faculty of
food technology
and biotechnology
University of Zagreb

međunarodni znanstveno-stručni skup
19. Ružičkini dani
DANAS ZNANOST – SUTRA INDUSTRIJA
21. – 23. rujna 2022. | Vukovar, Hrvatska

The comparison of denitrifying dephosphatation at pulse and step addition of electron acceptor

Dijana Grgas[1], Ana Marija Prskalo[1], Tea Štefanac[1], Mirna Habuda-Stanić[2], Sanja Radman[3], Tibela Landeka Dragičević*[1]

[1]University of Zagreb, Faculty of Food Technology and Biotechnology, Pierotti Str. 6, 10000 Zagreb/Croatia
[2]J.J. Strossmayer University of Osijek, Faculty of Food Technology Osijek, F. Kuhača 18, Osijek/Croatia
[3]University of Split, Faculty of Chemistry and Technology, R. Boškovića 35, Split/Croatia
*Corresponding author

Introduction

For phosphorus removal via denitrifying dephosphataion the alternating anaerobic and anoxic conditions are required. Phosphate accumulating organisms (PAO) under anaerobic conditions uptake carbon source, store it as polyhydroxyalkanoate (PHA), use glycogen pools and release orthophosphate into the mixed liquor. Then, under anoxic conditions, with NO_2-N or NO_3-N as electron acceptor, PAO uptake orthophosphate, use PHA pools and renew glycogen pools. Denitrifying dephosphatation via nitrite has some advantages such as 30 % lower oxygen requirements, lower C requirements and 50 % lower sludge production. However, nitrite is an inhibitor to many microorganisms present in the activated sludge, including PAO. To prevent nitrite inhibition, nitrite instead od being added at once at the beginning of anoxic conditions – pulse feed, nitrite can be added in multiple portions during the anoxic conditions – step feed. Denitrifying dephosphatation is an sustainable wastewater treatment process for wastewater with low C/N ration.

Materials and methods

- ✓ The batch experiments were performed in laboratory glasses of working volume 0.5 L placed on magnetic stirrer at 100 r/min (for anoxic conditions) with activated sludge from parental reactor acclimatized to denitrifying dephosphatation.
- ✓ The temperature, pH value and dissolved oxygen (DO) concentration were monitored with WTW Dur Ox and WTW 3210 Oxi, and WTW SenTix 41 and WTW 330i.
- ✓ The experiments were performed with acetate as a carbon source, at C/N ratio 3, with 17.5 mg PO_4-P/L and N/P ratio 4.
- ✓ Nitrite source – stock solution for: (i) 70 mg NO_2-N/L in pulse feed, and (ii) 10 mg NO_2-N/L added in 7 portions in step feed
- ✓ COD (chemical oxygen demand), NO_2-N and PO_4-P were determined according to Standard methods (APHA, 2005).

Discussion

- ✓ The 69.5 % and 68.2 % COD removal was achieved in pulse feed (Fig. 1) and step feed (Fig. 2) experiments, respectively. The nitrite showed no inhibition effect to the COD removal.
- ✓ The complete NO_2-N removal (Figs. 1 and 2) was recorded in both experiments (pulse feed and step feed). The high nitrite concentration did not inhibit denitrifiers. The ratio C/N 3 was sufficient for complete denitritation of 70 mg NO_2-N/L.
- ✓ PO_4-P removal of 36 % and 72 % was recorded in pulse feed (Fig. 1) and step feed (Fig. 2) experiments, respectively.
- ✓ The high nitrite concentration (70 mg NO_2-N/L) showed an inhibition effect to PAO when added at once, pulse feed (Fig. 1).
- ✓ The inhibition effect was avoided in step feed experiment (Fig. 2) when electron acceptor was added at concentration of 10 mg NO_2-N/L in seven portions.

