 85 percent of the sewage sludge must be treated to recover phosphorus by 2030. Mono-incineration or drying is required to produce commodities such as phosphorus based fertilisers. The purpose of this scheme is to prevent the continued contamination of soils by microplastics and heavy metals. On the other hand, phosphorus may be used as a valuable fertiliser. "We faced up to this issue early on and have now an energy saving condensation drying system including sophisticated conveyance in continuous operation," reports Johann Seiwald, General Manager of the Großache Nord sewage treatment association in the Austrian state of Tirol.

Heat pump modules for providing the process air and for condensation.

Photo: Harter

First, an economic feasibility study was conducted. The engineering consultants mandated compared several drying methods for this purpose. Drying must always be preceded by mechanical dewatering of the sludge. Thereafter, the water content is about 25 to 30 percent. The target of the project was to fully dry the sludge such that >90 percent dry matter is obtained. The sewage sludge is then biologically stable. A specific energy input is required to remove the bound water after dewatering. The drier the sludge, the higher is the energy required to remove the residual humidity. So, energy expenditure is enormously important if the goal is to obtain 90+ percent dry matter – and it is generally important in this day and age, for that matter.

Energy and Cost

High temperature drying was not taken into consideration as a result of the investigation. Systems venting process air into the environment and, therefore, requiring exhaust air treatment were also disregarded. Another disqualifier was the creation of hazardous dust-air mixtures. So, energy-efficient heat pump based condensation drying got on the shortlist. This technology produced the best energy value in this special high dry matter segment. Seiwald explains: "The sewage treatment plant in question includes a treatment facility for regional food waste. The resulting substrate is used to produce methane which, in turn, is employed to generate about 140 percent of the power we need. Therefore, investment in a power operated drying system using the power generated by the two existing block-type thermal power stations suggested itself." This drying technology is also exhaust air free and provides the highest safety from explosion hazards.

The investigation clearly revealed that drying is always necessary and reasonable economically. Disposal cost rose by 20 percent within the project period alone. And the operators expect prices to continue to rise in the forthcoming years. As for investment cost, condensation drying also came off well because the cost is comparatively low and, thus, also attractive for smaller treatment

plants. The future maintenance effort was also considered to be low. Transport cost to the disposal site would also be considerably reduced by drying and resulting lower sludge quantity which, in turn, would have a positive effect on carbon emission.

Besides all these aspects, other major factors were, of course, taken into consideration as well, such as engineering, economy, emission, and logistics. Fire and explosion safety were also critical issues. Concerns of government authorities and their cognizant engineers also mattered. All these aspects had to be harmonised before the project started. The final choice was for heat pump based condensation drying which requires little energy for good performance and provides quite a few more benefits.

Special Challenge: High Utilisation in a Winter Sports Region

The Großache Nord sewage treatment association operates a sewage treatment plant at Erpfendorf. It purifies the wastewater of three communities with a total of 25,000 residents. Erpfendorf is situated in a region highly developed for tourism. The region is much frequented by winter sports guests in the cold season. Many family holiday-makers, cycling and alpine sports enthusiasts enjoy their stay here in summer. During this period, the number of people almost doubles – and the resulting wastewater as well. This situation was a critical factor that had to be duly reflected in the plant layout and design.

Following project approval by the federal state government, the sewage treatment association initially awarded a planning contract for this large-scale project to the general contractor Sonnek Engineering of Vienna. The latter, in turn, got the technology partners Siag K. Seidnitzer and Harter on board. Siag was responsible for conveyance and Harter for drying. The two partners realised an energy efficient sewage sludge belt drying system with sophisticated conveyance in a joint effort. The constructive and innovative co-operation of the responsible companies and the general contractor Sonnek ensured smooth interfacing of planning, engineering, manufacture, assembly, commissioning and service.

