

# Thermal Hydrolysis Process

*A simplified explanation of the process, the impact and practical guidance*

Joost Edens, Luca Foppiani, Erwin Dirkse

DMT Environmental Technology B.V., & Sustec B.V., part of DMT Group [www.dmt-et.nl](http://www.dmt-et.nl)

Let's be clear



## **Abstract**

The thermal hydrolysis process (THP) has proven to be a valuable process to optimize anaerobic digestion by increasing the biogas production and by increasing the digester capacity. The process is gaining interest worldwide and utilities and biomass valorisation companies are looking to apply this process. This article describes the basic principles of the process, its benefits, items to consider when to apply THP and provides upfront key-point that have to be addressed before implementing THP process.

## *Keywords*

Sludge treatment, biosolids, disintegration, Thermal Hydrolysis, Advanced Digestion, Biogas, cTHP.

## **Introduction**

Sludge disposal is an increasing part of the running costs of water treatment facilities. Conversion with anaerobic digesters (AD) has been implemented worldwide to reduce digestate volume and to obtain revenue, biogas. Recent years, a pretreatment process has been growing in popularity to improve further digestate disposal volumes and increase biogas yields, process like the thermal hydrolysis process. While there are other forms of hydrolyzation, such as bacteriological and chemical, thermal hydrolysis is providing the largest impact to the sludge disposal volume, benefitting the end user.

## **What is thermal hydrolysis?**

Material is fed into a reactor on an elevated temperature. Sludge cells adhesion (flocs) and cell wall structures are disintegrated due to rapid temperature increase, high-temperature reacting time and (rapid) temperature decrease. All three factors have an impact on the breakdown efficiency, one larger as the other. One way of measuring the breakdown is the increase of soluble chemical oxygen demand (COD). Research has shown that this increases from already treating at 70°C (pasteurization temperatures), but really 'kicks in' from 120°C. While with higher temperatures more COD is solubilized, the fraction of inert matter of COD and other impurities as inert organic Nitrogen are also released. Since these commonly are sent with the reject sludge liquor back to the treatment plant, there is a perfect balance between maximum solubilization and minimum inorganic compound release. The common reaction time for a thermal hydrolysis process (THP) is 30 minutes, on a temperature of 140°C.

## **What are the benefits?**

The disintegration of bacterial cells and sludge flocks mostly impacts the sludge produced during the treatment process, also referred to as Secondary Sludge (SS), Waste Activated Sludge (WAS), Site Activated Sludge (SAS) or Excess Sludge (ES). There, implementing a THP as pretreatment for the AD commonly improves the final dewaterability from about 20% dry solids (DS) to about 30% DS. Due to



the disintegration, organic matter (OM) or volatile matter (VM) degradation is within the AD process improved from around 30% to 50%. When applying THP to primary sludge, the VM degradation may be improved from 55% to 60%, with little or no dewaterability improvement.

When considering THP, from a process impact point of view, application to WAS only is therefore the preferred route. Hygienisation of the sludge can be achieved by other low-cost processes, such as pasteurization.

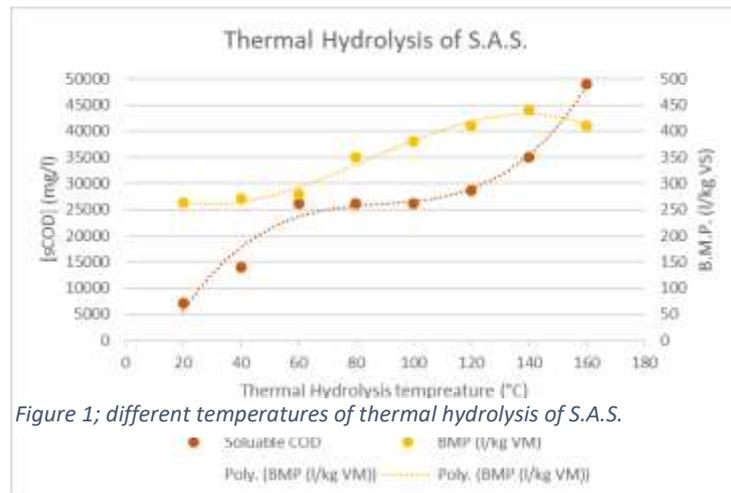


Figure 1; different temperatures of thermal hydrolysis of S.A.S.

