Biological flocculants from and for saline (waste) water treatment

Victor Ajao
victor.ajao@wetsus.nl

Motivation

Large amounts of saline wastewater are generated by industries such as food, petrochemical and tannery. This has adverse effects on aquatic life, water potability and agriculture when discharged into the environment untreated. Currently, wastewater particle removal is widely achieved with the use of inorganic coagulants or/and oil-based organic polymeric flocculants. Both have non-negligible drawbacks: the former leaves residual metal particles in treated water and the latter leads to formation of toxic degradation products[1]. Hence, the use of synthetic coagulants/flocculants can hardly be considered a sustainable wastewater treatment approach.

Technological challenge

Microorganisms responsible for the biological degradation of organic pollutants in (waste) water excrete biopolymers, generally referred to as extracellular polymeric substances (EPS). These EPS provide attractive and non-toxic flocculating properties.

More often than not, single-type EPS (usually polysaccharides) are obtained by the enrichment of isolated microbial strain[2]. Although this strategy yields biodegradable polymers, the disadvantage is that pure cultures need to be fed with expensive and unsustainable carbon sources as well as valuable nutrients. Our approach is to utilise a mixed microbial population used in wastewater treatment to concurrently produce EPS as flocculants.

The technological challenge is therefore to develop strategies on how saline industrial wastewater treatment can be combined with maximum EPS production, and further fundamental studies on the biopolymer characterization (Figures 1 and 3) and flocculation mechanisms.

