CHARACTERIZATION OF THERMAL HYDROLYSIS AND ANAEROBIC DIGESTION COMBINED PROCESS IN A PILOT PLANT

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In a conventional wastewater treatment plant about 60% of sewage pollution is converted in sludge that is treated in the anaerobic digestion for its stabilization and biogas production. However, anaerobic digestion presents some disadvantages, such as high hydraulic retention time (above 20 days), high digester volume (high cost) and a limited degradation rate of the organic matter at the hydrolytic stage. Therefore, the improvement of the process is associated with the improvement of the hydrolysis step. A higher and faster degradation could be achieved by the enhancement of the solubilisation of the non-dissolved compounds, by breaking them into monomers more accessible for the anaerobic bacteria. Therefore, it is necessary to introduce a pre-treatment unit prior to digester.
Among the different alternative treatments (mechanical, biological, ultrasound,…), thermal hydrolysis stands out from the rest, being its principal advantage that the thermal energy requirement could be satisfied by the energy generated in the process and therefore get an energetically self-sufficient system. Although thermal hydrolysis is widely studied in the literature, most of the researches have looked at a laboratory scale point of view for batch biodegradability test. However, in order to get reliable data about the technology and set the calculation basis for a future plant, the operation of a pilot plant is necessary, quantifying not only the biogas performance, but also the digestate characteristics (dewaterability, sanitation, …).

The objective of this research is to make a technical and economic feasibility study from a practical point of view, working in a pilot plant fed with concentred sludge (that is an energy requirement of the process), and evaluating the digestate characteristics (dewaterability, rheology, sanitation,…).

The pilot plant is composed by two units:

Thermal hydrolysis unit: Thickened waste activated sludge (10L) is fed to the hydrolysis reactor with a progressive cavity pump (Pmax= 12bar) and is activated a pressure control that lets introduce steam from a boiler to maintain a temperature of 170ºC and pressure of 8 bar in the interior of the reactor. After 30 minutes, the content of the reactor is decompressed to the flash tank. The hydrolyzed waste activated sludge is blended with thickened primary sludge in the same volatile solid ratio.

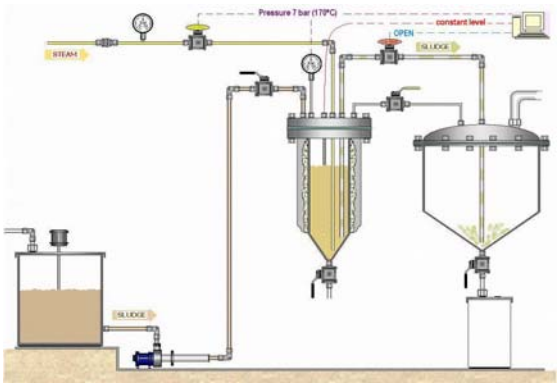

Figure 1. Thermal Hydrolysis pilot plant.

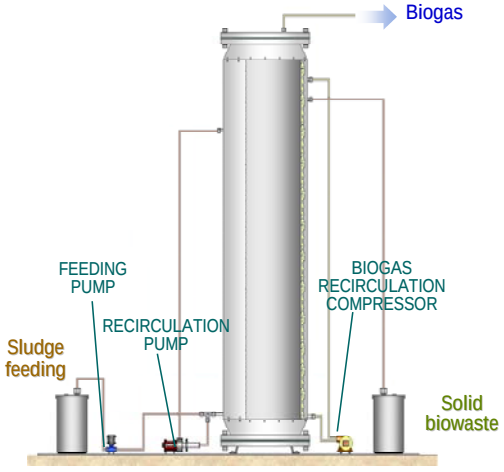

Figure 2. Pilot plant for sludge digestion

Anaerobic digestion unit. The mixed sludge is continuously fed to a mesophilic anaerobic digester (200L) provided with a sludge recirculation pump and a biogas compressor to assure a complete agitation and avoid dead zones inside the reactor.
The approach of the study is:

- to evaluate the influence of the thermal hydrolysis on the digestion kinetics (residence time needed in the digester?)
- to define best the thermal hydrolysis pre-treatment time (different than the conventional 30 minutes?)
- digester performance 8VS removal, biogas production, …) compared to the conventional digestion
- digestate characteristics (pathogens, CST, viscosity,…) compared to the conventional digestion

Relevant publications

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Pérez-Elvira S.I, Fdz-Polanco M, Fdz-Polanco F (2010). Increasing the performance of anaerobic digestion: Pilot scale experimental study for thermal hydrolysis of mixed sludge. Journal of Frontiers of Environmental Science and Engineering in China 4(2): 135-141.

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