Anaerobic Co-digestion of Municipal Wastewater Sludge and Biodiesel Waste Glycerin

The Edmonton Waste Management Centre of Excellence (EWMCE) and the University of Alberta, with support from CDM and WERF, partnered to develop a pilot-scale anaerobic co-digestion system to study the effects of biodiesel waste glycerin (BWG) on anaerobic digestion of municipal wastewater sludge (MWS). The objectives of this study were to: i) investigate the effects of increasing the proportion of waste glycerin mixed with sludge from municipal wastewater treatment on methane production, and ii) identify the maximum loading of the BWG while avoiding a process upset.

Biodiesel is an alternative fuel made from vegetable oil or animal fats formulated exclusively for diesel engines. Glycerol (1,2,3-propanetriol),also known as glycerin, is the principle by-product generated from trans-esterification of vegetables oils and animal fats during refining. Glycerin can be purified for other uses, but this process can be expensive, and the amount of waste glycerine produced far exceeds the need for glycerin products. Instead, glycerin has become a waste; one that is expensive to transport and dispose of. Anaerobic digestion, is an alternative method to use industrial organic wastes - it degrades and stabilizes organic matter while producing useful biogas. However, many industrial organic wastes cannot be treated directly because the organic wastes are limited in nutrients and may be toxic to the microorganisms that carry out the digestion. One possible solution is to co-digest the organic wastes with municipal wastewater sludge, which is high in nutrients and has a robust community of microbes to carry out the digestion process and produce biogas.

A specialized pilot plant was adapted to carry out this study, with two identical reactors. One of the reactors (the “control digester”) processed only MWS, while the other (the “test digester”) processed the same amount of MWS as the control digester, but with BWG added in gradually increasing amounts. The BWG quantities were proportional to the total chemical oxygen demand (COD) targets – 130%, 150%, and 180% of the initial COD of the control digester. The continuously stirred tank reactors were operated under mesophilic conditions (36±1 ºC) with a solids retention time of 20 days. Samples were collected from the inlet and outlet streams of both reactors and analyzed for various parameters (e.g. COD, total solids, volatile solids, etc.), and the amount and composition of the biogas was measured.

BWG could be added without causing a process upset, up to 150% of the feed COD from the control digester (1.1% volume of BWG per volume of MWS). Up to this proportion, there was increased COD and volatile solids removal of 82% and 63%, respectively, as well as increases of 65% in biogas production and 83% in methane production. Addition of BWG in proportions higher than 150% led to process disturbance or failure.

Therefore, co-digesting waste glycerine, with municipal wastewater sludge actually enhanced the digester performance by increasing COD and volatile solids removal, thereby increasing the amount of valuable methane produced. This study demonstrated co-digestion of two distinct waste streams as an effective way of beneficially using waste materials that could otherwise cause disposal problems.

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