Application of polymer nanocomposites in the treatment of oily water

Vanessa Akeda, L. Spinelli, C. R. E. Mansur* and E. F.Lucas

Institute of Macromolecules, Federal University of Rio de Janeiro (IMA/UFRJ), CT, Bl. J, Cidade Universitária, Ilha do Fundão. POBox: 68525, 21945-970, Rio de Janeiro, Brazil – spinelli@ima.ufrj.br; celias@ima.ufrj.br;elucas@ima.ufrj.br

* Corresponding author.

Abstract. A number of processes are used for the treatment of oily water (oil emulsions in water) that come from the oil industry. Each strategy for treatment depends not only on the level of requirements, according to environmental norms established for the location where the water is thrown out, but also on the relative cost of the treatment. The objective of the present study is the removal of oil from oily water by adsorption in polymer nanocomposites. Nanocomposites were prepared from cationic polyelectrolytes and sodium bentonite. Synthetic emulsions of petroleum in water were treated with the nanocomposites that were obtained. The results showed that, in the tests containing only treated sodium bentonite, the removal of oil was around 70%, whereas the use of polymer nanocomposites raised the adsorption of oil to the between 80% and 98%. These values were dependent on the type of polymer, the mass of material, and the contact time.

During the production of petroleum, in systems that operate with secondary recovery, often there is also production of some of the water that is used in the injection process. As a result, the large volumes of water that are generated are to be thrown out in the sea. The water treatment systems are generally divided into three large categories, considering the requirements for levels of purity. The use of tertiary separation systems such as adsorption in active carbon becomes necessary in order to reach levels at which the oil thrown out is less than 10mg/L. In addition to the oil, this kind of treatment is also designed to remove aromatic compounds that are in the production water and that are the most toxic for the environment.

The present study aims to obtain nanostructured materials with an ionene-bentonite base, from commercial sodium bentonites and polymers of the (2.y-tetramethyl-ionenes) type that were obtained [1] beforehand; the objective of this is to apply them to the process of purifying water contaminated with oil. These polymers are ammonia polyquaternary ones that have quaternary nitrogen in the main chain, and they were selected because their load density and size of hydrophobic chain can be varied easily. The clays used in this study were a commercial bentonite, which had a capacity of cationic change (CTC) of 100meq/100g of clay and organophylic clay. Initially, the commercial bentonite was treated with an NaCl solution. The preparation of the nanocomposites consisted of swelling the clay treated in water for 24 hours and then putting a polymer solution into this system by drops and leaving it under agitation for 24 hours. Following this, the nanocomposite obtained was filtered, washed with water, dried and separated. The process of removing the oil from the water consisted of adsorption tests in a thermostatic Shaker agitator, at room temperature. The O/A emulsions were prepared using concentrations of oil from 50 to 200 ppm and masses of nanocomposites of 0.01g. Aliquots of the samples were taken out at a contact time interval between 15 and 120 minutes, and they were analyzed in a Varian spectrofluorimeter, in wave lengths of excitation and emission of 360 and 600nm, respectively.

The results showed that, in the tests containing only the treated sodium bentonite, the removal of oil was around 70%. The efficiency of the removal of oil from contaminated water by nanocomposites formed from sodium clay was similar to that observed for the nanocomposites formed from organophylic clay. The nanocomposites that showed lower efficiency in the oil removal were those that were produced with untreated bentonite and the polymers produced from dibromoalcane with 10 and 12 atoms of carbon. This means that, in this case, the incorporation of a polymer whose chain is smaller than the untreated clay one made the structures more efficient. On the other hand, the incorporation of chains of poly-ionenes that have a larger sized chain made the clay more efficient after the treatment with NaCl.

The systems under study showed efficiency above 90% in oil removal when the oil content was relatively low (50 ppm). For concentrations above 100ppm this efficiency was reduced to around 80%.

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References

[1] A. P. Costa Filho, A. S. Gomes e E. F. Lucas. Polímeros: Ciência e Tecnologia, 15/3 (2005) 212-217.