**《Water Research》杂志刊登“采用好氧颗粒污泥优化曝气法的脱氮除磷策略”**

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关键词：供氧策略；好氧颗粒生物膜；反硝化；反硝化除磷

摘要： 采用好氧颗粒污泥生物膜进行废水处理，能够在单一反应器中同时去除COD、氮和磷。由于反硝化作用受DO和COD浓度的影响，本文对颗粒污泥系统中可能提高氮磷去除率的供氧策略和COD浓度进行了试验。首先，对硝化－反硝化交替进行（AND）的供氧策略与传统的硝化－反硝化同时进行（SND）的供氧策略进行比较，当COD、氮和磷的浓度分别为1.6 gL−1 d−1, 0.2 gL−1 d−1和 0.08 gL−1 d−1时，采用SND供氧，氮的去除率限制在62.3 ± 3.4%。COD浓度越高，氮的去除率越高，这说明硝化作用受COD的影响。AND供氧的效果比SND供氧的效果更好，在COD的浓度为1.6 gL−1 d−1时，氮的去除率可以提高到71.2 ± 5.6%。可能是因为低氧时段有利于反硝化除磷，从而有更多的COD被用于氮的去除。间歇曝气的厌氧时段更有利于氮的去除，在最低COD浓度下的去除率都可以达到78.3 ± 2.9%。在所有条件下试验得出的磷的去除率都在88%－98%之间，与污水中亚硝酸盐和硝酸盐的浓度呈负相关（r = −0.74, p < 0.01）。在较低的COD浓度下，产生了N2O气体的副产物，并且反应器中7%－9%的氮是以N2O的形式排出的。但是，在较高的COD浓度和AND条件下，N2O的量会显著降低。

**Optimized aeration strategies for nitrogen and phosphorus removal with aerobic granular sludge**

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Abstract: Biological wastewater treatment by aerobic granular sludge biofilms offers the possibility to combine carbon (COD), nitrogen (N) and phosphorus (P) removal in a single reactor. Since denitrification can be affected by suboptimal dissolved oxygen concentrations (DO) and limited availability of COD, different aeration strategies and COD loads were tested to improve N- and P-removal in granular sludge systems. Aeration strategies promoting alternating nitrification and denitrification (AND) were studied to improve reactor efficiencies in comparison with more classical simultaneous nitrification–denitrification (SND) strategies. With nutrient loading rates of 1.6 gCOD L−1 d−1, 0.2 gN L−1 d−1, and 0.08 gP L−1 d−1, and SND aeration strategies, N-removal was limited to 62.3 ± 3.4%. Higher COD loads markedly improved N-removal showing that denitrification was limited by COD. AND strategies were more efficient than SND strategies. Alternating high and low DO phases during the aeration phase increased N-removal to 71.2 ± 5.6% with a COD loading rate of 1.6 gCOD L−1 d−1. Periods of low DO were presumably favorable to denitrifying P-removal saving COD necessary for heterotrophic N-removal. Intermittent aeration with anoxic periods without mixing between the aeration pulses was even more favorable to N-removal, resulting in 78.3 ± 2.9% N-removal with the lowest COD loading rate tested. P-removal was under all tested conditions between 88 and 98%, and was negatively correlated with the concentration of nitrite and nitrate in the effluent (r = −0.74, p < 0.01). With low COD loading rates, important emissions of undesired N2O gas were observed and a total of 7–9% of N left the reactor as N2O. However, N2O emissions significantly decreased with higher COD loads under AND conditions.

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