

Treatment of digested sludge wastes from Paper industry with diptera larvae

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Abstract

- ✓ Paper manufacturing using waste paper generates a high amount of wastes, about 70% of which is de-inking sludge generated in the process of removing inks and coatings [1]. Sludge is a continuous source of renewable biomass feasible for energy recovery, alternative to landfills [1]. Moisture content of this sludge at the end of the deinking process is high, around 100 wt % in dry base, which results in high handling and transport costs and lower efficiency of energy recovery.
- ✓ The anaerobic digestion of biomass allows to increase the added value of biomass wastes by producing a methane-rich biogas used to produce electricity and heat and an organic by-product, the digestate, that could be valorized in agriculture [2]. However, the digestate may not be often suitable, as it comes from the digester, for the direct application to agricultural soils, so a series of pretreatments must be applied.
- ✓ One alternative to application of digested sludge wastes as soil amendment is treatment with diptera larvae. The treatment of the digested sludge or digestate will reduce the wastes to a minimum amount of pupal remains (coveres) by larvae of diptera. The study and analysis of the performance of *dipterous larvae* has been tested on corpses [3].
- ✓ The growth of the larva depends, among other factors, on the temperature, humidity and quality of the food. *Hermetia illucens* (Diptera, Stratiomyidae) presents a wide spectrum of food, mainly of organic wastes. It is known as "black soldier fly", due to the dark colour of its body. Its flight is erratic and the appearance of its body confuses it with wasps, thus, eluding the attack of potential predators. Its presence in the Iberian Peninsula has been recently confirmed, which makes it an appreciated specie in reduction processes of organic wastes [4-5].
- ✓ In this paper, the wastes of de-inking sludge from anaerobic digestion by the technology of spouted bed have been remediated by *diptera larvae*.

Experimental

✓ Biomass wastes

Digested sludge waste generated in the anaerobic treatment of de-inking sludge from Paper industry

Density, $\rho_s = 1130 \text{ kg/m}^3$

Particle diameter, d_p , 2.5-5 mm

Solid moisture content of 103 wt% (dry basis) measured by Mettler Toledo HB43-S Halogen hygrometer



Digested de-inking sludge

✓ Larvae of diptera

Hermetia Illucens larvae were provided by Bioflytech S.L.



Larvae of *Hermetia Illucens*

Results

✓ Procedure

- ✓ The procedure consists in utilizing two experimental units:
 - One unit is a control, and consists of introducing an amount of larvae, thirty, in a vessel covered with a grid, where is a common substrate, cat food.
 - The other one is an experimental unit, which consists of introducing an amount of larvae, thirty, in a vessel covered with a grid, where is the substrate, digested de-inking sludge.
- ✓ The growth state of the larvae has been monitored through time, in order to follow the growth result as the consequence of the feeding.
- ✓ The development of the larva concludes with the molt to increase in size and to convert into a fly.



Larva of *Hermetia Illucens* with digested de-inking sludge



Fly Larva
Hermetia Illucens



Larva of *Hermetia Illucens* with cat food



Larva
Hermetia Illucens

✓ Treatment process

- ✓ The growth of the larvae has been observed through time. It has been observed that between 3-4% die or leave the container, so they are eliminated.
- ✓ Three months later a 20 % of larvae fed with digested de-inking sludge have transformed to flies. Whereas in the control vessel, with cat food, no fly emerged.

References

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