BIOGAS EXPLOSION PRE-TREATMENT OF MUNICIPAL SLUDGE TO ENHANCE ENERGY BALANCES IN WWTP

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Social and political demands for the sustainable use of energy resources have prompted the water industry to step up energy-saving efforts. In addition to the high costs of electricity and other energy carries, companies in the water industry are increasingly responding to the heightened environmental awareness of their customers. In water resources management, it was found that energy demand for wastewater treatment plants (WWTPs) constitutes a major share of overall energy consumption. Some of this energy can be recovered by exploiting the energy potentials of wastewater, for example, for organic matter transformation into biogas sludge is the only stream that can produce energy in a WWTP. Subsequently received biogas could be used for generating electricity and heat or directly for some process in a WWTP. Implementing sludge treatment processes, prior to anaerobic digestion, the medium-term goal of becoming an energy-neutral or even energy-positive WWTP seems feasible and appropriate. In this sense, thermal hydrolysis "steam explosion" is widely used to increase methane production. In parallel the "ammonia explosion" process is used in the field of straw hydrolysis.

Figure 1 shows the results obtained from the WWTP in which the pretreatment system prior to anaerobic digestion was installed, which allows increasing the biodegradability of sludge by 35%.
In these new conditions without changing any other parameter of design or operation usual for others WWTPs, the plant becomes energetically self-sufficient.
Analyzing the mechanisms of both processes, it is possible to conclude that a process of "biogas explosion" can lead to results similar to those of the "steam explosion".

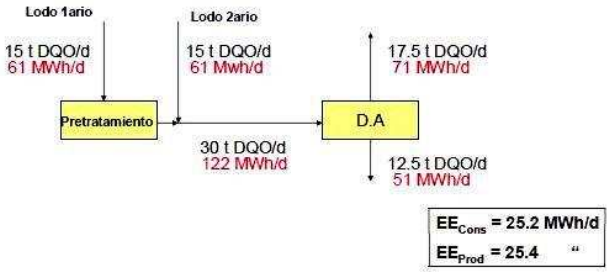

Fig. 1. Material and energy balances for a WWTP with pretreatment before anaerobic digestion

This work aims to establish the fundamentals and efficiency of the new "gas explosion" (CH_4, CO_2, biogas) process, design and build an experimental set-up. The experiments will be carried out in a lab scale experimental set-up, which will be designed and constructed based on our own experience in thermal hydrolysis, due to this research constitute an initial basic study on a new gas explosion process. The system will operate at batch mode and its flow diagram is reflected in figure 2.

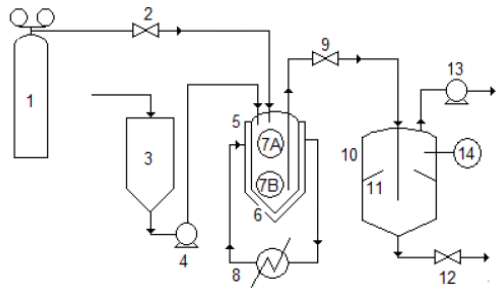

Fig. 2. Diagram of "gas explosion" system

The system consists of a bottle of gas (CH_4, CO_2, biogas) (1), flow regulation valve (2), feeding tank (3), sludge feeding pump (4), pressure reactor (5), casing (6), meters for pressure, temperature and time (7A,B), heating fluid (8), flash valve (9), flash tank (10), deflection plate (11), hydrolysed sludge release valve (12), vacuum pump (13), vacuum meter (14).

Steam explosion disintegrates the cell membranes, thus enhancing solubilisation, but the biodegradability of the hydrolysate might be limited. Biogas explosion physically breaks up the microbial cell walls, and its effect depends on the mode of pressurization and the pressure applied.
Therefore, in order to get the final best result – the highest biogas production it is necessary to evaluate the effect of operating variables:

- Type of used gas;
- Sludge concentration and proportion sludge/gas;
- Operation time;
- Temperature;
- Pressure in the reactor and pressure in the flash tank.