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An innovative bioreactor set-up that reduces membrane fouling by adjusting the filamentous bacterial population

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ABSTRACT

Membrane bioreactors (MBR) constitute an advanced wastewater treatment technology over conventional activated sludge processes, however, membrane fouling remains the basic obstacle preventing their universal application. Extended research has been carried out on this issue but an optimal solution has not yet been found. This research proposes an innovative solution to mitigate membrane fouling by manipulating the filamentous bacterial population in activated sludge. The filamentous bacterial population was adjusted by modifying the MBR set-up, where the aerated bioreactor was divided into two in-series chambers. When a food to microorganisms (F/M) ratio of between 0.4 and 0.5 g COD/g MLSS$_*$d and a dissolved oxygen concentration of 0.5±0.3 mg/L was applied in the first chamber, the filamentous index (FI) ranged between 2 and 3 and the activated sludge presented high porosity, thus resulting in low trans-membrane pressure (TMP) and reversible membrane fouling. In the second chamber, the dissolved oxygen concentration was adjusted to 2.5±0.5 mg/L and the F/M ratio ranged between 0.01 and 0.02 g COD/g MLSS$_*$d, resulting in an overall F/M ratio within the typical range of 0.08 – 0.10 g COD/g MLSS$_*$d. Thus, further filamentous bacteria growth was inhibited and soluble microbial products (SMP) concentration was minimized. Finally, TMP was controlled within the range of 2 – 2.5 kPa for over three months, in contrast to the corresponding TMP of the conventional membrane bioreactor that gradually increased from 2.5 to 5 kPa in the first 25 days and reached 12 kPa after 43 days working time. Therefore, reversible and irreversible membrane fouling was controlled successfully through the proposed innovative filamentous MBR configuration.

Keywords**:** Filamentous Index; Membrane fouling; Soluble microbial products; Extracellular polymeric substances

1. Introduction

Conventional biological wastewater treatment is the most common wastewater treatment process, and is based on the use of microorganisms for the removal of soluble organic compounds, aiming to improve effluent quality. Nevertheless, one of the most significant problems of conventional biological wastewater treatment is the presence of filamentous bacteria. These bacteria can cause bulking and