Development of a nanocomposite membrane based on reduced graphene (r-GO) and zeolite 13X for the removal of metal ions with bactericidal actions

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In the last decades, adsorption by membranes is considered an economical wastewater treatment method to raise the emerging problem of a clean water shortage (i.e. sea and produced water, industrial waste water etc). Graphene-based composites (GO and r-GOs) are a new emerging class of materials promising applications in water disinfection and the fouling/biofouling membranes. In this work, we manufactured nanocomposite membrane combining reduced graphene oxide (r-GO) and zeolite advantages. Zeolite 13X (UOP) was chosen (Si/Al=1) for its affinity towards metal ions, highly hydrophilic character, high thermal stability. Graphene oxide and the nanocomposite membrane were synthesized from natural graphite (Aldrich) in the MackGraphe Research Center laboratories according with modified Hummers method. All materials were characterized by SEM, AFM, FT-IR, XRD, TG/DTA and WCA.

The proposed synthesis method involved the deposition on a nylon substrate by vacuum filtration starting from a GO and zeolite 13X homogeneous mixture (2:1 ratio) dispersed in aqueous solution. r-GO was obtained by reducing dispersed GO in the resultant homogeneous GO solution using hydrazine, to compact the structure and force the water flow into functionalized pores as well as increase the adsorption/rejection capacity.

Batch tests for r-GO/ZEO13X membrane adsorption highlighted a strong selectivity towards Na^+, K^+, Ca^{2+} and Mg^{2+} thus attesting that functional groups exhibited strong metal–ligand interaction ion in aqueous solutions. Finally, the bactericidal properties of the membrane against Gram-positive (*S. aureus* Sa2 and *E. faecalis* ATCC 29212) and Gram-negative (*Escherichia coli* APN1, *Pseudomonas aeruginosa* PaPh32 *and* AC12a) species suggested that GO/ZEO13X membranes are a promising approach for the development of novel antimicrobial membranes in water purification technologies.