COMBINED SLUDGE DRYING AND INCINERATION

Sludge is the unwanted by-product of the wastewater treatment process. After mechanical dewatering it typically is a concentrated mix of 20% solids in 80% water. The solids consist of inert matter (sand...) and organic matter in a ratio which depends on many factors (e.g. whether or not the sludge has been digested). Mechanically dewatered sludge is biologically unstable and requires further treatment because its disposal in a landfill is not allowed or not wanted. A good solution is thermal drying, which removes the water from the sludge. It is however, not a complete solution as the remaining dry sludge still needs to be disposed off (in a cement kiln, an incinerator, etc.). Direct incineration is a viable alternative, but it requires additional fuel for a stable combustion process.

An intelligent and proven set-up is to combine drying with incineration: the dryer removes part of the water, thereby increasing the heating value of the sludge to above the threshold for autothermal combustion. The incineration of the pre-dried sludge must generate enough energy to cover the energy (heat) consumption of the dryer.

EXCESS SLUDGE

The objective of the integrated sludge treatment is the complete and efficient destruction of the excess sludge.

From the point of view of thermal treatment, mechanically dewatered sludge consists of three components:

1. Water: the biggest fraction (typically 80%). Water removal by thermal treatment means evaporation, which requires large amounts of heat (thermal energy).
2. Inert matter: typically sand and other minerals. Inert matter is not affected by the thermal processes of drying or incineration.
3. Organic matter. The biological components (VSS) in the wastewater are removed by the biological treatment process and are converted into the biosolids that are collected in the primary or secondary settlement. Part of this organic matter may be converted in biogas in the digesters. The organic matter is the only source of energy for the integrated thermal treatment!

HEAT RECOVERY FOR DRYING

Mechanically dewatered sludge cannot be incinerated autothermally, i.e. reaching a temperature above 850°C without the use of auxiliary fuel. Auxiliary fuel is a big operational cost and thus is to be avoided. That’s why it is necessary to increase the %DS before incineration.

And so we come to the two steps of the thermal process:

1. Drying in order to increase the %DS.
2. Incineration of the pre-dried sludge.

Drying is a heat consuming process, whereas incineration produces heat. In integrated sludge treatment both processes are designed so that the heat required for drying is recovered from the heat released by the incineration.
In the integrated sludge treatment process Waterleau uses either one of its two sludge drying technologies: the HYDROGONE® horizontal disc dryer or the PUTTART® vertical sludge dryer – granulator (see separate leaflets). Both are indirect dryers, with the inherent benefits of being very safe and leading to small gas flows to be treated.

Mechanically dewatered sludge is introduced into the sludge dryer and comes into contact with the hot plates of the heat exchanger, heated by steam or thermal oil. The sludge is heated and the water in the sludge evaporates (at 100°C, near atmospheric pressure). The vapours are extracted from the dryer and transferred to the vapour condenser. The sludge dryer is a near perfect heat exchanger, i.e. the heat released by the steam or thermal oil is nearly all used for heating of the sludge and evaporation of the water.

The vapours are condensed and the condensate is returned to the WWTP influent for treatment. A small portion of the vapours does not condensate and, as they contain volatile organic compounds (VOCs), requires further processing. The sludge incinerator is the ideal solution as it operates as a thermal oxidiser to destroy the VOCs.
SLUDGE INCINERATION

Incineration is combustion or oxidation (reaction with oxygen) of the organic matter thereby releasing large quantities of energy (heat). The water in the sludge is evaporated (this requires heat). The small inert particles in the sludge are carried with the flue gases as particulate matter (PM) or dust.

In the integrated sludge treatment process Waterleau uses its HELIOSOLIDS® fluidized bed incinerator (see separate leaflet).

As the lower heating value of the sludge is still relatively low after pre-drying, the combustion air is preheated as much as possible. This brings extra heat into the reactor.

The sludge is introduced into the incinerator together with the hot combustion air. The flue gases travel vertically upward into the post-combustion chamber where they burn out and in which the legally required residence time of more than 2 seconds is guaranteed.

1. HELIOSOLIDS® fluidized bed reactor
2. Steam boiler
3. Steam drum
4. Cyclone
5. Reactor
6. Baghouse
7. Stack
8. Dust container
INTEGRATED SLUDGE TREATMENT

Integrated sludge treatment is thus the clever combination of indirect sludge drying and efficient sludge incineration. Depending on the specific project context many variations are possible:

1. If the sludge is sufficiently mechanically dewatered (typically >28%DS), it is possible to recover additional energy (heat and/or power).
2. Alternatively, the plant can be designed to dry part of the sludge completely (i.e. >90%DS), so that an alternative use (e.g. as biofuel) is possible.
3. The plant can also process external sludge, not only the sludge of the WWTP on which it is built.
4. If the sludge is digested, the biogas power plant can be combined with the integrated sludge treatment plant to achieve further optimizations.

![Diagram of integrated sludge treatment system]

- **HELIOSOLIDS®** sludge incineration
- **HYDROGONE®** sludge drying

**Sludge transfer and reception**  **HYDROGONE® sludge drying**  **HELIOSOLIDS® sludge incineration**  **Heat recovery**  **Flue gas cleaning**
HYDROGONE® & HELIOSOLIDS: COMPLETE AND EFFICIENT DESTRUCTION OF EXCESS SLUDGE

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.