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## **ENHANCED ANAEROBIC DIGESTION PERFORMANCES: EFFECT OF SLUDGE ULTRASOUND PRE-TREATMENT AND ROLE OF THE MICROBIAL POPULATION**

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### **Abstract**

Ultrasounds pretreatment aims to convert waste activated sludge, characterized by recalcitrant particulate organics, into a soluble, more biodegradable form, maximizing anaerobic stabilization and biogas recovery. Objective of this work was the assessment of the efficiency of high frequency ultrasounds, as 200 kHz, to improve sludge anaerobic digestion performances. Parallel batch anaerobic digestion tests were performed to evaluate anaerobic biodegradability of 20 or 200 kHz sonicated secondary sludge, operating at food/inoculum ratio of 0.5 and 1. Ultrasound pretreatments, independent on the frequency, accelerated the initial hydrolysis phase, and the effect was more marked working at high inoculum content. Moreover, the biogas produced by the sonicated sludge was always higher than that produced by the untreated one. This gain seemed to be independent on the F/I ratio for the digestion of the 20 kHz pretreated sludge, while, in the case of sludge treatment at 200 kHz, the biogas improvement was particularly high (about 40%) at F/I=0.5. In fact, at F/I=1, the biogas gain was only +4% due to an evident slowdown of the biogas production of the sonicated sludge, due to the accumulation of soluble organic substances, evidenced by the soluble COD pattern, suggesting decoupling between hydrolysis and methanogenesis. Fluorescence In Situ Hybridization (FISH) analysis allowed to highlight the establishment in the anaerobic biomass of different methanogens responsible for the biogas production depending on the extent of readily biodegradable substrates availability for the methanogenesis or on the amount of inoculum utilised at the start up of the anaerobic digestion process.

*Key words:* anaerobic digestion, kinetics, methanogens, secondary sludge, ultrasound pretreatment

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