Bioaugmentation of Aerobic Granular Sludge with specialized degrading granules treating 2-fluorophenol wastewater

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Abstract (350 words)

The industry growth has been accompanied by an increase in the amount of industrial chemicals being released into the environment. Indigenous microbial communities in wastewater biotreatment processes are not always effective in removing xenobiotics.

This work aimed to evaluate the efficiency of a new bioaugmentation strategy in an aerobic granular sludge sequencing batch reactor (AGS-SBR) system fed with 2-fluorophenol (2-FP). Bioreactor performance in terms of phosphate and ammonium removal, 2-FP degradation and chemical oxygen demand (COD) was evaluated.

The new bioaugmentation strategy consisted in producing granules using extracellular polymeric substances (EPS) extracted from AGS as a carrying matrix and a 2-FP degrading strain, *Rhodococcus* sp. FP1. The produced granules were used for the bioaugmentation of a reactor fed with 2-FP. Shortly after bioaugmentation, the produced granules broke down into smaller fragments inside the bioreactor, but 2-FP degradation occurred. After 8 days of bioaugmentation, 2-FP concentration inside the reactor started to decrease, and stoichiometric fluorine release was observed 35 days later. Phosphate and ammonium removal also improved after bioaugmentation, increasing from 30% to 38% and from 20 to 27%, respectively. Complete ammonium removal was only achieved when 2-FP feeding stopped, and phosphate removal was not recovered during operation time. COD removal also improved after the addition of the produced granules.

The persistence of *Rhodococcus* sp. FP1 in the reactor was followed by qPCR. *Rhodococcus* sp. FP1 was detected 1 day after in the AGS and up to 3 days after bioaugmentation at the effluent. Nevertheless, the 2-FP degradative ability remained thereafter in the granules. Horizontal gene transfer could have happened from the 2-FP degrading strain to indigenous microbiome as some bacteria isolated from the AGS, 3 months after bioaugmentation, were able to degrade 2-FP.

This study presents a promising and feasible bioaugmentation strategy to introduce specialized bacteria into AGS systems treating recalcitrant pollutants in wastewater.

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