Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2020.25942

192 (2020) 78–96
July

Understanding transparent exopolymer particle occurrence and interaction with algae, bacteria, and the fractions of natural organic matter in the Red Sea: implications for seawater desalination

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Received 19 February 2020; Accepted 7 April 2020

ABSTRACT

Binding of particulate and dissolved organic matter in the water column by marine gels allows the sinking and cycling of organic matter into the deeper water of the Red Sea and other marine water bodies. A series of four offshore profiles were made at which concentrations of bacteria, algae, particulate transparent exopolymer particles (p-TEP), colloidal transparent exopolymer particles (c-TEP), and the fractions of natural organic matter (NOM), including biopolymers, humic substances, building blocks, low molecular weight (LMW) neutrals, and LMW acids were measured to depths ranging from 90 to 300 m. It was found that a statistically-significant relationship occurs between the concentrations of p-TEP with bacteria and algae, but not with total organic carbon (TOC) in the offshore profiles. Variation in the biopolymer fraction of NOM in relationship to TEP and bacteria suggests that extracellular discharges of polysaccharides and proteins from the bacteria and algae are occurring without immediate abiotic assembly into p-TEP. In the water column below the photic zone, TOC, bacteria, and biopolymers show a generally common rate of reduction in concentration, but p-TEP decreases at a diminished rate, showing that it persists in moving organic carbon deeper into the water column despite consumption by bacteria. The data presented herein are the first to link TEP concentrations in the Red Sea with the fractions of NOM as measured using liquid chromatography organic carbon detection (LCOCD) technology. The oceanographic and water quality investigations show the seawater used for reverse osmosis desalination from the nearshore or offshore would yield nearly equal treatment challenges. Use of deep water intake systems to obtain seawater with reduced p-TEP and bacteria concentrations would not significantly impact treatment if it would be feasible which is not.

Keywords: Transparent exopolymer particles; Natural organic matter; Biofouling; Red Sea; Seawater reverse osmosis desalination

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