

## **HIGHLY EFFICIENT BUCHER HPS DEWATERING TECHNOLOGY PRIOR TO INCINERATION TO ACHIEVE A POSITIVE ENERGY BALANCE IN SLUDGE TREATMENT**

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### **Abstract**

Waste water treatment generates high amounts of sludge and the strategies in the past decades were focussed on disposal routes and reduction of the sludge quantity with minor focus on the energy balance.

Today, biosolids are more and more considered as a source of carbon, energy and are recycled as primary resources.

But, even with advanced sludge treatment processes like AD, there is a loss of energy if a complete sludge treatment energy balance including incineration is made. Reducing organic contents results in a loss of heating value that has to be balanced by a more efficient dewatering, achieving higher sludge cake dryness at low energy cost and without heat consumption.

The Strasbourg (France) case study shows that thanks to the high dry solids content achieved by Bucher HPS sludge press, the waste water treatment plant is changing from a fossil energy consuming sludge process using 1500m<sup>3</sup> fuel/year, to a positive energy balance sludge line producing 17-18 GWh/year of bio-methane to sell.

In South of France, the Beziers-Mediterranée agglomeration extended its WWTP and decided to set-up an incineration plant. One of the key parameters was to operate the furnace without neither gas nor fuel consumption. Thanks to advanced dewatering they will be able to fulfil the fixed goals and even fully recover the heat produced by the furnace.

### **Keywords**

Increased Bio-methane production, Bucher HPS, energy recovery, incineration, positive energy balance in sludge treatment, sludge dewatering, Dehydri Twist..

## Introduction

Waste water treatment generates high amounts of sludge. In the past decades sludge management strategy was centred around sludge amount and reduction problems without big concern on energy consumption and residual value of something often still considered as a waste. Nowadays, in a context of ecological, economic and energetic crisis with growing stress on primary resources, a more global approach is needed.

Biosolids are more and more considered a valuable resource, full of organic matter, ammonia, phosphorus and even in precious and semi-precious metals. Biosolids are one of the future primary material and energy resource.

Biosolids reused in agriculture is more and more a concern or is even forbidden in some countries. Even if agricultural reuse stays a conventional evacuation way, higher treatment level will be required to ensure users acceptance (hygienisation aspect, phosphorus availability, agronomical value,...)

There are plenty of problems and solutions and one of the most common is anaerobic digestion or boosted AD that allows to convert part of organics into biogas. But to be efficient, produced energy has to be valued and not simply consumed by the other treatment steps.

Indeed, in most cases, the energy produced by AD is fully used by further sludge treatments such as sludge drying and/or incineration.

Facing those energetic issues, WWTP's of Strasbourg Euro Metropole and Beziers Méditerranée Agglomération, with totally different processes, decided to implement Bucher HPS piston press in order to increase WWTP energetic efficiency and even produce energy from sludge incineration.

## Bucher HPS dewatering technology

Bucher HPS piston press is an innovative mechanical sludge dewatering technology.

The technical concept is based on 2 principles:

