Società Chimica Italiana

SCI2021

XXVII CONGRESSO NAZIONALE DELLA SOCIETÀ CHIMICA ITALIANA

LA CHIMICA GUIDA LO SVILUPPO SOSTENIBILE

14–23 SETTEMBRE 2021

Sessioni Plenarie – ABC – ANA

BOOK OF ABSTRACTS
XXVII congresso della SCI, 2021

La chimica guida lo sviluppo sostenibile
14-23 settembre 2021

ISBN 978-88-94952-24-7

Removal of poly- and perfluoroalkyl substances (PFAS) from aqueous matrix by using hydrogel containing nanostructured carbon material

C. Stevanin[a], R. Boaretto[a], T. Chenet[a], M. Cescon[a], S. Caramori[a], L. Pasti[a]

[a] *Department of Chemical, Pharmaceutical and Agricultural Sciences, University of Ferrara, Via L.Borsari 46, 44121 Ferrara, Italy*

Extensive use of per- and polyfluoroalkyl substances (PFAS) has caused their ubiquitous presence in natural waters. Consequently, water remediation from "forever chemicals" is a critical issue that needs to be addressed promptly due to their adverse health outcomes in humans. It is therefore necessary to study new methods for the removal and elimination of pollutants from water, and membrane-based technology has rapidly become a competitive alternative with respect to traditional methods [1]. In particular, mixed matrix membranes (MMMs), that are composed by a continuous polymer phase and a dispersed inorganic filler have gained importance due to their fouling, permeate quality and longevity characteristics. Different types of fillers had been utilized in MMMs, such as zeolites, mesoporous silica, carbon nanotubes (CNTs), montmorillonite, and metal–organic frameworks.

In this work nanostructured carbon material has been included in several formulations of hydrogels which differ in hydrophilicity, cross-linking and swelling, and the adsorption efficiency of all the formulations had been determined and compared to the adsorption of powder nanostructured carbon. The hydrogel matrices were obtained using two different monomers of polyethylene glycol diglycidyl ether (PEGDE): PEGDE_Ethyl, that presents hydrophilic characteristics, and PEGDE_Propyl, which is more hydrophobic; these two PEGDE monomers were used in a mass polymerization reaction with other two different monomers having amine substituent groups, JEFFAMINE and polyethylene glycol amine functionalized, which give different types of cross-linking in the membranes; for each formulation, a percentage of carbon material, 2.5% and 5% w/w, was added.

For all MMMs, adsorption kinetic and isotherm studies were carried out using the batch method, where a known quantity of adsorbent was placed in contact with a known volume of solution with a known concentration of PFAS. All the results obtained were compared with the values obtained for the powder of the carbon material. Kinetic studies showed that within 6 hours the kinetic equilibrium is reached for all the MMMs considered, while the swelling study was carried out by weight control at different contact times up to 24 hours. The isothermal study was carried out with a contact time of 24 hours, keeping the solution stirred at room temperature and evaluating, by LC/MS analysis, the change in concentration of the pollutant in the solution before and after the contact with the adsorbent material.

The data obtained showed that the MMMs has a higher adsorption efficiency than the powdered nanostructured carbon material. Furthermore, the different hydrophilicity, swelling and cross-linking characteristics play a fundamental role in the saturation capacity (qs) of different MMMs. In fact, qs was improved of about 20 mg of PFAS per gram of adsorbent material, passing from qs = 30.1 ± 1.4 mg / g for powdered nanostructure carbon material to values higher than 50 mg/g for MMMs. Moreover, the results showed that the MMM with the highest saturation capacity was the membrane with higher hydrophobicity characteristics which presents more affinity for per- and polyfluoroalkyl substances.

[1] A.E. Amooghin et al., *Progress in Materials Science*, **2019**, *102*, 222-295

SCI2021

14–23 SETTEMBRE 2021

XXVII CONGRESSO NAZIONALE DELLA
SOCIETÀ CHIMICA ITALIANA

ISBN 978-88-94952-24-7