PhD in Evolutionary Biology and Ecology

Università di Roma Tor Vergata

BIOFILMS IN INDUSTRIAL SYSTEMS: BIODIVERSITY, FORMATION MECHANISMS AND CONTROL STRATEGIES

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Highly structured micro-consortia composed of organisms adhering to surfaces and immersed in a self-produced exopolymeric matrix are known as biofilms and profusely colonize industrial cooling systems. Here biofilms develop attached to inner surfaces of heat exchangers, cooling towers, promoting biofouling with serious equipment damages. Although the role of biodiversity in biofouling has been recognized, little data are available on the microbial composition and structure of biofilm communities growing in cooling tower systems, where source communities are mostly riverine. Thus, the first aim of this project was to provide insights into the biodiversity and structure of biofilms in cooling systems. This was achieved through sampling across a set of European industrial systems and analyses based on Next Generation Sequencing (NGS), Catalyzed reporter deposition Fluorescence *In Situ* Hybridization (CARD-FISH) combined with confocal microscopy. A core biofilm microbiome, constituted by members of two families of Alphaproteobacteria and one of Betaproteobacteria, was found. We also hypothesized that members of one of these families may be responsible for the initial biofilm adhesion (Di Gregorio et al. 2017). A comprehensive insight into biofilm diversity and structure is crucial for developing biofouling control measures. Indeed, biofouling control has mainly based on the addition of chemical additives to circulating water, including biocides that are toxic and not fully effective in biofilm removal due to the protection provided by the matrix. A second aim of this project is to test environmentally sound, ‘green’ biodispersants, able to penetrate the matrix and reduce adhesion to exposed surfaces. The effect of a set of such compounds is currently tested on biofilm cultures, obtained from natural *inocula*, in a flow-lane incubator. Biofilm phototrophs, bacteria and matrix glycoconjugates are detected by multi-channel Confocal Laser Scanning Microscopy and image datasets are analysed for quantitative evaluation. Ultimate goal will be the development of a possible biofilm monitoring system, based on the hypothesis that cyclic guanosine monophosphate (c-di-GMP), an intracellular and conserved signal molecule, plays a role also in the initial cell adhesion of cooling systems biofilms,. C-di-GMP biofilm production will be tested using HPLC-MS in a pilot-scale systemdesigned and constructed *ad hoc* to simulate real industrial systems.

Di Gregorio L, Tandoi V, Congestri R et al. Unravelling the core microbiome of biofilms in cooling tower systems. *Biofouling* 2017; **14**:1–14.