INTEGRATED SLUDGE TREATMENT

THOROUGH SOLUTIONS FOR EXCESS SLUDGE
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Sludge is the unwanted by-product of the wastewater treatment process. This sludge consists of a concentrated mix of solids in water and is biologically unstable: the better the water treatment, the more complete the concentration of noxious wastes in the sludge, the “dirtier” the sludge. This is especially the case when untreated industrial wastewater is connected to the sewage system.

Sludge also contains organic matter, nutrients and energy which can be recovered. Optimizing the sludge value model consists of reducing its volume and making advantage of its intrinsic characteristics.

SLUDGE TREATMENT

Reducing the sludge volume is key in order to limit its handling and transport costs. A series of consecutive technologies makes it possible reducing the sludge volume up to 2 % of the initial volume. Mechanical and thermal dewatering increases the concentration of dry solids from 2% up to 90%, making the dried and stabilized sludge ready for easy storage and reuse as soil conditioner or fertilizer, depending on its composition. When sludge characteristics do not allow agricultural reuse, the best option is sludge destruction by incineration, reducing its volume to 0%.

The consecutive mechanical and thermal dewatering techniques require important amounts of energy. At the same time, sludge contains energy which can be recovered in two ways: sludge can be digested in anaerobic reactors, reducing sludge volume and generating biogas, which is recovered for the production of heat and electric power. Energy can also be recovered from dried sludge as it can be used as a fuel in a fluidized bed incinerator. The incineration process generates heat from the sludge, and this heat can be applied as thermal energy for the drying process or it can be transformed into steam for electricity production.
Fez, Morocco - BIOTIM solids
Capacity: 130,000 m³/d - 1,300,000 PE - 28,800 m³ biogas/d - 3.2 MWe - O&M: 10 years
Depending on sludge composition and local legislation, mechanically dewatered sludge can be used as a fertilizer or compost in agriculture or horticulture. If not, landfill or sludge destruction is the remaining option. In either case, mechanically dewatered sludge still may contain heavy metal ions and pathogens. Sludge odor can also cause discomfort. Stabilization of sludge may be necessary.

**dot.COMPOST®**

Dot.comPOST® is our sludge stabilization solution using lime, for sludge reuse in agriculture or landfill. Lime stabilization increases the dry solids content of sludge by raising the temperature which helps evaporating the water in the following reaction: $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{heat}$.

Apart from water evaporation, adding lime helps holding heavy metal ions in an insoluble form, eliminating pathogens and fermentation, as well as treating unpleasant odors. The sludge must be thoroughly and evenly mixed with lime. Dosing and mixing are critical and require special attention. Dot.comPOST is very cost effective but only applicable when the stabilized sludge can be accepted as a fertilizer or ‘compost’ in agriculture or horticulture.

**ADVANTAGES dot.COMPOST®**

- Reduction of pathogens
- Reduce the excess sludge mass and handling cost
- Improve rheological, mechanical and biological properties of the waste sludge
- Prevent fermentation and odor problems
- Improve soil physical properties (porosity, water retention, stability)
Marrakech, Morocco, BIOTIM® solids
Capacity: 120,000 m³/d - 1,300,000 PE - 18,000 m³ biogas/d - 1.8 MWe
SLUDGE DIGESTION: BIOTIM® SOLIDS

Sludge from wastewater treatment is a valuable energy source. After a first dewatering step in sludge thickeners or Dissolved Air Flotation (DAF) devices, Waterleau’s BIOTIM® Solids anaerobic digestion technology can be used for the production of biogas and the reduction of sludge volume. In the BIOTIM® Solids sludge digesters, the sludge undergoes a mesophilic anaerobic digestion. The methane generation is a key advantage of the anaerobic process. After BELGAS® methane desulfurization, the treated biogas can be used to generate heat and electric power in cogeneration units while reducing the carbon footprint and greenhouse emissions of the wastewater treatment plant. Up to 70% of the energy needs of a wastewater treatment plant can be provided by sludge digestion.

