SESSION: *Advanced materials for water treatment and environmental sustainability*

Preference: ORAL

Porous polymeric composites for water-oil separation

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Oil-water separation is a significant challenge owing to the increasing amount and complexity of oily wastewater produced by several sources. For example, wastewater from industries contains different types of oil, lubricants and cooling agents, metal residuals, and other organic and inorganic components. On the other hand, wastewater from domestic sewage is composed not only of organic substances, but also contains a significant number of pathogen microorganisms. Overall, the varying characteristics and complexity of oily wastewater require innovative materials and integrated removal processes. Here, will be presented a number of polymeric based porous materials developed in the Smart Materials group of the Italian Institute of Technology that are able to separate oil from water through sorption and filtration processes. As will be proved, the appropriate surface engineering of pre-existing porous materials and/or the adoption of simple fabrication technologies that successfully combine polymers with functional particles, result in the formation of innovative porous 3D systems able to separate oil from water through the selective oil absorption or through gravity driven filtration. In particular, on polyurethane foam substrates, solutions of submicron particles and polymeric ligands are applied through spray- or dip-coating, resulting in the pores surface decoration with a nanocomposite thin layer, which transforms the foams in excellent oil sorbents [1]. The intrinsic pore structure of the foams affects the maximum oil absorption capacity, which can reach up to $60gr_{oil}/gr_{foam}$ and the separation process can be repeated for several operational cycles. Concerning the 3D filters, novel composite foams are developed through multidiscipline approaches, which allow the tuning of the pores structure, the surface roughness as well as the surface chemistry, all facts that affect the gravity driven filtration efficiency, the flow rates and the types of oily wastewater that can be separated [2]. As will be proved, the foams are durable, and can work in several operating cycles without losing their performance, while they can have additional functionalities.

[1] J. Pinto et al. Int. J. Environ. Sci. Technol. 2017, 14 (10), 2055-2066
[2] L. Vásquez et al. ACS Appl. Mat. Int., 2019, 11 (33), 30207-30217

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