# THE EFFECT OF SHEAR STRESS ON THE FORMATION AND REMOVAL OF *BACILLUS CEREUS* BIOFILMS

Madalena Lemos[1], Filipe Mergulhão[1], Luís Melo[1], Manuel Simões[1*]
[1]*LEPABE, Department of Chemical Engineering, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, s/n, 4200-465 Porto, Portugal*
***E-mail address: mvs@fe.up.pt. Tel.: 00351 22 508 1654***

ABSTRACT

*In this study the influence of the shear force under which the biofilm was formed was assessed in terms of its removal when exposed to chemical and mechanical stresses. A bioreactor rotating system was used to form biofilms, allowing the simulation of shear stress ($\tau_w$) conditions found in industrial settings. Bacillus cereus was used as the model bacterium for biofilm formation. The biofilms were formed under different $\tau_w$ conditions (0.02, 0.07, 0.12 and 0.17 Pa), on AISI 316 stainless steel cylinders, during 7 days. Biofilm phenotypic characteristics, including thickness, biomass production and cellular density were measured. The biofilm density was found to increase with the shear stress. Nevertheless, no similar correlation was observed regarding the total cellular counts.*

*Ex situ tests were performed with benzyldimethyldodecyl ammonium chloride (BDMDAC) with simultaneous increasing $\tau_w$ values. Neither the application of BDMDAC nor the increasing series of $\tau_w$ (from 0.07-1.84 Pa), when tested independently, were sufficient to remove all the biofilms from the surface. However, additional removal of the biofilm was achieved with the combination of both mechanical and chemical stresses. In fact, the amount of biofilm remaining on the cylinders seems to be more influenced by the chemical stress, rather than by the hydrodynamic regime under which it was formed.*

*The overall results demonstrate the role of the hydrodynamic conditions under which the biofilms were formed on its susceptibility to chemical and mechanical actions. Moreover, even the synergistic actions of chemical and mechanical stresses were not sufficient to remove all the biofilms from the stainless steel cylinder surface.*