Results

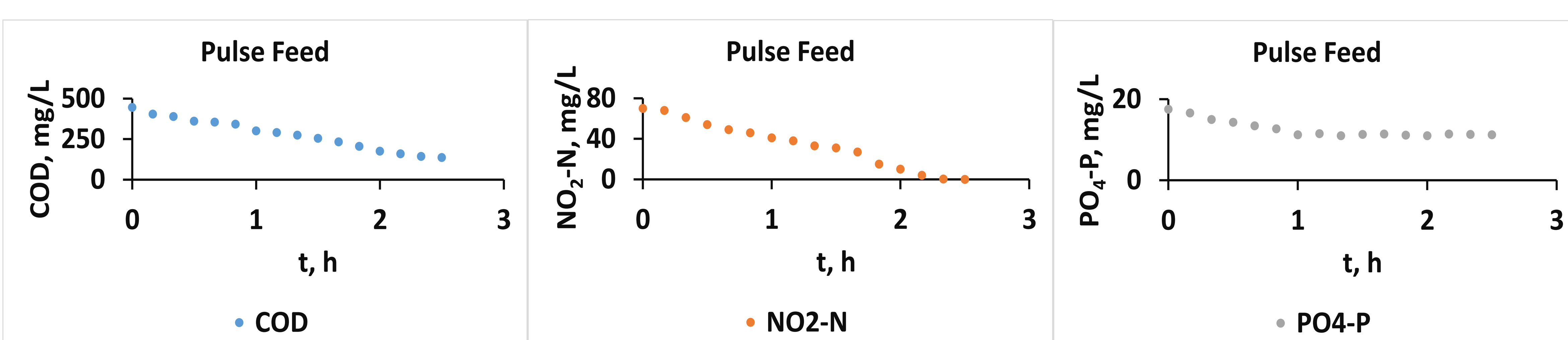

Figure 1. The effect of pulse feed to the removal of COD, NO_2-N and PO_4-P

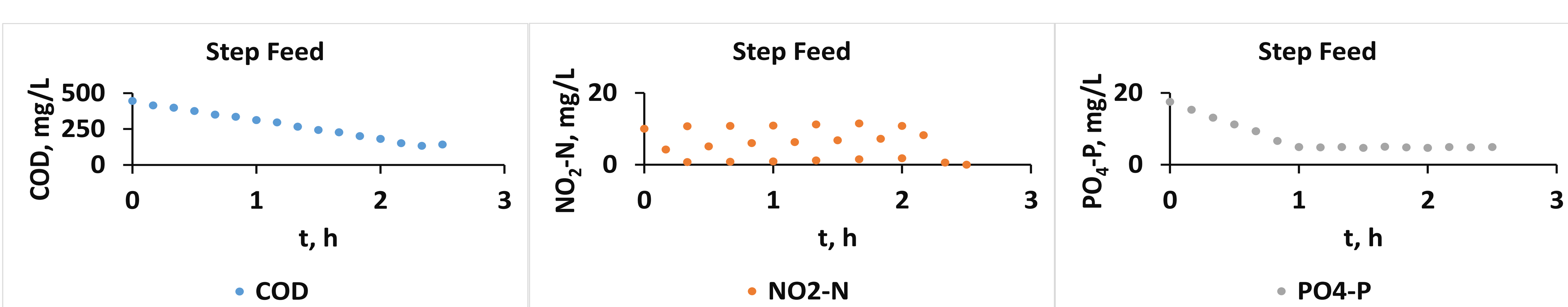

Figure 2. The effect of step feed to the removal of COD, NO_2-N and PO_4-P

References

APHA (2005) Standard Methods for the Examination of Water and Wastewater. APHA.

Tayà, C., Garlapati, V.K., Guisasola, A., Baeza, J.A. (2013) The selective role of nitrite in the PAO/GAO competition. Chemosphere. 93, 612-618.

Vargas, M., Guisasola, A., Artigues, A., Casas, C., Baeza, J.A. (2011) Comparison of a nitrite-based anaerobic-anoxic EBPR system with propionate or acetate as electron donors. Process Biochem. 46, 714-720.

Ye, L., Pijuan, M., Yuan, Z. (2013) The effect of free nitrous acid on key anaerobic processes in enhanced biological phosphorus removal systems. Bioresour. Technol. 130, 382-389.