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COMBINED ANAEROBIC DIGESTION OF GREEN WASTE WITH WASTEWATER TREATMENT PLANT MIXED SLUDGE IN CONTINUOUS STIRRED TANK REACTOR (CSTR)

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Most waste water treatment plants (WWTPs) treat primary and secondary sludge with anaerobic digestion (AD). A possibility for improving the economy and energy efficiency of WWTPs is to increase biogas production by co-feeding sludge with urban organic waste, which would be otherwise composted, incinerated or landfilled, depending on the local waste management system.

In this study, combined AD of different types of urban organic waste (i.e. food waste, garden waste and grass) with mixed sludge from WWTP was studied in continuous stirred tank reactor (CSTRs) at different hydraulic retention times (HRTs) and mixing ratios. The operating temperature ensured thermophilic conditions (55 °C) in order to maximize gas production and methane yield. Initially, CSTRs with a working volume of 7.5 liters were used to simulate the existing waste water treatment plants with 100% mixed sludge as a feedstock.

The pretreatment of mixed sludge in an anaerobic digester resulted in a daily gas production of 2 liter, specific methane yield of 289 N ml CH₄/ g VS and methane production rate of 175 ml CH₄/L-reactor/day as a baseline at 30 days HRT. However, the combined pretreatment and anaerobic digestion of co-substrates with 30 days HRT and VS ratio of 75:25 (food waste: plant material) resulted in 45 % increase in methane yield while the daily gas production and the rate of methane production was six times higher compared to the reference substrate (i.e. mixed sludge). Similarly, results for 50:50 mixing ratio with 30 days HRT showed an increment in methane yield of 30%, while the daily gas production and rate of methane production were five times higher than that of mixed sludge. The reactor monitoring showed that gas quality dropped from 70 % to 60% during co-substrates digestion, while there was an increase in total volatile fatty acids and ammonium contents in the digestion broth.

In general, co-digestion of urban organic waste with mixed sludge significantly improved the specific methane yield compared to AD of mixed sludge alone in existing WWTPs. The addition of garden waste, grass and household food waste with mixed sludge to digester significantly increased the specific methane yield, rate of CH₄ productivity and daily gas production. The collected digestate at steady state will be further analyzed for agricultural land application purpose and emission measurements.