ADVANTAGES BIOTIM® Solids

- Production of biogas available for heat and electric power generation
- Reduction of sludge volume and sludge handling cost
- Reduction of greenhouse gases

BELGAS® BIOSCRUBBER

The renewable energy from biogas is produced in combustion engines that drive electricity generators. Desulphurization of the biogas is necessary to increase life duration of combustion engines while reducing running cost. The BELGAS® scrubber uses activated sludge from biological wastewater treatment as a washing medium, omitting chemicals and avoiding costs for both water and chemicals.
Medinah, Saudi Arabia - HYDROGONE® horizontal disc dryer
Capacity: 2 x 5,300 kg/h evaporation - 120,000 tpy - 1,200,000 PE

Makkah, Saudi Arabia - HYDROGONE® horizontal disc dryer
Capacity: 2 x 6,500 kg/h evaporation - 130,000 tpy - 2,500,000 PE
THERMAL SLUDGE DRYING

Thermal drying is used to achieve up to 80% volume reduction and up to 90% weight reduction, dramatically reducing sludge handling and transport costs. Waterleau proposes two types of indirect dryers: HYDROGONE® horizontal disc dryer and PUTTART® vertical dryer granulator. The choice between both types depends on the desired capacity and the DS (Dry Solids) content of the dried product.

HYDROGONE® horizontal disc dryer

The HYDROGONE® sludge drying technology is an efficient, safe and economical solution for integrating thermal sludge drying in large wastewater treatment plants. The dried sludge can be pelletized or used as fuel in an incinerator for green energy production.

HORIZONTAL DISC DRYER

The HYDROGONE® consists of a heated turning rotor in a stator. The rotor consists of a series of heated discs, placed on a central shaft. The stator is a cylindrical vessel that can be equipped with a heated jacket. The discs (and stator) are heated with steam, hot water or thermal oil. The combined action of the turning discs, the swords between the disks and the agitator blades on the perimeter of the discs ensures optimal heat transfer while slowly moving the product through the equipment.

The dry product is continuously discharged through a frequency controlled discharge screw placed at the bottom at the opposite end of the dryer. Dry product can be partially recycled to the inlet in order to prevent the formation of the glue phase in the dryer.

APPLICATIONS HYDROGONE®

- Drying of municipal sludge (primary, secondary, digested, ...)
- Industrial sludge
- Paper mill sludge
- Manure, chicken litter, ...
- Organic waste

ADVANTAGES HYDROGONE®

- Partially (up to 40% of DS) or complete sludge drying (up to 90% of DS)
- Safe drying process: no fire and explosion risk
- Compact size, limited building height
- Wide range of capacities (from 100 to 6,500 kg/h water evaporation)
- Low maintenance costs
- Robust and proven design
- Minimal energy consumption
Poznan, Poland - PUTTART® vertical dryer-granulator
Capacity: 3 x 3,100 kg/h evaporation - 94,000 tpy - 1,500,000 PE
PUTTART® vertical dryer - granulator

The PUTTART® vertical dryer-granulator is a high capacity installation for simultaneous sludge drying and granulating and can be used for municipal and industrial sludge. The unique drying-granulating combination results in a valuable pathogen-free, easily storable fertilizer end-product.

VERTICAL DRYER - GRANULATOR

Mechanically dewatered sludge is extracted from the reception bunker and pumped to the coater. The coater puts a fresh layer of wet sludge around dry recycled granules. The coated granules enter the dryer from the top and fall onto the first tray. The tray is internally heated with thermal oil. This means that drying is done in an indirect way (no fire and explosion risk).

The granules are transported from the inner to the outer circumference of the tray by raking arms, mounted on a slowly rotating central shaft. The granules roll over the tray and thus friction is minimal. At the outer side of the tray, the granules fall on the tray below. The granules are now transported back to the center. This zig-zag movement is repeated on the trays below.

At the bottom of the dryer the granules are collected and the larger granules are separated from the smaller ones. The small granules are recycled to the coater; the large granules are cooled and evacuated to storage.

Vapors are condensed while incondensable gases (odors, VOC) are evacuated and destroyed.