Sophisticated Conveyance

All wet sludge used to be – and continues to be – stored in an open but roofed hall on the sewage treatment plant premises. “This hall provided space enough for the drying system which was ultimately installed there,” explains Reinhold Specht, managing owner of Harter. The area around the hall is also large enough for transport containers to arrive and leave.

The solution installed today is as follows. The putrefied sludge is first dewatered mechanically using two screw extrusion presses. Following dewatering, two screw conveyors pass the sludge to the so-called wet sludge receiving hopper featuring a controlled discharge bottom. There, five screw conveyors pass the sludge to a transverse collecting screw from where it is transported by an inclined screw conveyor to enter the drying system from the top. The sludge is dried in the drying system to obtain the desired dry matter content. Following drying,

Photo: Harter

Sewage sludge shall be treated to recover phosphorus in order to close the phosphorus cycle within the new few years.

the dried matter is again moved upwards by an inclined screw conveyor to a reversible horizontal screw conveyor. The dry sludge is passed through rotary valves to a distributing screw at each end of the latter. The two vertically adjustable distributing screws are placed above the transport containers. They have three outlets each for uniform loading of the containers. There is a total of two transport containers with a capacity of 34 cubic metres each. They are loaded in turn with dry sludge which is then transported to the disposal or incineration site.

Siag furnished a solution using weighing provisions for the complex conveyance system. The weighing provisions control both the fill level in the wet sludge receiving hopper which, in turn, controls the loading of the dryer, and the optimal loading of the transport containers.

Continuous and Fast Drying

The drying system comprises five belt dryer modules with two horizontal belts about each other. The whole system is 11.3 m long, 3.2 m high, and 2.4 m wide. The sludge is hopper fed onto the upper belt to run through all modules. At the end, the belt is deflected so that the sludge falls onto the lower belt to run through the full length of the dryer again. The belt speed is variable. A total of three sensors monitors the sludge height on the two belts. The five modules are directly connected to form a compact system. Each module has its own air recirculation system. The recirculation fans purpose-designed for Harter produce an airflow rate of 37,500 m³/h maximum.

The dehumidification unit integrated in each module provides the required process air and is also responsible for the condensation process. The belt dryer is designed to process 2,200 tons of sludge per year. Being modular the system may be expanded any time. The whole belt drying systems is controlled through an HMI panel in the control cabinet of the system. The connected load of the whole system is 120 kW.

Specht explains: "For drying the sludge, we make use of a special low temperature technique developed more than 30 years ago. Heat pump based condensation drying is highly efficient. It is capable of drying at temperatures between 20 °C and 90 °C in an energy efficient way". In the Erpfendorf application, the drying temperature is 40 °C. The drying period may be controlled with the standard period being two hours. The dry matter content of the sludge is 18 to 26 percent before drying and about 90 percent after drying. The water extraction rate is 7.5 tons max. per day. It complies with the specified six to eight tons per day requirement.

The process air required for drying is extremely dry and, thus, unsaturated. By its physical nature, it absorbs the humidity contained in the sludge readily and quickly. The humid air is then cooled. The humidity condenses to form water which is fed into the supply line of the treatment plant. The drying system is closed in terms of energy and air. Therefore, no exhaust air treatment is required. The closed air circuit makes this technique independent of the seasons or climatic fluctuations so that high process reliability is ensured.

Seiwald summarised contentedly: "The association's decision to realise the sludge dryer with Harter has turned out to be the optimum solution for us. The co-operation was characterised by high quality and engineering expertise. The executing companies' credo always to strive for the best result has made this project a big success. As operator of the sewage treatment plant, we are thus best placed for the future. *(agk)*

Mono-incineration or drying is required to produce phosphorus based fertilisers from sewage sludge ashes.

DRYING TIME	TEMPERATURE	WATER EXTRACTION CAPACITY	DRY SUBSTANCE CONTENT
approx. **2 HOURS** (standard, variable control)	**40 °C**	max. **7,5 t/d**	**18-26 %** before drying → **> 90 %** after drying

Key figures for sewage sludge drying in Tyrol