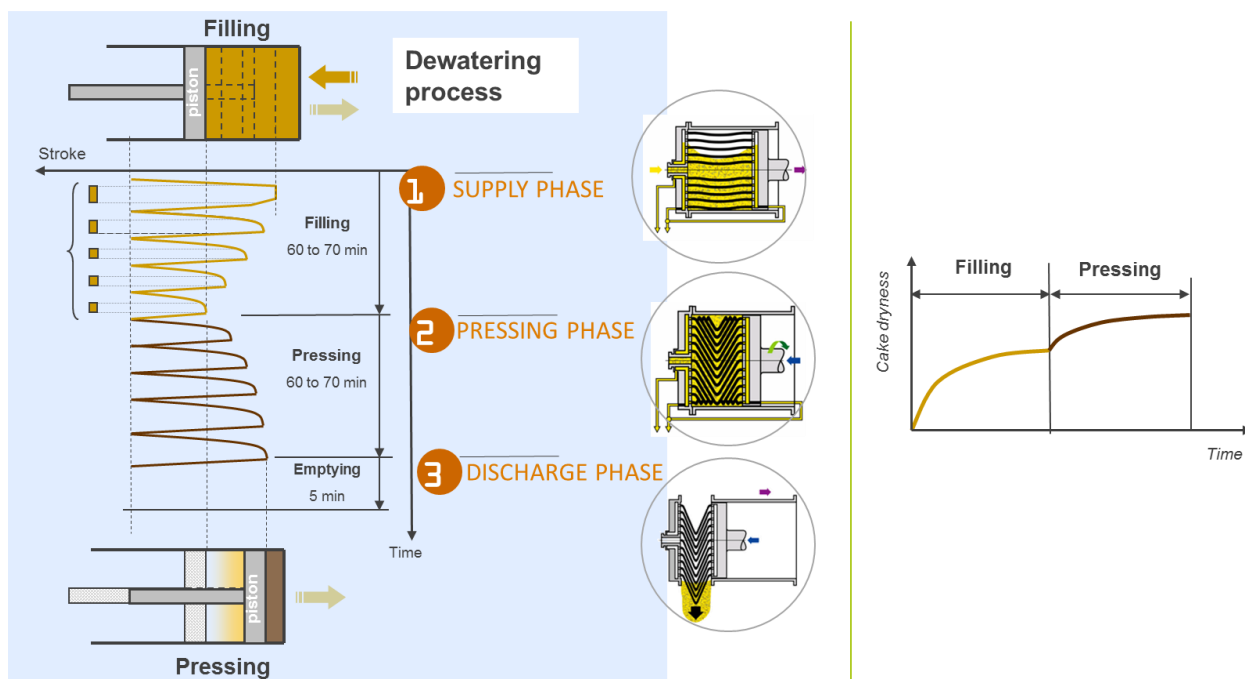
- applying pressure to the sludge in a pressing chamber via a hydraulic piston
- shearing of the sludge and permanent renewal of contacts between filter medium and flocculated sludge thanks to the movement of the piston while the whole chamber is rotating

The press cycle is divided into 3 phases (figure 1):

- filling with preliminary pressing
- pressing and loosening
- dewatered sludge discharge

With low energy consumption (20 to 30 kWh/TDS) and a sludge cake volume reduction from 25 to 50% in comparison to conventional dewatering processes, the Bucher Press contributes to WWTP energy efficiency and to greenhouse gas emission reduction.

Due to high DS content achieved, Bucher HPS dewatered sludge cakes are, in most cases, auto thermal, avoiding an expensive and energy intensive drying step in front of incineration units.



**Figure 1: Bucher HPS dewatering process**

## Strasbourg WWTP sludge stream upgrade project (France)

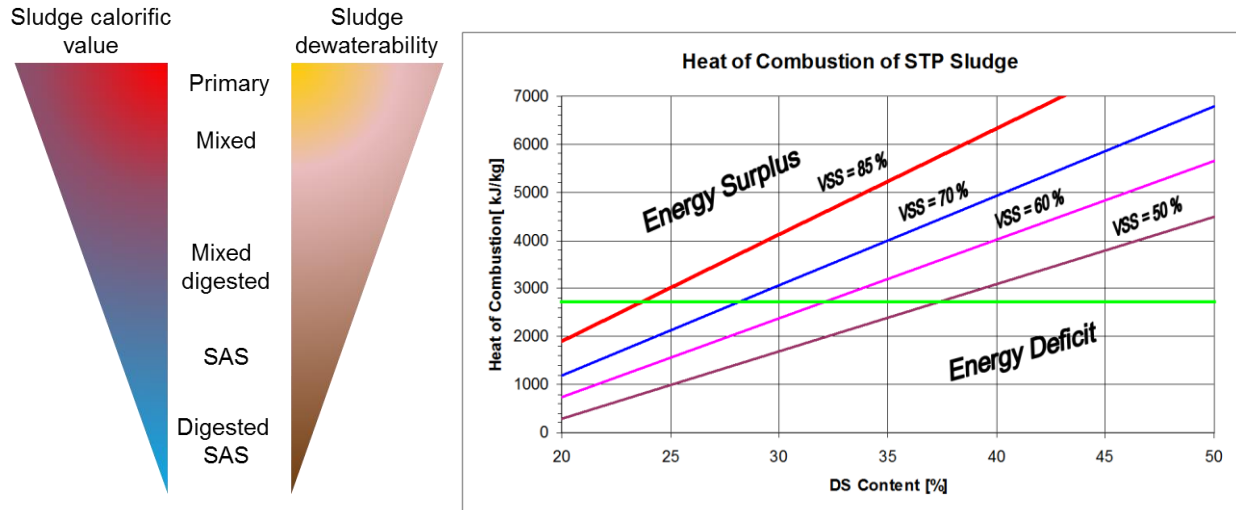
The Urban Community of Strasbourg has ambitious environmental goals in terms of greenhouse gases emission reductions and energy efficiency improvement using renewable energy sources. With a treatment capacity of 1,000,000 inhabitant equivalents, the La Wantzenau Wastewater Treatment Plant is the fourth largest WWTP in France. The sludge produced by the plant is 50/50 primary/biological (expressed in DS). The volume of biogas produced by this facility's digesters represents a potential energy generation capacity of 16 GWh/year of network injectable biogas, which is equivalent to the annual needs of 5,000 low energy consumption homes.

