Solar sewage sludge drying – a reasonable solution if based on intelligent and sustainable design

Greenhouse with sludge turner SRT 9

The RoS 3Q 440 system is designed to dewater thin sludge with 1% DR or thickened sludge with 3% DR

Solar sewage sludge drying has become a generally accepted ecological and economical technology. To make the implementation and operation of a solar drying plant a sustainable success, all relevant aspects need to be fulfilled: economic and planning aspects but as well acceptance on the part of the operator and the public.

One of the plants that offer both, a perfect design concept and acceptance, is installed on WWTP Penzing Weil near the Upper Bavarian lake Ammersee located southwest of Munich. About 8,500 residents are connected to this aerobic stabilised sewage treatment plant. In 2008, when WWTP Penzing Weil was requested to measure PFT, high concentrations of perfluorinated tensides were found and disposal costs rose from 30,000 € to about 100,000 €. Investing into sludge treatment with the aim to reduce annual disposal costs therefore became financially rewarding. Consequently, a sludge treatment plant including sludge dewatering and drying was started to be built at the beginning of 2010.

After its completion and a test phase the new plant was officially put into operating in July 2010. The process of sludge treatment starts with a HUBER ROTAMAT® Screw Press RoS 3Q 440. A screw conveyor automatically transports the compacted sludge into the greenhouse and drops sludge onto the greenhouse floor. The sludge turning/transporting assembly SRT 9 both distributes and transports the sludge inside the greenhouse. At the end of the greenhouse the dried granular sludge is dropped into a storage bunker from where it is loaded on trucks by a wheel loader 5 to 6 times a year.

Dryer efficiency variations between summer and winter are compensated by two buffer tanks for thin sludge with 700 m³ capacity each. Depending on the weather conditions, the sewage works operator feeds more or less sludge to the dryer. Either directly the thin sludge settled in the secondary clarifier or the prethickened sludge from the tanks can be dewatered in the HUBER ROTAMAT® Screw Press RoS 3Q. The plant operation program provides for the possibility to select at the push of a button whether to feed to the screw press excess sludge with approximately 1% dry substance or statically thickened sludge with approximately 3.5% dry substance.

Where no storage capacity is available or the available space is scarce, the solar dryer efficiency can be increased by adding exhaust heat or ‘ecological heat’. ‘Ecological heat’ in this case means the heat generated ecologically from clarified wastewater by means of a heat pump. The HUBER heat exchanger RoWin guarantees reliable operation with low maintenance requirements. This type of heat exchanger provides automatic removal of algae and other pollutants that may settle on the exchanger surfaces.

The greenhouse length and thus drying surface required depends on the requested drying efficiency. The required power depends on the dewatering results the ROTAMAT® Screw Press RoS 3Q is designed to achieve. Against this background, the greenhouse hall on WWTP Penzing was designed a couple of metres longer than actually necessary. The plant operators use the resulting increased dryer capacity to reduce the polymer consumption of the dewatering system and in this way save even more costs.

Automatic sludge feeding into the greenhouse eliminates the need for material transfer points and wheel loaders, and saves operators work and time. They benefit from an excellent sludge handling concept that minimises odours. Direct feeding and immediate turning of the sludge in the dryer instantly brings the sludge into a safe, virtually aerobic condition that ensures minimum odour development. No odour at all is noticed on WWTP Penzing Weil.

For efficient and odour-free drying, climate technology and mechanical equipment components must be selected and designed to perfectly suit each other. The HUBER climate control system incorporates experiences from operation, measurements in the greenhouse and theoretical thermodynamic principles. The greenhouse is equipped with climate sensors, ventilators and ventilation flaps. The electrical control system ensures an ideal drying climate is constantly maintained inside the greenhouse hall by monitoring the water absorption capacity of the air inside and outside the hall and by limiting condensate. The run time of the ventilators that directly aerate the sludge bed is controlled according to the work cycles of the sludge turning machine (and the freshly turned sludge bed zones) and the drying capacity of the air. The air is routed differently as required in the different sludge drying areas. Of course, the control system always gives priority to the safety of mechanical components and protection of the building against storm.

