



## Improvement in the efficiency of hydrolysis of anaerobic digestion in sewage sludge by the use of enzymes

Ibrahim Gar Al-Alm Rashed<sup>a</sup>, Joseph Akunna<sup>b</sup>, Mohamed Mohamed El-Halwany<sup>a\*</sup>,  
Ahmed Farag Fadil Abou Atiaa<sup>c</sup>

<sup>a</sup>Engineering, Mathematics and Physics Department, Faculty of Engineering, Mansoura University, Egypt  
Tel. +20 123455789; Mobile +20 125945904; email: halwany22@yahoo.com; halwany22@hotmail.com

<sup>b</sup>Environment Education, University of Abertay Dundee

<sup>c</sup>KAHA CO for Chemical Industries, Egypt

Received 13 October 2009; Accepted 18 February 2010

---

### ABSTRACT

The effects of enzymatic pre-treatment on a mixture of sludge (primary, secondary, digested) collected from different municipal wastewater-treatment plants was investigated by batch experiments in the laboratory to enhance the hydrolysis of sludge. The experiments were carried out at mesophilic (37°C) temperature. Six commercially available enzymes, supplied by Novo Industries, were used which were Alcalase, Carezyme, Celluclast, Lipolase, Termamyl and Viscosyme. The experiment showed that with 50% digested sludge and 0.1% enzyme dosage of Carezyme and the mixed enzymes there was 11.5% and 10.6% decrease in volatile solids (VS), whereas with 25% digested sludge and 0.1% Viscosyme enzyme was very much effective for VS reduction compared with the blank (it shows 16.3% higher than blank). In another set of experiments, which differed in sludge characteristics with 25% digested sludge and 0.5% enzyme dosage the culture containing the mixed enzymes presents the highest percentage of VS reduction among all the samples (13.6% higher than blank), where with 25% digested sludge and 0.5% enzyme dosage of Termamyl and mixed enzymes show 13.5% and 12.8% greater VS reduction respectively compared with the blank. The experimental work showed that enzymatic pre-treatment can be successfully used as a pre-treatment step for treating sludge mixture produced from municipal wastewater treatment plant and the performance of individual enzymes largely depends on the characteristics of sludge.

*Keywords:* Sewage Sludge; Enzymes; Hydrolysis; Anaerobic digestion

---

\* Corresponding author.