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Startup operation and process control of a two-stage sequencing batch reactor (TSSBR) for biological nitrogen removal via nitrite

Wei Zeng*, Yongzhen Peng, Shuying Wang

Key Laboratory of Beijing for Water Quality Science and Water Environment Recovery Engineering, Department of Environmental Engineering, Beijing University of Technology, 100 Pingleyuan, Chaoyang District, Beijing, 100124, China
Tel. +86 (10) 67391918; Fax +86 (10) 67392627; email: Christine-zeng@hotmail.com

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ABSTRACT

The startup operation and process control of a two-stage sequencing batch reactor (TSSBR) was investigated to improve the efficiencies of organic substrate degradation and nitrification via nitrite from a chemical industrial wastewater with high COD and nitrogen concentrations. A control strategy using process variables as dissolved oxygen (DO), oxidation–reduction potential (ORP) and pH was implemented. The conventional SBR test results showed that based on DO and pH breakpoints at the transition of COD removal and nitrification, organic substrate degradation and nitrification could be separated and occurred in two different reactors termed TSSBR. For the purpose of improving the process flexibility and saving aeration energy, the variations of DO, ORP and pH in TSSBR were characterized. The developed control strategy for TSSBR was that in the SBR1, DO and ORP breakpoints indicated the end of COD removal; in the SBR2, the DO breakpoint and ammonia valley on the pH profile represented the end of nitrification; a nitrate knee on the ORP profile and a nitrate apex on the pH profile indicated the completion of denitrification. A stable nitrite-type nitrification was achieved in the SBR2 with nitrite accumulation rate above 95%. The TSSBR demonstrated an improved organic substrate degradation rate by 40% and nitrification rate by 60% in comparison with conventional SBR. The TSSBR consisting of SBR1 and SBR2 was a two-sludge system, i.e., heterotrophs and autotrophic nitrifiers in the different reactors, which is favorable to improve the treatment efficiency and increase the proportion of nitrifiers in the SBR2 biomass.

Keywords: Two-stage SBR; Nitrite-type nitrification; Nitrogen removal; Process control

* Corresponding author.