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Biological nitrogen removal from landfill leachate using anaerobic–aerobic process: Denitritation via organics in raw leachate and intracellular storage polymers of microorganisms

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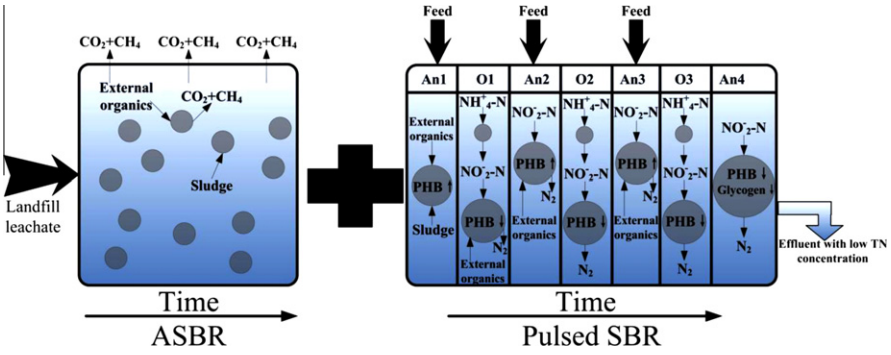
HIGHLIGHTS

- Advanced nitrogen removal of leachate was achieved without carbon source addition.
- Pulsed SBR took full advantage of organics in raw leachate for denitritation.
- PHB and glycogen were used as electron donor orderly for endogenous denitritation.
- A hypothesis showed that DNGAOs were responsible for endogenous denitritation.
- Endogenous DNR changed with type alteration of internal carbon source used.

GRAPHICAL ABSTRACT



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ABSTRACT

A system which combined ASBR with pulsed SBR (PSBR) was introduced to enhance COD and nitrogen removal from the real landfill leachate. ASBR was used to degrade the organics from raw leachate mainly. Three equal feeds mode was applied in PSBR operation. The results obtained from the joint operation period (157 days) show that the COD removal rate of ASBR was 83–88% under the specific loading rate of 0.43–0.62 gCOD $gVSS^{-1}$ day^{-1}. PSBR's operation can be divided into four phases according to the different influent NH_4^+-N which increased to 800–1000 mg L^{-1} finally, and total nitrogen (TN) removal rate of more than 90% with the effluent TN of less than 40 mg L^{-1} was obtained. PHB and glycogen can act as electron donor for endogenous denitritation orderly with the hypothetical function from DNGAOs. Consequently, the system achieved COD and TN removal rate of 89.61–96.73% and 97.03–98.87%, respectively, without any extra carbon source addition.

1. Introduction

Sanitary landfill is widely used in municipal solid waste (MSW) treatment throughout the world because of the convenience and low capital cost. As a result, the rainwater percolates through the waste material and the biodegradation of the MSW organic fraction generates a severely contaminated leachate, which is characterized by high concentration of organics, nitrogen, inorganic salts and heavy metals. If the landfill leachate has not been collected cautiously and discharge safely, it could be the potential pollution source that contaminates soil, surface water and groundwater (Nehrenheim et al., 2008).

At present, the chief methods to treat sanitary landfill leachate are physico-chemical and biological processes. Some researches (Uygur and Kargi, 2004; Park et al., 2001; Chiang et al., 2001) found

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