### Past situation

When Suez overtook plant operation on 01/10/2010 the plant was highly dependent of fossil energies. Only 40% of the biogas produced was reused and incineration exhaust energy wasn't valorised. The fuel consumption for incineration of sludge and complementary digester heat up was close to 1.500 m<sup>3</sup>/year, 16,6 GWh/year.

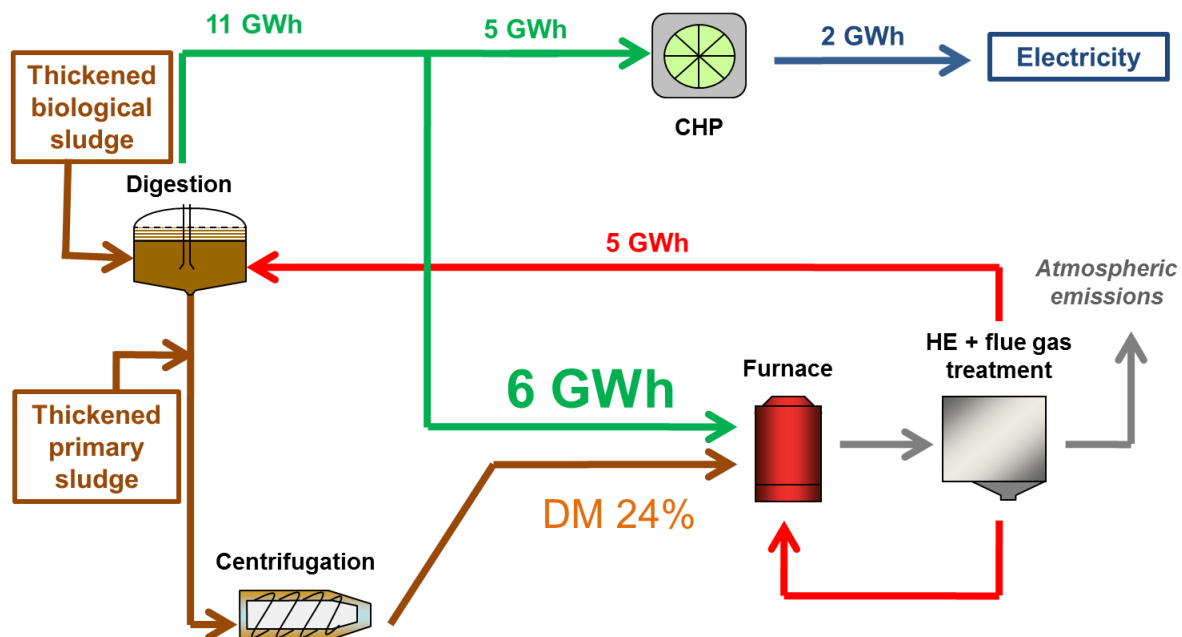
Suez first improved the energy balance by:

- implementing new equipment's to recover exhaust heat from incineration plant,
- improving bio gas purification to use the bio gas for sludge incineration,
- Reducing biogas production in order to increase the thermal capacity of centrifuge dewatered sludge (Digested SAS only mixed with fresh primary sludge) see figure 2.



