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Co-treatment of Municipal Wastewater and Organic Wastes in an Up-flow Anaerobic Sludge Blanket (UASB) Reactor

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Abstract

The treatment of domestic wastes where they in liquid form (wastewater) or solid form (organic and inorganic) is of major environmental and public health concerns in several developing countries. Unfortunately, and due to several ongoing crises, a considerable portion of the domestic wastes generated in Lebanon are disposed of, untreated, in aquatic reservoirs and unsanitary landfills. This occurs despite the valuable resources (bioenergy, re-used water, nutrients) that can be exploited. Whilst several technologies (the vast majority of them aerobic in nature) have been utilized for the treatment of domestic wastewater, more recently anaerobic methods have gained traction: anaerobic treatment has demonstrated several preferences over conventional aerobic methods, i.e., negligible energy consumption, low sludge production, and energy recovery in terms of biogas. Although anaerobic treatment of wastewater has received a wider research interest in the past decades, there is sparse literature or research on the anaerobic simultaneous co-treatment of municipal wastewater and the organic fraction of municipal solid wastes. This proposal came into view based on several rationales. Many municipalities are promoting installation of organic wastes shredders in the sinks, which will mix it with sewage, thus both will be conveyed using the sewage infrastructure to the nearest treatment plant. It is also hypothesized that mixing the organic component of municipal solid waste with domestic wastewater will result in a higher chemical oxygen demand (COD) content of the wastewater which will produce more biogas and enhance the nutrient and mineral content of the mixture that could promote the biomass activity. In this work, the effects of organic wastes addition to a synthetic wastewater stream on biomass activity, on sludge quantity and quality, effluent quality and biogas production are investigated. The experiments were conducted in two phases using an up-flow anaerobic sludge blanket reactor (UASB) under mesophilic conditions. In phase one, the performance of the USAB reactor in treating synthetic wastewater only was investigated under different operating conditions (different hydraulic residence time (HRT) to assess the activity of biomass, quantify the accumulated sludge in the reactor and optimize the performance. While in phase two, both wastewater and organic wastes will be co-treated in the same UASB at similar conditions, and similar analyses were conducted to determine the impact of co-treatment on biogas generation and treatment efficiency. A

lab scale UASB reactor has been in operation for two years. Synthetic wastewater (850 mgCOD/L) was fed at different HRTs (24,16,12,6 hours) and it showed propitious performance with COD removal efficiencies varying between 75-90%. Although only minor sludge withdrawal was made for analysis, it took almost two years for the sludge level to reach the outlet of the reactor. The produced biogas contained 62-67% methane. Currently, organic wastes will be added to the synthetic wastewater according to the ratio that represents daily production per capita (200 Liter SWW + 700 grams OFMSW). The significance of this research lies in the potential of achieving major energy consumption reduction as compared to aerobic processes, substantial cut in organic wastes and sludge handling expenses, potential increase in biogas production and accomplish a much lower environmental impact.

Keywords: Anaerobic digestion, wastewater, organic-solid wastes, biogas