Due to the disintegration, the structure and therefore rheology of the sludge is permanently changed. This enables operators to feed into existing AD reactors on DS concentrations twice of untreated WAS sludge. Now, existing AD reactors can process twice the amount of sludge while maintaining similar retention times.

### What else do I need to know?

As explained above, you now can feed into your digester with higher DS concentrations. That means that adjustment of prethickening equipment possibly is required. Typically, the sludgestream feeding into a THP system is 11 to 16 % DS. After a THP-system, the hydrolyzed stream is commonly too high in temperature to feed into a digester directly. Addition of (prethickened) primary sludge is a direct cooling method to reach the desired AD-temperature. When this is insufficient or not available, you can consider to switch to thermophilic (55°C) digestion. Alternatively cooling can be performed to get to mesophilic (40°C) digestion temperature.

Since you have increased the dry solid concentration, the concentration of ammonium as released within the digester, as well as additional organic matter degradation, will be increased. It is important to evaluate up-front what that increased concentration will become to avoid operational issues. Various experiences in WWTP's are present to handle these increased concentrations. It is commonly accepted to work with concentrations up to 3 g/l. When phosphorus is (biologically) captured in the sludge, release and thus concentration in the digester will also increase. Sustec can advise what the impact of these elevated concentrations will be, if you have to take preventive measures or apply sidestream specific treatment steps (ammonium reduction or struvite precipitation).

### Why do I apply this process?

Basic principle of hydrolyzation is to degrade cell structures or other complex structures. It originated from handling wood in the paper- and pulp industry. Primary sludge consists much more out of colloidal material, hence the impact of THP is relatively small, with 10 % improvement at best. When considering thermal hydrolysis to improve dewaterability and biogas yield from biomass digestion, the structure of these biomasses should be looked at. This is why the impact of THP on SS is an



improvement of 65 % of conversion to energy. As explained above, hygienisation can be reached by other, lower cost solutions, such as pasteurization or the addition of CalciumCarbonate ( $\text{Ca}_2\text{CO}_3$ )

### **What are advantages of the TurboTec® THP?**

Now-a-days there are several THP-suppliers active on this market, so how do you pick the right supplier for your project? Some basic considerations are the level of knowledge of each supplier. Not only of their own technology, but in particular the impact of their technology when applied to your sludge treatment line, waterline and overall energy balance. Demonstration of this knowledge on fullscale sites will help within the engineering phase of the project to bring your project to a success. Main difference within the present players is the operating principles of each. These is either on batch or continuous basis.

Sustec, part of DMT groups, has developed a continuous thermal hydrolysis process (cTHP). The technology has been installed on waste water treatment plants since 2008 and has realized full-scale references. This experience and the experience of the company as whole, makes it a reliable technology and a trusted partner. Multiple advantages are linked to continuous systems, of which the main two are being lower in investment cost (THP and auxiliary equipment as steam boiler and buffering), as well as being able to operate on lower temperatures (140°C) while maintaining similar energy recovery efficiencies. This is an advantage because higher temperatures (160°C) cause an increase of release of inert organic nitrogen and COD into the liquid phase and therefore affect the process. This is difficult to handle for a WWTP, since it has to compensate for these additional inorganic compounds by further improving the reduction efficiency on organic degradable compounds.

### **What should I do now?**

If you have question about the thermal hydrolysis process, our specialist are happy to help you with your questions. We can draw up a business case and help you answer your questions about the technology and the implementation on your site. We would be happy to work together with you to understand from both CAPEX and TOTEX point of view the impact, as well as discuss engineering items to consider. Sustec, part of DMT group, offers various types of THP, to enable cost-efficient co-digestion of sludge, also with other streams and the production of hygenised sludge.