**Figure 2:** Calorific value linked to dewatering potential of different sludge types

In fact digestion reduces the sludge organic content, dewaterability and calorific value. Produced methane wasn't sufficient to compensate the loss of thermal capacity so Suez decided, based on experimental results, to give priority to heating value instead biogas production in order to achieve at least a neutral energy balance presented in figure 3.



**Figure 3:** Modified treatment line in order to achieve a positive/neutral energy balance

Those adjustments already allowed big savings achieving a neutral to positive energy balance. But Suez and Strasbourg Eurometropole higher goal was to unlock the full energy potential of the sludge to turn the plant from neutral to a green energy production plant.

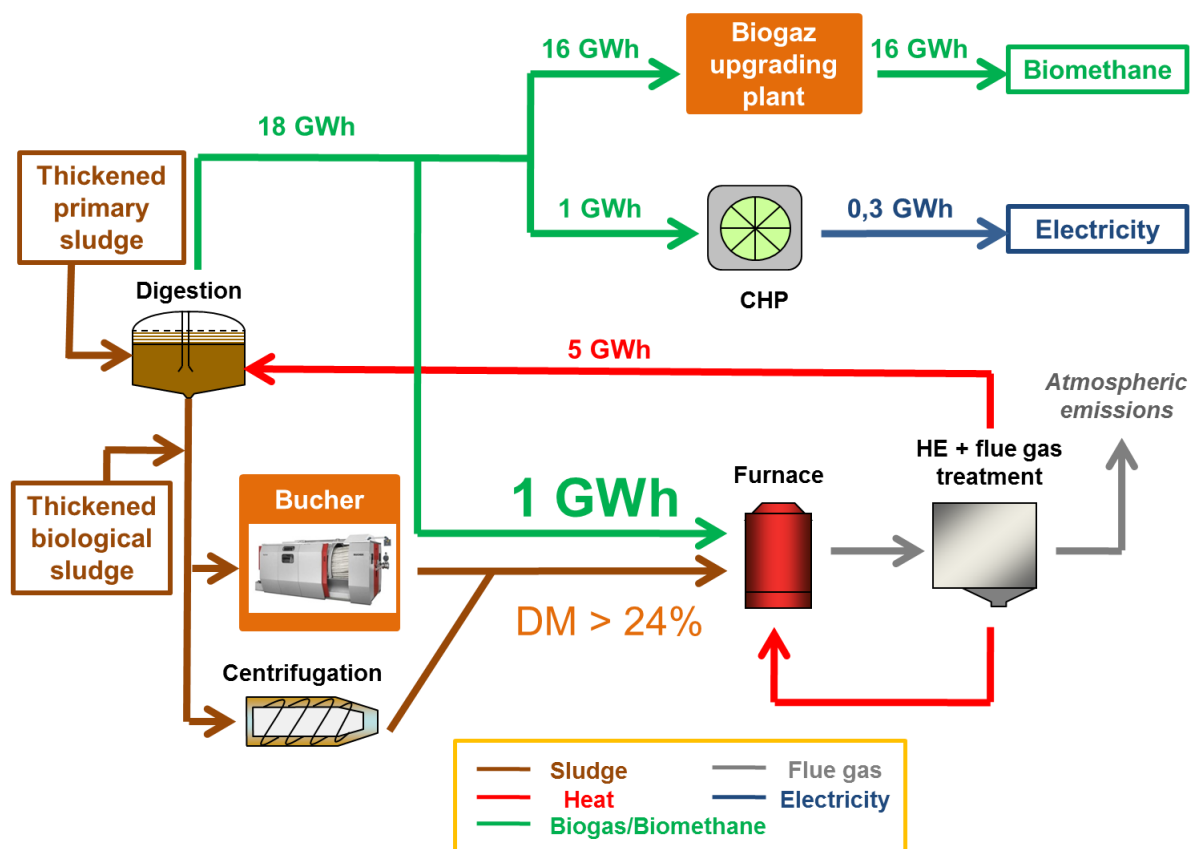
## Present situation

To unlock the full potential of energy recovery (16GWh/year) in the sludge they had to increase gas production by digesting the primary sludge and in the same time increase sludge calorific value at lowest energy costs.

