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Influence of pH on the anaerobic fluidised bed reactor performance for palm oil mill effluent treatment
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Abstract
The effect of pH on the performance of a pilot-scale anaerobic fluidised bed reactor (AnFBR) was studied using palm oil mill effluent (POME) as the substrate. The performance of the 2000-litre reactor at different operating conditions, such as organic loading rates and retention times was studied. This acidic agro-industrial wastewater (pH 4.0–5.0) was neutralised by adding slacked lime. It was observed that, within 12 hr of hydraulic retention time (HRT), the AnFBR removes as high as 85% of the substrate chemical oxygen demand (COD) at a loading rate of 4 kg/m3 day. High pre-treatment cost is needed to neutralise the bulk volume of wastewater that was generated from the palm oil industries. Thus, an attempt was made to study the performance of the AnFBR under pH shock load. The influent pH was increased to 9.2 and then dropped around 5.0 to intensify the effect of the pH shock load. At shock load, the reactor performance for COD removal dropped by about 25% lower than the optimum condition. The maximum and minimum COD removal rates during the short period of continuous shock load were 60% and 56.5%, respectively. The average effluent pH remained steady at around 6.1. From the analysis, it was revealed that the anaerobic fluidised bed had the buffering ability and was capable of treating POME with moderate removal efficiency at an influent pH of 5.0.

Author Keywords
anaerobic fluidised bed reactor; palm oil mill effluent; pH shock loading; reactor performance

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References

- Lee, ZS, Chin, SY, Lim, JW
  Treatment technologies of palm oil mill effluent (POME) and olive mill wastewater (OMW): A brief review
  (2019) *Environmental Technology and Innovation*, 15, p. 100377.
- Sitorus, B, Sukandar, Panjaitan, SD.
  Biogas recovery from anaerobic digestion process of mixed fruit-vegetable wastes
  (2013) *Energy Procedia*, 32, pp. 176-182.
- Eryildiz, B, Lukitawesa, Taherzadeh
  Effect of pH, substrate loading, oxygen, and methanogens inhibitors on volatile fatty acid (VFA) production from citrus waste by anaerobic digestion
  (2020) *Bioresource Technology*, 302, p. 122800.
  MJ
- Zhang, W, Li, L, Xing, W
  Dynamic behaviors of batch anaerobic systems of food waste for methane production under different organic loads, substrate to inoculum ratios and initial pH
  (2019) *Journal of Bioscience and Bioengineering*, 128 (6), pp. 733-743.

- Alzate, ME, Muñoz, R, Rogalla, F
  Influence of substrate to inoculum ratio, biomass concentration and pretreatment
  (2012) *Bioresource Technology*, 123, pp. 488-494.

- Capson-Tojo, G, Trably, E, Rouez, M
  Dry anaerobic digestion of food waste and cardboard at different substrate loads, solid contents and co-digestion proportions
  (2017) *Bioresource Technology*, 233, pp. 166-175.

- Kawaiv, M, Nagao, N, Tajima, N
  The effect of the labile organic fraction in food waste and the substrate/inoculum ratio on anaerobic digestion for a reliable methane yield
  (2014) *Bioresource Technology*, 157, pp. 174-180.

- Borja, R, Banks, CJ, Sánchez, E.
  Anaerobic treatment of palm oil mill effluent in a two-stage up-flow anaerobic sludge blanket (UASB) system
  (1996) *Journal of Biotechnology*, 45 (2), pp. 125-135.

- Halim, KA, Yong, EL.
  Integrating two-stage up-flow anaerobic sludge blanket with a single-stage aerobic packed-bed reactor for raw palm oil mill effluent treatment
  (2018) *Malaysian Journal of Sustainable Agriculture (MJSA)*, 2 (1), pp. 15-18.

- Kim, SH, Choi, SM, Ju, HJ
  Mesophilic co-digestion of palm oil mill effluent and empty fruit bunches
  (2013) *Environmental Technology (United Kingdom)*, 34 (13–16), pp. 2163-2170.

- Vijayaraghavan, K, Ahmad, D, Aziz, MEBA.
  Aerobic treatment of palm oil mill effluent
  (2007) *Journal of Environmental Management*, 82 (1), pp. 24-31.

