#19

MONITORING DEPOSITS BUILD-UP USING A NOVEL MECHATRONIC SURFACE SENSOR (MSS)

Ana Pereira[1], Roxane Rosmaninho[1], Joaquim Mendes[2] & Luis F. Melo[1]
[1] *LEPAE, Department of Chemical Engineering, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, s/n, 4200-465 Porto, Portugal*
[2] *Department of Mechanical Engineering, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, s/n, 4200-465 Porto, Portugal*
Corresponding author: lmelo@fe.up.pt

ABSTRACT

The formation of biofilms and other organic or mineral deposits in drinking and industrial water systems, as well as in food process equipment, is a well-known problem, which is almost impossible to eradicate, although it can be minimized. The strategy for fouling mitigation usually involves monitoring the deposit build up as one of the most important tools available.

The aim of this work is to presents a new portable and economic on-line monitoring device called Mechatronic Surface Sensor (MSS), patented by the authors. This device uses vibration principles to detect and measure on-line fouling formation and/or detachment.

The present configuration of the sensor is composed of a piezoelectric actuator and a vibration sensor fixed on a PVC surface that fits into a flow cell. The actuator produces a vibration that propagates along the PVC plate and is measured by the sensor. The vibration characteristics are dependent on the amount and physical properties of the deposit.

The MSS displays significant advantages over the other available monitoring devices: (i) it can be applied to very different surfaces (metals, polymers, glass, etc.); (ii) it does not require direct contact of the sensor elements with the foulant fluid or the attached deposit; (iii) it monitors a significant surface area in order to get a representative average measurement and iv) it provides an instantaneous response that can be automatically correlated to the properties of the deposit.
Tests were carried out with the following types of deposits formed under different flow conditions: biofilms, silicate deposits and layers of calcium phosphate caused by a simulated milk solution (SMUF).
From these experiments, the following main conclusions could be drawn:
a) The response signal amplitude is a good parameter to monitor the build-up of deposits on sensor surface; comparison between deposits with similar structural features showed that higher masses correspond to smaller signals;
b) Good correlations were found between the output signal and the wet mass per unit of area for all the tested deposits;
c) A damping factor was defined that can be correlated with the different deposit structures (for example, biofilms and inorganic deposits). For the same amount of mass, higher amplitude variations were found for the more elastic deposits;
d) Variations in the deposit attached to the surface could be quantified: e.g., after adding chlorine to a biofilm layer, the subsequent detachment was readily detected by the MSS.

Acknowledgements -The work has been undertaken as part of the research project SAFER ("Surveillance and control of microbiological stability in drinking water distribution networks"), which is supported by the European Commission within the Fifth Framework Programme, "Energy, Environment and sustainable development programme" (contract no. EVK1-2002-0018).