In order to maximise the biogas production potential without changing the digestion capacity, primary sludge has to be digested instead of biological sludge while the final dewatered sludge cake heating value has to be increased. A comparison of different existing technologies showed that the piston press was the best solution to achieve this goal due to its boosted dewatering performance.

The implementation of one HPS 12007 piston press from Bucher-Unipektin (1000 to 1600 kg DS treated per cycle) to dewater only a part of the sludge produced by the plant is sufficient to increase the total sludge heating value (mix of centrifuge and piston press sludge) to a level close to autothermic threshold with a power consumption lower than 30 kWh/ T DS.

The Figure 4 here below shows the new energy balance obtained.



**Figure 4: Energy balance after implementation of the Bucher Press in treatment line**

In the end, to digest primary sludge instead of biological sludge allows to produce 63% more biogas on digesters. The decrease of the sludge dewaterability induced by this modification is fully compensated by the implementation of the piston press that allows achieving better dewatering performance compared to the initial centrifugation unit. The increase of the dryness of the cake that will enter the furnace makes it possible to largely limit the biogas consumption needed to run it (83% less) as summarized in Table 1 here under.

**Table 1: Impact of the modification of the sludge treatment line on dryness and heating value**

	Digested sludge	Biogas produced  GWh	Centrifuge dryness  %	Piston press dryness  %	Biogas consumed (furnace) GWh	Recovered bio methane  GWh
Initial situation	Biological	11	24	0	6	0
New situation	Primary	18	22	30	1	16

### Beziers WWTP sludge stream upgrade project (France)

The Beziers Wastewater Treatment Plant has a capacity of 220,000 inhabitant equivalents. The sludge produced is only SAS and represents 6 586 kg DS/d at 5.5% dryness before dewatering and the VS content is above 80%.

When the upgrade of the sludge stream line has been discussed, several specifications were defined and the technical solution chosen needed to answer to the following challenges:

- To make it possible for a downstream incinerator to run without gas nor fuel consumption, which means to find a simple way of increasing the sludge dryness to its auto-thermal level (a minimum of 24% for the biological sludge of Beziers);
- Not to use the heat produced by the furnace so that this heat can be fully recovered;
- To minimize odour emission.

The piston press technology answers perfectly to these specifications.

The implementation of two HPS 7507 piston press from Bucher-Unipektin (600 to 1000 kgDS treated per cycle and per machine) to dewater the total amount of sludge produced by the plant allows to obtain a sludge dryness from 24 to 26% (versus 18 to 20% with the initial centrifuge unit), with a capture rate of 98%, without heat consumption and no odour emission (the machine is operated completely closed).

The sludge cake produced is auto-thermal and mixed with a small quantity of external grease (also treated on the plant), makes it possible to run a downstream incinerator without neither gas nor fuel consumption (except transitional phase or cold start).

Moreover, the automatic regulation allows a constant optimization of the piston press parameters to the quality of the sludge to treat making the performance stable. The machine consumes less energy compared to the centrifuge of the initial sludge line and presents no thermal risk compared to a thermal dryer.

## Conclusion

Those plants are two examples of how sludge coming from totally different processes could be integrated in a global approach combining performances and energy efficiency.

In both cases the Bucher press is the key element of the process by achieving sufficient dewatering performances to allow a direct feed of an incinerator without need for a cost and energy intensive drying step.

Performances are achieved under full automatic operation conditions and at low energy costs. Experience and trials have shown that a Bucher HPS press is able to dewater most types of biosolids to levels that exceed the expected lower heating value for incineration.

Those results are opening a lot of solutions to integrate the WWTP's as part of the energy grid and as a source of recycled raw materials.

The choice for the treatment line is fully open, from most basic to advanced processes and will depend of the local context, and the kind of energy or resources needed.

The Bucher HPS press will offer the lowest post treatment costs for biosolids whatever the treatment line. Even a simple aerobic waste water treatment process is, in this way, able to fully recover exhaust heat energy from direct biosolids incineration.

An anaerobic digestion and THP will allow converting a big part of organics from biosolids to bio-methane, or HTC processes can produce "bio-coal" that could be easily transported to another site, e.g. a coal power plant.

In the public sludges are becoming more and more biosolids, a valuable product. Tomorrow, waste water treatment will be commonly considered as water energy and resource recovery plants.

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