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Transparent exopolymer particles: Potential agents for organic fouling and biofilm formation in desalination and water treatment plants

Edo Bar-Zeev[a], Ilana Berman-Frank[a], Boris Liberman[b], Eyal Rahav[a], Uta Passow[c], Tom Berman[d]*

[a]*Mina and Everard Goodman Faculty of Life Sciences, Bar Ilan University, Ramat Gan, Israel*
[b]*I.D.E., Kadima, Israel*
[c]*Marine Science Institute, University of California, Santa Barbara, 93106 CA, USA*
[d]*Kinneret Limnological Laboratory, Israel Oceanographic and Limnological Research, POB 447, Migdal 14950, Israel*
Tel +972 4 690 9476; email: tomdebberman@gmail.com; tberman@ocean.org.il

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ABSTRACT

Transparent exopolymer particles (TEP) are ubiquitous in marine and freshwaters, and have been subject to intensive study by oceanographers and limnologists over the past 15 years. These microscopic organic particles (visualized by Alcian Blue staining for acid polysaccharides) may be considered a planktonic form of exopolymeric substances (EPS). Two aspects relating to the potential involvement of TEP as important agents in organic fouling and biofilm formation on membranes in desalination and wastewater treatment plants were investigated: the efficiency of pretreatment processes in decreasing the amounts of TEP reaching the RO membranes at the Adom desalination plant, Ashkelon; and the active involvement of TEP in the early stages of biofilm formation. This study revealed that although pretreatment at the desalination plant lowered the levels of water quality parameters such as chlorophyll and SDI by ~90% relative to input, TEP concentrations were only decreased by ~30% upstream of the RO membranes. To follow TEP in the early stages of biofilm formation, glass slides were suspended in seawater over several days. Slides were removed daily, stained with Alcian Blue (for TEP) and DAPI (for bacteria) and examined under the microscope with Nomarski light illumination and UV-epifluorescence. By 18 h, we observed many areas stained with Alcian Blue as well as some individual bacteria on the surface. The Alcian Blue stained areas were not due to EPS proliferated by bacteria attached to the surface but derived from TEP originally in the feed water. After 18 h, there were increasing areas stained with Alcian Blue and greater numbers of bacteria growing on stained and unstained areas of the substrate surface. Taken together, these results imply that TEP in source waters are indeed likely to be key players in the establishment and subsequent development of biofilm on membranes and that pretreatment technology does not effectively remove these particles from reaching membranes. Recognition of the importance of TEP in aquatic biofilm formation could lead to the use of TEP as an indicator of the efficacy of current pretreatment methods as well as to the development of improved techniques to remove these particles upstream of membranes in desalination and wastewater treatment plants.

Keywords: Transparent exopolymer particles; TEP; EPS; Biofilm formation; Membrane desalination pretreatment

* Corresponding author.