EFFECT OF PARTICLE SIZE ON THE ANAEROBIC BIODEGRADATION RATE OF WASTED ACTIVATED SLUDGE THERMALLY PRETREATED

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Introduction. Anaerobic digestion is the best method of stabilizing waste activated sludge (WAS). The solids hydrolysis is the rate limiting step during anaerobic stabilization of WAS and can be attributed to the cells and cell clusters of poorly biodegradable compounds[1]. Therefore, the application of pre-treatments that promote cell lyses as well as also increased hydrolysis of cellular materials can be usable[2]. Thermal pre-treatments are more efficient to increase the anaerobic digestion of sludge, but this leads to many diverse results in terms of increased biogas production, from 40 to 100 %[3]. The hypothesis that may explain these variations are related to the particle size distribution. Therefore, in this paper we evaluated its effect on specific biodegradability of thermally pretreated of WAS (55-90 °C).

Methods. Was evaluated the effect of temperature on the solubilization of WAS, the test range was 55 to 90 °C. We also determined the specific energy of the disintegration of flocs by linearization of the equation of Arrhenius.
Were performed anaerobic biodegradation kinetics of thermally pretreated WAS with different particle sizes, Φ_p (2.5, 8 and 16 µm). With the kinetic data generated was calculated: the removal efficiency (Efr), the rate methane production (Vc) and the specific rate of anaerobic biodegradation (V_B).

Results. Solubilization of volatile suspended solids increases with the temperature going from 7.3 % to 55 °C to 26.7 % at 90 °C, these values are in the range reported for similar temperatures, for example[3] report solubilization of 19% and 10% respectively for WAS pretreated at 121 °C for 30 minutes.
The relationship between the rate constant (k) and the temperature can be described by the equation of Arrhenius: $\boldsymbol{k = A * exp\left(\frac{-E}{RT}\right)}$
The disintegration energy (E) was calculated by linear regression of ln (k) versus reciprocal temperature. The slope of Fig. 1, represents E, Therefore the flocs disintegration energy is 19,317 cal/mol. This energy is below that required to eliminate a microorganism (79,000 cal/mol).

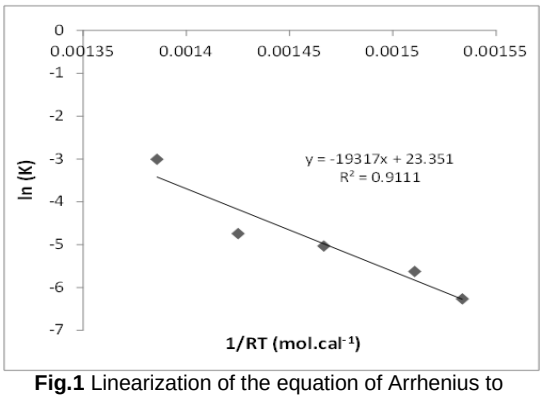

Fig.1 Linearization of the equation of Arrhenius to determinate the energy of the flocs disintegration in WAS.

The assumption made is that flocs destruction is not uniform, therefore the liquid fraction of thermally pretreated of WAS, is that the particle sizes is bigger than 2 µm, so the availability substrate is being the limiting for the anaerobic digestion.
The efficiency was better to reduce the particle size; this behavior is maintained both for methane production rate to the specific rate, Table 1.

Table 1. Kinetic parameters of degradation of thermally pretreated WAS in different particle diameters.

Φ_p (µm)	Efr (%)	Vc $\left(\frac{mL\ CH_4}{d}\right)$	V_B $\left(\frac{gDQO_{CH_4}}{gSSV*d}\right)$
2.5	64±1	13±1	0.18±0.01
8	56±1	12±1	0.17±0.02
16	53±1	11±2	0.15±0.02

Conclusions. Statistical analysis of the 9 kinetic studies, allow recognizing that the particle size has a significant effect on the removal efficiency, but not on the methane production rate or for the specific rate biodegradability.

References.

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