APPLICATIONS PUTTART®

- Drying of municipal sludge (primary, secondary, digested, ...)
- Industrial sludge
- Paper mill sludge
- Manure, chicken litter, ...
- Organic waste

ADVANTAGES PUTTART®

- Complete sludge drying (up to 90% of DS)
- Drying and granulating in one
- Safe drying process: no fire and explosion risk
- Wide range of capacities (from 3,000 to 14,000 kg/h water evaporation)
- LILLIPUT® disk dryer-granulator for smaller capacities
- Low operating costs
Pitesti, Romania - HELIOSOLIDS® fluidized bed reactor
Capacity: 80,000 tpy - Energy production: 1.6 MWe
SLUDGE INCINERATION

Bio-solids like municipal sludge, industrial sludge and fine solids can be incinerated with the advantage of eliminating the sludge. Depending on the calorific value of the sludge being incinerated, pre-drying of the sludge, pre-heating of the combustion air as well as the use of an auxiliary fuel may be necessary. Energy from the incineration process can be recovered as green energy source for thermal sludge drying.

HELIOSOLIDS® fluidized bed incinerator

The HELIOSOLIDS® fluidized bed reactor is a fluidized bed furnace for the staged combustion of wastewater sludge, bio-solids, industrial sludge and fine solids. The reactor features integrated heat recovery, a stable fluidization and combustion process, and integrated flue gas cleaning.

FLUIDIZED BED INCINERATOR

A fluidized bed is a sand bed through which air is blown vertically from bottom to top at a speed that keeps the individual sand particles floating. The HELIOSOLIDS® fluidized bed reactor is a so-called bubbling bed, which means that the fluidization air speed is such that the particles are not carried away with the air. The sand bed behaves like a boiling liquid.

Sludge is introduced in the reactor just above the bed. The fluidization air is injected in the sand bed using a specially designed distributor plate that has to guarantee an even distribution of the air in the bed, and to avoid that sand flows back in the air duct. The organic solid fraction of the sludge is thermally oxidized generating a high temperature, while the remaining water in the sludge is evaporated. The inert solid fraction of the sludge is elutriated with the combustion gases, and will be captures in the flue gas treatment.

APPLICATIONS HELIOSOLIDS®
- Municipal and industrial WWTP sludge
- Oily sludge and slurry
- Spent grains
- Paint and paint sludge
- Shredded wood and pellets
- Biosolids
- Meat and bone meal (MBM)

ADVANTAGES HELIOSOLIDS®
- Total destruction of sludge
- Energy recovery from combustion process
- Flexibility in operation and injected waste streams
- Perfect combustion
- High ROI
- Low flue gas emissions
Marrakech, Morocco, BIO TIM® solids
Capacity: 120,000 m³/d - 1,300,000 PE - 18,000 m³ biogas/d - 1,8 MWe
The purpose of integrated sludge treatment is to maximize the intrinsic value of sludge in its volume reduction process. Depending on sludge characteristics, one or more from the aforementioned treatments steps is used to optimize the sludge value model.

- Sludge digestion and biogas production, used as energy source for operating the WWTP plant
- Sludge drying, as a pre-treatment step for sludge incineration
- Sludge incineration with heat recovery, used for both thermal sludge drying and for additional electric power generation

Sludge drying requires energy (heat), sludge incineration produces heat. The combination of sludge drying and sludge incineration is a proven set-up for treatment of excess sludge. Sludge drying increases the heating value of sludge above the threshold of autothermal combustion, which allows energy recuperation to cover the energy consumption of the dryer.

The next step is to combine the sludge digestion (BIOTIM® solids) with gas engines in CHP, sludge drying (HYDROGONE® horizontal disk dryer and PUTTART® disk dryer granulator) and HELIOSOLIDS® sludge incineration, with treatment of all side streams (e.g. ammonia stripping, BELAIR® flue gas treatment). Also phosphates are concentrated in the combustion ashes from where this limited available nutrient can be recovered.

Waterleau is one of the few players having all the necessary knowhow to set up these complex, integrated treatment systems.
A COMPLETE PORTFOLIO OF SLUDGE VALORIZATION SOLUTIONS TURNING A PROBLEM WASTE INTO AN OPPORTUNITY

We all have the responsibility to handle our natural resources in a careful and sustainable way. Waterleau develops environmental technologies and offers sustainable solutions for water, air and waste treatment, as well as for energy recovery. As an EPC contractor and operator, Waterleau counts more than 1000 references for municipal and industrial clients around the world.