Title: The mechanism of biological phosphorus removal under Anoxic-aerobic alternation condition with starch as sole carbon source and its biochemical pathway

Authors: Dacheng Luo, Linjiang Yuan, Lun Liu, Yang Wang, Wenwen Fan

PII: S1369-703X(18)30008-1
DOI: https://doi.org/10.1016/j.bej.2018.01.007
Reference: BEJ 6856

To appear in: *Biochemical Engineering Journal*

Received date: 23-5-2017
Revised date: 2-11-2017
Accepted date: 6-1-2018

Please cite this article as: Dacheng Luo, Linjiang Yuan, Lun Liu, Yang Wang, Wenwen Fan, The mechanism of biological phosphorus removal under Anoxic-aerobic alternation condition with starch as sole carbon source and its biochemical pathway, Biochemical Engineering Journal https://doi.org/10.1016/j.bej.2018.01.007

The mechanism of biological phosphorus removal under Anoxic-aerobic alternation condition with starch as sole carbon source and its biochemical pathway

Dacheng Luo, Linjiang Yuan[1] Lun Liu, Yang Wang, Wenwen Fan

Key Laboratory of Environmental Engineering, Shaanxi province, Key Laboratory of Northwest Water Resources Environment and Ecology, MOE, Xi'an University of Architecture and Technology, Xi'an, 710055, China

[1] Corresponding author at: Tel. /fax: +86 29 82201354.
E-mail address: yuanlinjiang@xauat.edu.cn (Linjiang Yuan)

Highlights

- 1.A new metabolic pathway of BPR under Anoxic-aerobic alternation condition was established.
- 2. Glycogen supply energy for phosphorus removal under the anoxic aerobic process.
- 3. NMR demonstrate the role of glycogen and lactic acid in the BPR process.
- 4. In this process, the P removal was accomplished without P release.

Abstract: A new excess phosphate uptaking in an anoxic-aerobic sequencing batch reactor (SBR) using starch as sole carbon source that was different from the traditional biological phosphorus removal in anaerobic-aerobic alternation condition was confirmed and reported previously. To reveal its mechanism and biochemical pathway of metabolism, this study was conducted. Nuclear magnetic resonance (NMR) technique was applied to trace the carbon metabolism in the SBR applied by supplying ^{13}C label starch. Results show that the phosphorus removal rearched 80% without any P release during the whole process. The sludge had a very lower accumulation of polyhydroxyalkanoates (PHAs) but a higher accumulation of glycogen. The metabolic pathway of glycogn synthesis and phosphorus removal was proposed that during the anoxic phase, the starch was hydrolyzed and then converted to lactic acid by lactic acid producing organism (LPO). Adenosine triphosphate (ATP) was generated from the lactic acid formation, and uesd for polyphosphate (poly-P) synthesis. In the meantime, lactic acid was used to synthesize glycogen by phosphate accumulating organisms (PAOs). In the aerobic stage, PAOs oxidized glycogen to release energy for cell growth and its maintenance, as well as phosphate uptake and poly-P synthesis. The LPO performed the majority of the P removal in the SBR during the anoxic stage. This study improves our understanding to how phosphorus removed in the anoxic-aerobic system.
Keywords: Anoxic-aerobic SBR; Starch; Glycogen; Biological phosphorus removal; NMR; Lactic acid

1. Introduction

Classical enhanced biological phosphorus removal (EBPR) technology is widely applied in