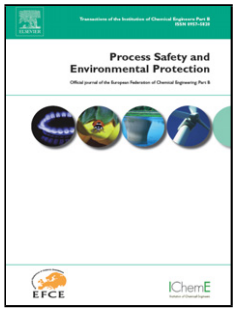

Title: Adaptive neural-fuzzy inference system vs. anaerobic digestion model No.1 for performance prediction of thermophilic anaerobic digestion of palm oil mill effluent

Authors: Hui Min Tan, Darwin Gouwanda, Phaik Eong Poh

PII: S0957-5820(18)30125-3
DOI: https://doi.org/10.1016/j.psep.2018.04.013
Reference: PSEP 1356

To appear in: *Process Safety and Environment Protection*

Received date: 26-1-2018
Revised date: 17-4-2018
Accepted date: 20-4-2018

Please cite this article as: Tan, Hui Min, Gouwanda, Darwin, Poh, Phaik Eong, Adaptive neural-fuzzy inference system vs.anaerobic digestion model No.1 for performance prediction of thermophilic anaerobic digestion of palm oil mill effluent.Process Safety and Environment Protection https://doi.org/10.1016/j.psep.2018.04.013

Adaptive Neural-Fuzzy Inference System vs. Anaerobic Digestion Model No.1 for performance prediction of thermophilic anaerobic digestion of Palm Oil Mill Effluent

Hui Min Tan, Darwin Gouwanda and Phaik Eong Poh*
School of Engineering, Monash University Malaysia, Jalan Lagoon Selatan, 47500 Bandar Sunway, Selangor D.E., Malaysia

**E-mail: poh.phaik.eong@monash.edu*

Highlights

- A total of 6 prediction models are proposed for modelling of palm oil mill effluent (POME) treatment; 3 using anaerobic digestion model no. 1 (ADM1) and 3 using adaptive neuro fuzzy inference system (ANFIS)
- Treatment of POME takes place under thermophilic anaerobic digestion using upflow anaerobic sludge blanket-hollow centered packed bed (UASB-HCPB) reactor
- For ANFIS, parameters involved are pH, organic loading rate (OLR), chemical oxygen demand (COD) and total suspended solids (TSS)
- For ADM1, parameters involved are pH, COD, oil and grease (O&G), alkalinity, volatile fatty acids (VFA) and methane composition
- Comparison is then done between ADM1 and ANFIS to determine the best prediction model

Abstract – Palm oil industry generates high volume of palm oil mill effluent (POME) albeit contributing significantly to the economy of several ASEAN countries. This necessitates effective waste management methods. Thermophilic high-rate anaerobic reactor accompanied by an accurate model to define and to predict the process performance can be a promising solution for POME treatment. Various mechanistic and meta-heuristic models had been developed, but not specifically designed for thermophilic anaerobic digestion of POME. This study explores the possibility of using ADM1 for estimating the performance of a thermophilic anaerobic reactor for POME treatment and compares it to Adaptive Neural-Fuzzy Inference System (ANFIS) model. A total of six prediction models were developed using ADM1 and ANFIS to estimate effluent pH, COD (Chemical Oxygen Demand), Total Suspended Solids (TSS) and methane composition. Results indicated that all ANFIS models were better than ADM1 models, with difference in the average error of up to 6.81%. However, ADM1 is more suited for better understanding of overall reaction of the system particularly via sensitivity analysis performed on the models.

Keywords: Palm oil mill effluent, anaerobic digestion, thermophilic, adaptive neural-fuzzy inference system, ADM1