ABSTRACT

The increase in concerns over climate change, fossil fuel depletion, and solid waste management led to a move towards waste-to-energy. The inherent advantages of anaerobic digestion (AD) made this technique widespread however the intrinsic difficulty in longer hydrolysis period due to recalcitrance nature of lignocellulosic waste made this technique challenging also. To reduce the recalcitrance nature of yard waste several pretreatment techniques such as: liquid hot water, electrochemical, thermo-chemo-sonic, and laccase enzyme pretreatment have been investigated in this research. The results of liquid hot water pretreatment technique showed that the highest organic matter solubilisation was found in case of microwave pretreatment at: 140 °C for 100 s. The biochemical methane potential of microwave pretreated yard waste resulted in an improvement in methane yield to 364 ± 11 mL/gVS on 26th day of AD, which was 1.1 times higher than that of untreated (328 ± 15 mL/gVS on 45thday of AD). In order to balance the nutrient in AD of microwave pretreated yard waste, anaerobic co-digestion of food waste with microwave pretreated yard waste was conducted. The highest methane production of 431 mL/gVS was observed for codigestion of food waste with microwave pretreated yard waste at the F/M ratio of 1.5. For AD of electrochemical pretreated yard waste, the ultimate biogas production of 446 mL/gVS was achieved in comparison to the untreated yard waste of 287 mL/gVS on 35thday of AD. A net energy gain of 4.75 kJ/gVS and net profit of US$ 7.4 per 1 ton of yard waste indicates the applicability of electrochemical pretreatment for pilot scale. The optimum Thermo-Chemo-Sonic pretreatment condition for maximum organic matter solubilisation was: 2997 kJ/kgTS ultrasonic energy, 74 °C, 10.13 pH.The optimum pretreatment condition for laccase mediated enzymatic pretreatment for highest delignification was: solid loading 19.76 % of TS, treatment duration 9 h, and pretreatment temperature 44.5 °C. The methane yield after 30 day of AD for untreated YW was 294 ± 12 mL/gVS and for laccase enzyme pretreated yard waste at the optimum condition was 405 ± 15 mL/gVS.

Keywords: Anaerobic digestion, Yard waste, Pretreatment, Biochemical methane potential