Organic carbon source effect over the performance and the microbial community in a groundwater denitrifying granular sludge bioreactor

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Abstract
It has been observed that nitrate contamination, disperse into groundwater supplies from large-scale use of agricultural fertilizers, is evidently a significant human health risk. Conventional groundwater treatment technologies, such as anion exchange, reverse osmosis and electrodialysis/electrodialysis reversal, have not proved to be safe environmental technologies because they remove nitrate and other constituents to a concentrated waste stream requiring disposal under high energy requirements [1]. For these reasons, in this project, a novel denitrifying granular sludge bioreactor technology was built, started-up and operated for the treatment of nitrate-contaminated groundwater. The bioreactor was built amended with a nitrate polluted synthetic groundwater composition (100 mg-N L-1 of Nitrate) and a variable concentration of sodium acetate, modified during the operation time to analyze the influence of the influent organic carbon in the denitrification process. Moreover, Molecular biology techniques were done using Illumina MiSeq high throughput sequencing protocols in order to characterize the hypervariable regions V1-V2-V3 of 16S rRNA gene of Bacteria, V3-V4-V5 of 16S rRNA gene of Archaea and ITS region of Fungi [2]. Finally, multivariate redundancy studies linking the microbial community structure with the physicochemical performance were done. The overall conclusion showed that the denitrifying granular sludge amended with low concentrations of sodium acetate is an efficient, cost-friendly alternative for the treatment of groundwater polluted with nitrate.

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Physico-chemical performance and microbial characterization of granular sludge system for groundwater denitrification PC 27

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Abstract

The intensive agriculture applications over land have caused damages to the quality water resources. Thus, the fertilizers applied to the land release nitrogen to the groundwater as nitrate ion. The groundwater is the first drinking water resource in human settlements, by this way the nitrogen in drinking water is a precursor of human diseases. Usually, biological denitrification was used for nitrate removal and carried out by heterotrophic-denitrifying bacteria under anaerobic conditions. Thus, the novel aerobic granular sludge technology was implemented for the removal of nitrate from groundwater, due to the understanding that granular biomass favours anaerobic conditions in the core.

The aerobic granular sludge treatment was performed in a lift sequential batch reactor aerated with air through fine bubble at the bottom. The hydraulic retention time was 6 hours; the pH and oxygen were controlled at 7.4±0.3 and 7.8 ± 0.2, respectively. The influent was a synthetic medium simulating contaminated groundwater, and organic matter at decreasing concentrations was added to estimate the lowest concentration for an optimal denitrification process. The nitrogen, organic matter and granules properties were monitored. Biological samples were taken, which were subject to DNA extraction. The DNA pools were used for absolute quantification of the target genes (archaeal and bacterial 16S rRNA, fungal 18S rRNA, *norB*, *nosZ* I and *nosZ* II genes) involved in formation and stabilization of granular sludge and denitrification process. These results suggest that the implementation of aerobic granular sludge system to nitrate removal from groundwater is a successful and innovative technology, which saves costs and is biologically safe.

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