The mechanical equipment components for sludge turning and transport are at the heart of the solar dryer. The sludge turning assembly consists of a rotating double shovel that draws itself through the greenhouse along chains. While the shovel rotates and at the same time travels forwards, the sludge is aerated, turned around, granulated and transported. When the sludge turning/transporting assembly arrives at the end of the hall, each individual sludge granulate grain has been aerated. This cycle normally is performed every hour. In the feeding phase, turning of sludge in the wet zones in the front section and its aeration over the full greenhouse width takes place even every 20 minutes. As the complete sludge bed is restacked, the quasi-aerobic condition of the sludge is reliably maintained and optimal preconditions for drying are achieved.

Through backmixing of dry sludge granulate and sludge aeration the HUBER Solar Active Dryer SRT 9 provides the sludge bed conditions required for maximum drying results

Another exceptional feature of the HUBER SRT system is continuous backmixing of sludge. The double shovel is also used to move sludge from one place to another. Backmixing of dry granulate into the sludge feed increases the dry residue to 40% directly after feeding. At this dry residue level, any odour-intensive biological activities are stopped. In addition, sludge with 40 % DR is more open-pored, easier to dry, less pasty and therefore easier to process mechanically so that the long life of the applied technology is guaranteed. On the other side of the sludge bed, the dry side, continuous backmixing produces the opposite effect. The zone where the granulate becomes very dry is very short. This is the zone where dry material is exposed to mechanical stress with the result of dust being generated. The sludge bed that is generated throughout the greenhouse hall length by the backmixing effect excels with a very long basic drying area where the dry residue slowly increases from 40% to 60%. This is the area where the actual drying process takes place. The requested dry residue of usually 80 to 85% DR is achieved only in the last 10 to 15 m of the sludge bed.

As the sludge turner transports and relocates the sludge in its shovels, it permits the removal of dried granulate optionally on the same gable side of the greenhouse hall where the wet sludge is fed. The plant can be designed for granulate discharge into an underground screw conveyor with grate cover. It is for example possible to build the greenhouse in the boundary area of the WWTP grounds without the need to build another road and a second traffic area at the other end of the greenhouse. On WWTP Penzing, however, the conventional solution was selected with sludge feeding and removal taking place on the opposite ends of the greenhouse. This design variant made more sense with regard to the structures already existent on this site.

The operators on WWTP Penzing have the choice to feed their sludge automatically or optionally by means of a wheel loader but, according to plant manager Markus Keller, do not use the latter option. One push of a button would be sufficient to make the sludge

turner work off a heap of sludge built by the wheel loader. Continuous automatic feeding ensures that the screw immediately feeds the amount of sludge that has accumulated after a quarter of an hour. As described above, this is the better design solution for minimum odour development. If, however, the sludge to be dried is stabilised and well dewatered, automatic feeding is not necessarily required. The sludge turner assembly moves on precast concrete parts as it travels through the greenhouse hall. The design of the actual drying area on WWTP Penzing resembles a normal road. The precast concrete parts take over the function of the kerb stone edge of a road, the space in between is covered with asphalt. The foundation is frost-proof and hardly statically loaded by the machine and sludge. Optimum operator support during the plant start-up phase and afterwards is provided with a remote control connection. The electrical control system records the relevant parameters and via secure internet connection makes them at any time available for the experts in the German HUBER headquarters. Also operating statuses, such as total sludge bed height or operation cycle presently going off, are transferred in real time.

The electronic components to be installed directly on the turner assembly have been limited to the minimum. No control box is mounted on the travelling turner assembly but only a somewhat bigger closed terminal box. The majority of the control components required are integrated in the main control cabinet which is installed in the sheltered area of the drying hall. Their exposure to environmental conditions therefore is reduced significantly with the result of easy maintenance and a long product lifetime. The system installed in the 100 m long and 10 m wide greenhouse on WWTP Penzing is a HUBER Solar Active Dryer SRT 9. Systems for 7 m and 12 m greenhouse width are available as an option.

Solar drying is the most eco-friendly solution to dry sewage sludge. In addition to the economic benefits obtained through reduction of the sewage sludge volumes to be disposed of, also the environmental impact is reduced: Fewer trucks are required for sludge removal with the result of reduced carbon dioxide emission. The high dry residue content in the dry granulate improves the thermal value of the material to be disposed of. It offers plant operators a variety of disposal options so that they get more independence in sludge disposal.

Related Products:

- HUBER Solar Active Dryer SRT

Related Solutions:

- Sludge Drying with Solar and Renewable Energy

HUBER Technology, Inc.
1009 Airlie Parkway
Denver, NC 28037

Phone: (704) 949-1010
Fax: (704) 949-1020
huber@hhusa.net
http://www.huber-technology.com

A member of the HUBER Group