Investigating Microbial Inhibitions in Anaerobic Co-digestion of Fats, Oil and Grease (FOG) with Municipal Sludge & Their Effect on Process Kinetics

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Abstract: In an era when most of the wastewater treatment plants are being upgraded to serve as water resource recovery facilities, reducing and in some cases eliminating, the dependence on the grid for energy requirements remains one of the preeminent targets. Methane yields from conventional anaerobic digestion systems aren't sufficient to fulfil the requirements of these modern-day resource recovery facilities. Although there are numerous articles on co-digestion of municipal sludge with FOG waste reporting noticeable increase in biogas production, our present study is focused on the intermediates formation and consumption at various stages occurring in the duration of the test which is generally lacking. This information is crucial in understanding the nature and the mechanism of inhibition which are not very well understood. Preliminary studies were conducted to find a PS:TWAS:FOG ratio (v/v) which enabled us to produce maximum possible biogas and use that ratio for the next set of experiments. Among all the ratios tested, the sample with 25% FOG yielded the highest methane production at 150.94 mL-CH_4/g-COD, followed by sample with no FOG addition at 124.32 mL-CH_4/g-COD. For samples with FOG content higher than 25%, methanogenesis ceased to occur producing very little methane ranging from 13.95 mL-CH_4/g-COD to 16.93 mL-CH_4/g-COD. It was worth noticing that sample with 25% FOG content, which produced only 288mL biogas in the first 45 days, could overcome inhibition and produced over 800mL in the following 30 days. These results support the new findings that suggest possible recovery of digesters inhibited after a certain lag phase and contradicts earlier hypothesis of LCFA inhibition to be irreversible. We are now in the process of running two semi-continuous digesters (1xControl and 1x25% FOG) with samples being collected at regular intervals to identify and quantify the intermediates being formed and keeping track of these individual compounds.