Impact of industrial wastewater on aerobic granules morphology and nitrification process in bioreactors

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Abstract

Aerobic Granular Sludge (AGS) is an innovative wastewater treatment process used for carbon and nutrients removal from wastewater. Aerobic granules present a compact structure resistant to variable wastewater composition. Process disturbances might affect bacteria, especially those present in the granules outer layers, such as nitrifiers. In this study, fish canning wastewater with variable composition was treated for 107 days using an AGS sequential batch reactor. The operation was divided in 3 phases, according to different periods of organic loading rate (OLR): Phase I: 0.74 to 1.32 kg m^{-3} day^{-1}; Phase II: 1.33 to 1.70 kg m^{-3} day^{-1}; Phase III: 0.12 to 0.78 kg m^{-3} day^{-1}. Carbon removal and nitrification performance were evaluated. Morphological and structural changes within granules were followed by quantitative image analysis (QIA). Principal component analysis (PCA) was performed using QIA data alone and relating QIA with reactor performance. Along the operation, carbon removal was stable, reaching less than 100 mg O_2 L^{-1} at the outlet. Nitrification was inhibited during Phase II but recovered in Phase III. According to QIA data, biomass samples from Phase III clustered together, indicating higher granule stability. PCA analysis also revealed that a higher OLR might have led to a transitory loss of robustness during Phase II, recovered during Phase III.

This study shows that OLR, nitrification process and biomass morphological and structural changes are possibly correlated during the treatment of industrial wastewater by AGS process.

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