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BIOLOGICAL SEAWATER DESALINATION USING GREEN ALGAE AND CYANOBACTERIA

by

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Abstract

Water shortage in many coastal parts of the world is reaching alarming situation, including the United Arab Emirates. Urbanization and rapid population growth are generating critical water demands with an increase in per capita consumption. Seawater is usually treated by membrane processes such as reverse osmosis (RO). However, this technology is energy intensive and generates excessive brine as a waste. The solution to this problem can be found in natural remediation techniques that can reduce salt concentration from seawater, such as halophytes. A salt-tolerant species can consume Na^+ and Cl^- ions and increase cellular growth which is termed biological desalination or biodesalination. Lab-scale reactors were used to analyze all the strains having better salt tolerance capacities. Two species of cyanobacteria and three species of algae; *Trichormus variabilis*, *Phormidium keutzingianum*, *Chlamydomonas reinharditii*, *Euglena deses* and *Scenedesmus obliquus* were studied in different application combinations, i.e., in suspension, immobilized method and attached growth. *Phormidium keutzingianum* performed much better than all other studied strains and it showed salt tolerance up to 100 g/L. *Phormidium keutzingianum* strain was grown on a support media (zeolites) to develop biofilm for evaluation of salt bioaccumulation/biosorption in attached growth PBR for the treatment of direct seawater and placed outdoors in harsh UAE climate. A continuous flow system composed of an initial phase of packed bed attached growth *Phormidium keutzingianum* was experimented. It reduces ~40% of Cl^- ion from the real seawater within a hydraulic retention time of 7 days with minimal cell detachment into the effluent seawater. Therefore, the designed photobioreactor can be utilized as a hybrid approach to the existing desalination industry. This technology has the potential to revive our understanding of drinking water treatment based on natural remediation techniques. The technology will reduce water shortage issues, GHG emissions in the atmosphere, reduce operational cost, and energy requirements.

Keywords: Biological desalination, Biodesalination, Biosorption, Bioaccumulation, Algae, Cyanobacteria, Seawater desalination.