- Oliva, E, Jacquart, JC, Prevot, C.
  Treatment of waste water at the El Aguila brewery (Madrid, Spain). Methanization in fluidized bed reactors
  (1990) *Water Science and Technology*, 22 (1–2), pp. 483-490.

- Giuliano, A, Zanetti, L, Micolucci, F, Cavinato, C.
  Thermophilic two-phase anaerobic digestion of source-sorted organic fraction of municipal solid waste for bio-hythane production: Effect of recirculation sludge on process stability and microbiology over a long-term pilot-scale experience
  (2014) *Water Science and Technology*, 69 (11), pp. 2200-2209.

- Oles, J, Dichtl, N, Niehoff, HH.
  Full scale experience of two stage thermophilic/mesophilic sludge digestion
  (1997) *Water Science and Technology*, 36 (6–7), pp. 449-456.

- Devlin, DC, Esteves, SRR, Dinsdale, RM, Guwy, AJ.
  The effect of acid pretreatment on the anaerobic digestion and dewatering of waste activated sludge
  (2011) *Bioresource Technology*, 102 (5), pp. 4076-4082.

- Guštin, S, Marinšek-Logar, R.
  Effect of pH, temperature and air flow rate on the continuous ammonia stripping of the anaerobic digestion effluent
  (2011) *Process Safety and Environmental Protection*, 89 (1), pp. 61-66.

- Wang, K, Yin, J, Shen, D, Li, N.
  Anaerobic digestion of food waste for volatile fatty acids (VFAs) production with different types of inoculum: Effect of pH
  (2014) *Bioresource Technology*, 161, pp. 395-401.

- Zhai, N, Zhang, T, Yin, D
Effect of initial pH on anaerobic co-digestion of kitchen waste and cow manure
(2015) *Waste Management*, 38, pp. 126-131.

- Ma, AN, Cheah, SC, Chow, M
Current status of palm oil processing wastes management
(1993) *Environmental Science*,
(accessed on 7 August 2023)

- Sutton, PM, Huss, DA.
Anaerobic fluidized bed biological treatment: pilot to full-scale demonstration (New Orleans, Louisiana)
(1984) *Water Pollution Control Federation*,

- Idris, A.
(1989) *Scale-up studies on anaerobic fluidized bed*,
[PhD thesis]. University of Newcastle Upon-Tyne, United Kingdom

- Furumai, H, Kuba, T, Imai, T, Kusuda, T.
Transient responses of wastewater treatment and biomass development in a methanogenic fluidized bed
(1991) *Water Science and Technology*, 23 (7–9), pp. 1327-1336.

- Orhon, D, Taşh, R, Sözen, S.
Experimental basis of activated sludge treatment for industrial wastewaters—The state of the art
(1999) *Water Science and Technology*, 40 (1), pp. 1-11.

- Hobson, PN, Wheatley, AD.
(1993) *Anaerobic Digestion: Modern Theory and Practice England*,
Elsevier Science Publishers

- (1999) *Standard Methods for the Examination of Water and Wastewater*,
APHA. Water Environment Federation, American Water Works Association

- (2014) *Alkalinity Method*,
(accessed on 7 August 2023)

- Fannin, KF, Srivastava, VJ, Mensinger, JD, Chynoweth, DP.
(1983) *Marine Biomass Program: Anaerobic Digester Process Development and Stability Study*,
Institute of Gas Technology

- Chew, TY.
(1994) *The Use of Flocculants in Anaerobic Digestion of Palm Oil Mill Effluent*,
[Master's thesis]. Universiti Pertanian Malaysia

- Collivignarelli, C, Urbini, G, Fameti, A
Anaerobic-aerobic treatment of municipal wastewater with full-scale UASB and attached biofilm reactor
(1990) *Warter Science and Technology*, 22 (1–2), pp. 475-482.

- Matsumoto, A, Noike, T.
Effects of substrate composition and loading rate on methanogenic process in anaerobic fluidized bed systems
(1991) *Water Science and Technology*, 23 (7–9), pp. 1311-1317.

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