

Influence of substrate to inoculum ratio (S/I) on the treatment performance of food processing wastewater containing high oil and grease (O&G) in batch mode

Siti Baizura Mahat^a, Rozita Omar^{a,*}, Hasfalina Che Man^b, Aida Isma Mohd Idris^c, Siti Mazlina Mustapa Kamal^d, Azni Idris^a, Nurshafiqah Khairul Anuar^b

^aDepartment of Chemical and Environmental Engineering, Faculty of Engineering, Universiti Putra Malaysia, Serdang, Selangor, Malaysia, emails: rozitaom@upm.edu.my (R. Omar), melzura85@gmail.com (S. Baizura Mahat), azni@upm.edu.my (A. Idris)

^bDepartment of Agricultural Engineering, Faculty of Engineering, Universiti Putra Malaysia, Serdang, Selangor, Malaysia, emails: hasfalina@upm.edu.my (H. Che Man), shafiqah.kn@gmail.com (N.K. Anuar)

^cDepartment of Chemical Engineering, Faculty of Engineering and the Built Environment, SEGi University, Kota Damansara, Selangor, Malaysia, email: aidaisma@segi.edu.my (A.I. Mohd Idris)

^dDepartment of Process and Food Engineering, Faculty of Engineering, Universiti Putra Malaysia, Serdang, Selangor, Malaysia, email: smazlina@upm.edu.my (S.M. Mustapa Kamal)

Received 22 August 2019; Accepted 9 June 2020

ABSTRACT

Anaerobic digestion is one of the promising methods for treating high strength organic waste liquid with the recovery of energy such as biogas. The current study reports the physical–chemical characteristic of the waste, its treatment performance and methane gas production from a liquid organic substrate high in oil and grease generated from a food processing industry in Malaysia. The substrate is suitable for energy recovery as it contains high organic matter ranging between 15 and 17 g/L chemical oxygen demand (COD). The batch biodegradability test assays were used in anaerobic digestion of the food processing wastewater (FPW) for its treatment performance and methane yield at different ratios of the substrate (FPW) to inoculum (anaerobic digester sludge) (S/I) of 1.0, 1.5 and 2.0 for 54 d. From the results, S/I 1.0 ratio performance is ideal for COD, biochemical oxygen demand, total solids and volatile solids (VS) removal at 96.9%, 96.6%, 75.8%, 65.2%, respectively, showing a balanced substrate/food and microorganism (F/M ratio) in the digester that is important for the degradation of complex organic material. The maximum amount of specific biogas production rate was 228.6 mL/gVS in S/I of 1.0 treatment, with a methane gas production yield of 200.5 mL/gVS. While the minimum methane gas production yield of 67.5 mL/gVS was produced for S/I of 2.0. The specific biogas production rate was found at 84.6 mL/gVS. The higher substrate to the inoculum ratio of S/I 1.5 and 2.0 has delayed the biogas and methane production by 20 d. The results indicate that FPW anaerobic digestion is promising to treat the effluent and produce biogas containing a moderate amount of methane.

Keywords: Food processing wastewater (FPW); Methane yield; Anaerobic digestion; Treatment performance; Oil and grease (O&G)

* Corresponding author.