Activity of nitrifying bacteria in aerobic granular sludge treating food industry wastewater

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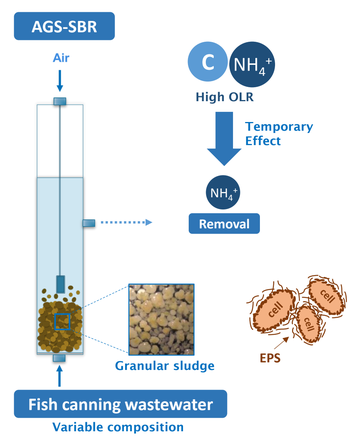
Introduction

Aerobic granular sludge (AGS) is a promising technology for treating industrial wastewater. AGS presents a diverse microbial community responsible for the simultaneous removal of carbon and nutrients. These communities are protected by **extracellular polymeric substances (EPS)**, providing a compact structure to the granules. As a result, bacteria present in the aerobic granules are more resistant to variable wastewater composition, as commonly produced in food industry. The **fish canning wastewater** is characterized by a variable composition in organic matter, nitrogen and phosphorous.

The **objective** of this work is to use an AGS process for treating food industry wastewater with variable composition and to evaluate the performance for chemical oxygen demand (COD) and NH_4^+ removal.

Methods

A lab-scale AGS-SBR (sequential batch reactor), with a working volume of 2.5 L, was operated in four successive treatments of 6 h-cycles per day. The reactor was inoculated with a mixture of granular sludge adapted to fish canning wastewater and granular sludge from a municipal AGS-SBR. Wastewater collected from a fish canning plant was used. The performance of the AGS-SBR was assessed for COD, NH_4^+, NO_3^- and NO_2^-.



Results

The AGS-SBR performance was evaluated during 90 days of operation which were divided into three phases (I, II and III).

Wastewater with variable composition was fed to the reactor (Table 1).

Table 1. Organic Loading Rate (OLR) and N-NH_4^+ concentration present in the fish canning wastewater during phases I, II and III (minimum and maximum values).

Parameters	Phase I	Phase II	Phase III
Period (days)	0 – 23	24 – 55	56 – 90
OLR (g COD L^{-1} day^{-1})	0.8 – 1.3	1.4 – 1.7	0.1 – 0.5
N-NH_4^+ (mg L^{-1})	17.3 – 31.0	18.3 – 41.5	10.3 – 40.5

COD removal

- COD concentration at the outlet reached less than 100 mg O_2 L^{-1} throughout the operation (Figure 1a);
- The higher OLR applied during phases I and II did not affect COD removal.

NH_4^+ removal

- Nitrification was variable during phase I and was inhibited during phase II (Fig. 1b,c and d);
- A fast improvement of the nitrification process occurred during phase III; NO_2^- concentration reached 6 mg N-NO_2^- L^{-1} and NO_3^- increased up to 18 mg N-NO_3^- L^{-1}.

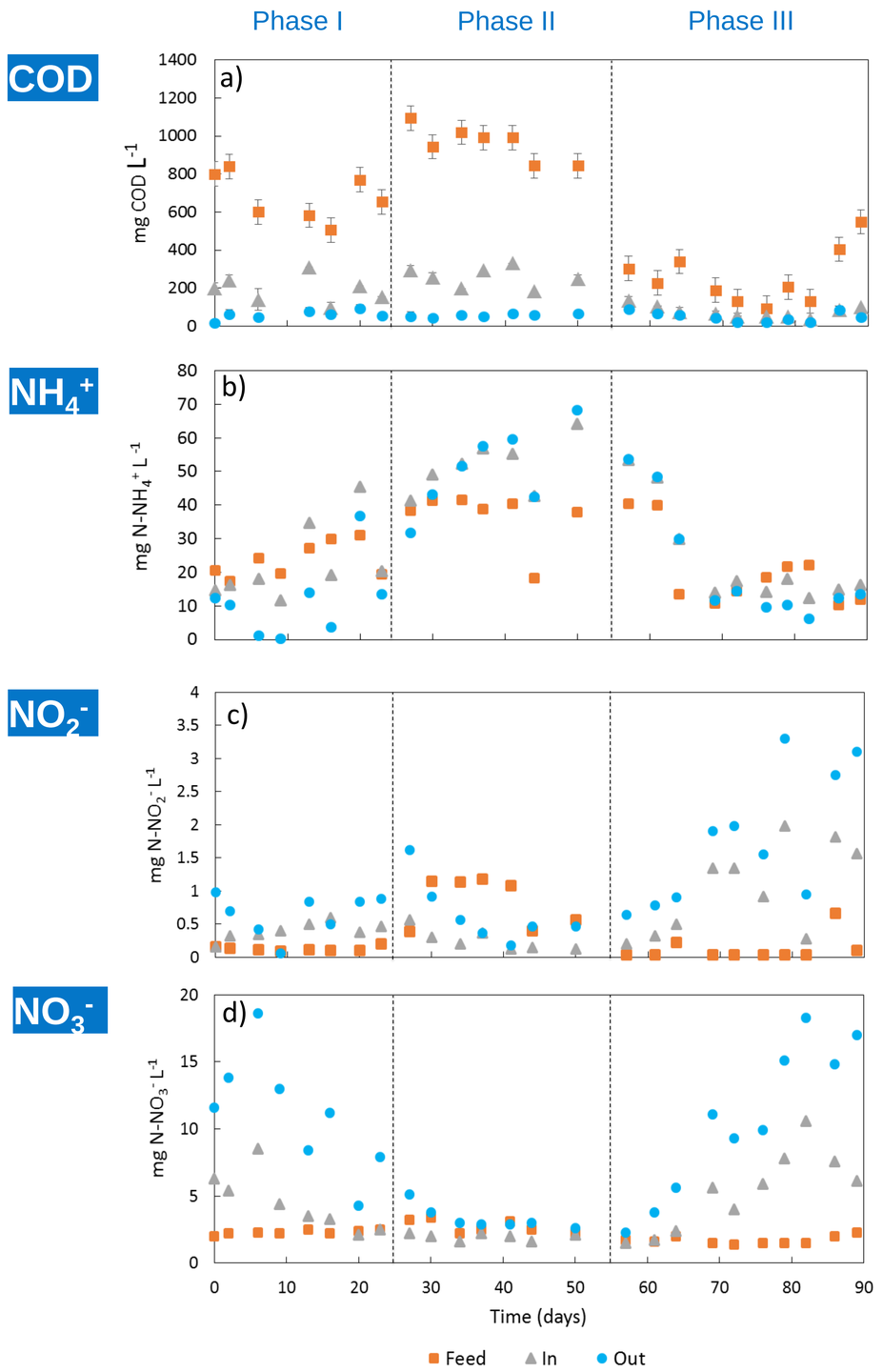


Figure 1. Concentration at the influent (■), in the reactor bulk liquid after anaerobic feeding (▲) and at the effluent (●) are shown.

Conclusions

The AGS-SBR presented a good COD removal from fish canning wastewater. When a higher OLR was applied, the growth of heterotrophic bacteria possibly affected the nitrification process. However, this negative effect was only temporary, as shown by the increase in ammonium removal during a period with lower OLR. The reactor operation is ongoing to better understand the relationship between nitrification, organic load and other parameters relevant for the treatment of food industry wastewater.

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