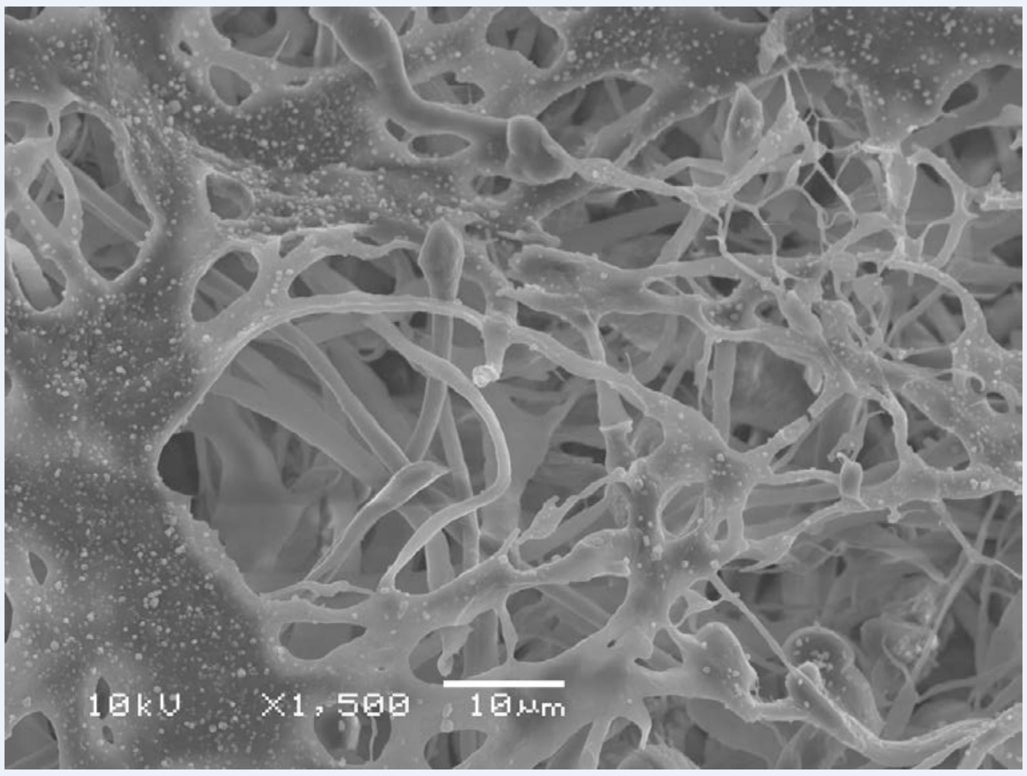

Fig 1. Scanning Electron Microscopy image of purified and lyophilised EPS

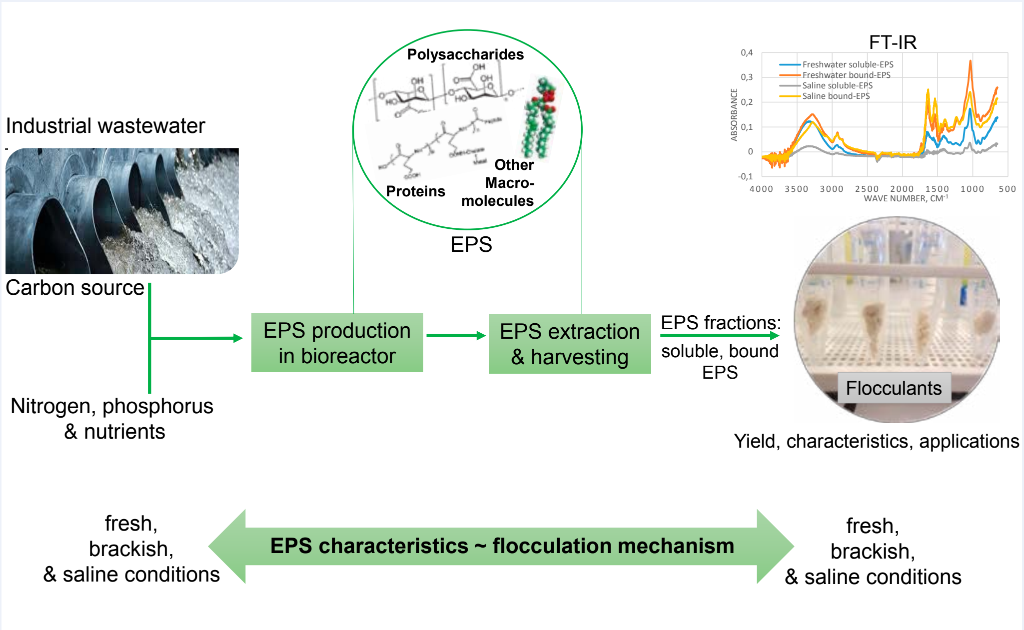

Fig 2: Graphical Abstract

Research goals

- To develop a reactor system that combines wastewater treatment with production of cheap, effective and sustainable 'saline flocculants'.
- To compare the flocculation performances of 'saline EPS' with 'fresh water EPS' and synthetic flocculants, and explain the differences.
- To elucidate the flocculation mechanisms of mixed EPS under saline conditions.

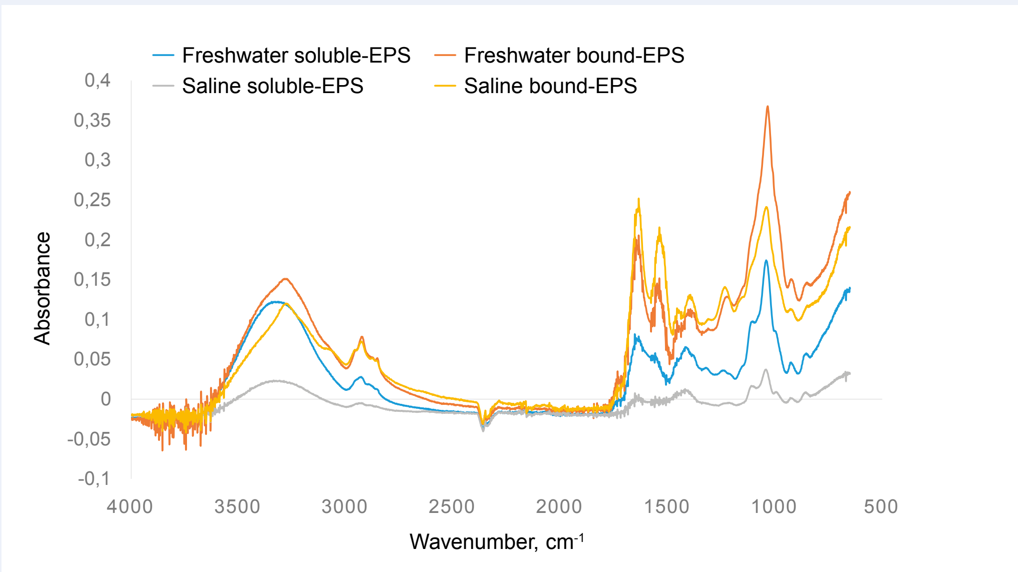

Fig. 3: Fourier transform infrared spectroscopy (FT-IR) of extracted EPS fractions (soluble and bound) reveals the presence of carboxyl, hydroxyl and amine groups, which are typical of carbohydrates and proteins.

[1] B. Bolto and J. Gregory (2007), Water Research, 41 (11), 2301–2324.
[2] S. A. Zaki, M. F. Elkady, S. Farag, and D. Abd-el-Haleem (2013), J. Environ. Bio., 34 (1), 51–58

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V. Ajao, dr. ir. H. Temmink,
dr. Ir. H. Bruning, prof. dr. ir. H. Rijnaarts