ANALYSIS OF BIOCIDE AND SURFACTANT INFLUENCING DETACHMENT OF BACTERIAL CELLS

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ABSTRACT

Adhesion and chemical induced detachment kinetics of *Pseudomonas fluorescens* ATCC 13525^T to glass surface were conducted *in situ* under flow conditions in a well-controlled parallel plate flow chamber (PPFC). Ortho-phthalaldehyde (OPA) and cetyltrimethyl ammonium bromide (CTAB), respectively, an aldehyde-based biocide and a cationic surfactant were applied at several concentrations to the glass attached bacteria. At the end of the chemical treatment the remaining adhered bacteria were characterized in terms of viability and cellular size. Simultaneously, planktonic cell surface characterization was conducted in order to correlate PPFC results with thermodynamic approaches for adhesion prevision and to evaluate the surface free energy of chemically treated cells and its relevance for adhesion strength.

It was observed that about 2.8×10^6 cells/cm^2 adhered to the glass surface after 30 min of bacterial flow through the PPFC, besides thermodynamic analyses demonstrate unfavourable adhesion of *P. fluorescens* to glass ($\Delta G_{adhesion}$ = 30 mJ/m^2). The application of OPA and CTAB promoted bacterial detachment in a small extent (< 20 %) for every compound and for every concentration tested. Additionally, detachment was not concentration dependent ($P < 0.05$). The remaining adhered bacteria were totally non-viable for OPA concentrations higher than 50 mg/L and for CTAB concentrations higher than 0.25 mM, showing a lack of correlation between bacterial viability and detachment failure. The cellular size decreased with attachment, with chemical treatment and with increase of concentration for CTAB ($P < 0.05$). Analysis of the surface free energy demonstrated that both chemicals promoted alterations of cell surface properties, increasing the adhesion strength between the cells and the glass surface. Both chemicals promoted the emergence of apolar characteristics, not dependent with concentration for OPA ($P > 0.1$). For CTAB, apolar characteristics increased with concentration ($P < 0.05$), switching from hydrophilic to hydrophobic for concentrations near the critical micellar concentration. The overall results emphasize the role of the adhesion process and the chemical stress on cellular physiological induced response. OPA and CTAB were markedly inefficient in the removal of glass attached *P. fluorescens*, demonstrating that bacteria can be non-viable but remain attached to the adhesion surface.