World Academy of Science, Engineering and Technology
International Journal of Biotechnology and Bioengineering
Vol:14, No:05, 2020

Comparison between Conventional Bacterial and Algal-Bacterial Aerobic Granular Sludge Systems in the Treatment of Saline Wastewater

Authors : Philip Semaha, Zhongfang Lei, Ziwen Zhao, Sen Liu, Zhenya Zhang, Kazuya Shimizu

Abstract : The increasing generation of saline wastewater through various industrial activities is becoming a global concern for activated sludge (AS) based biological treatment which is widely applied in wastewater treatment plants (WWTPs). As for the AS process, an increase in wastewater salinity has negative impact on its overall performance. The advent of conventional aerobic granular sludge (AGS) or bacterial AGS biotechnology has gained much attention because of its superior performance. The development of algal-bacterial AGS could enhance better nutrients removal, potentially reduce aeration cost through symbiotic algae-bacterial activity, and thus, can also reduce overall treatment cost. Nonetheless, the potential of salt stress to decrease biomass growth, microbial activity and nutrient removal exist. Up to the present, little information is available on saline wastewater treatment by algal-bacterial AGS. To the authors’ best knowledge, a comparison of the two AGS systems has not been done to evaluate nutrients removal capacity in the context of salinity increase. This study sought to figure out the impact of salinity on the algal-bacterial AGS system in comparison to bacterial AGS one, contributing to the application of AGS technology in the real world of saline wastewater treatment. In this study, the salt concentrations tested were 0 g/L, 1 g/L, 5 g/L, 10 g/L and 15 g/L of NaCl with 24-hr artificial illuminance of approximately 97.2 µmol m¯²s¯¹, and mature bacterial and algal-bacterial AGS were used for the operation of two identical sequencing batch reactors (SBRs) with a working volume of 0.9 L each, respectively. The results showed that salinity increase caused no apparent change in the color of bacterial AGS; while for algal-bacterial AGS, its color was progressively changed from green to dark green. A consequent increase in granule diameter and fluffiness was observed in the bacterial AGS reactor with the increase of salinity in comparison to a decrease in algal-bacterial AGS diameter. However, nitrite accumulation peaked from 1.0 mg/L and 0.4 mg/L at 1 g/L NaCl in the bacterial and algal-bacterial AGS systems, respectively to 9.8 mg/L in both systems when NaCl concentration varied from 5 g/L to 15 g/L. Almost no ammonia nitrogen was detected in the effluent except at 10 g/L NaCl concentration, where it averaged 4.2 mg/L and 2.4 mg/L, respectively, in the bacterial and algal-bacterial AGS systems. Nutrients removal in the algal-bacterial system was relatively higher than the bacterial AGS in terms of nitrogen and phosphorus removals. Nonetheless, the nutrient removal rate was almost 50% or lower. Results show that algal-bacterial AGS is more adaptable to salinity increase and could be more suitable for saline wastewater treatment. Optimization of operation conditions for algal-bacterial AGS system would be important to ensure its stably high efficiency in practice.

Keywords : algal-bacterial aerobic granular sludge, bacterial aerobic granular sludge, Nutrients removal, saline wastewater, sequencing batch reactor
Conference Title : ICAABA 2020 : International Conference on Advances in Algal Biotechnology and Applications
Conference Location : Sydney, Australia
Conference Dates : May 18-19, 2020