Application of nanofiltration to the treatment of acid mine drainage waters

E. T. R. Bastos[1], C. C. R. Barbosa[1], E. E. M. Oliveira[1], W. Scassioti Filho[2], V. B. C. de Queiroz[2]
e-mail:ednaruas@ien.gov.br

[1] *Division of Nuclear Engineering - IEN*
[2] *Laboratory of Poços de Caldas - INB*

Keywords: manganese; uranium; nanofiltration; acid mine drainage (AMD)

The present study investigated the potencial of nanofiltration membrane technique to remove dissolved species like uranium and manganese from acid mine water drainage (AMD) at Poços de Caldas Uranium Mine (Brazil). Nanofiltrarion is widely used in water treatment due to lower energy requirements and higher yields than reverse osmosis. The basis for separation by nanofiltration is the negative surface charge of the membrane. This results in rejection of multivalent anions, whilst associated cations are also rejected to maintain electro-neutrality [1-2]. Two different nanofiltration flat-sheet membranes of FilmTec/Dow (NF and SWNF) were tested. Experiments to evaluate the performance of the membranes were performed in a system with permeation permeation cell with displacement type flow tangential mark Flutrol (Figure 1). The considered parameters were the pressure, the volume reduction factor and the time of permeation [3].

The rejection rates for uranium and manganese increasing with the increasing operating pressure for both membranes and for the recovery in the permeate stream were equivalent to 80% of the original feed [4-6].

The results showed a high performance of the membrane, Dow/NF, for manganese reaching 99,5% (0,5 mgL^{-1} in permeate samples), illustrating the advantage of nanofiltration for the removal of manganese from acid mine water drainage; the CONAMA recommended values is 1,0 mgL^{-1}[7].

The divalent anions complex UO_2^{++}, were rejected between 83,8 % and 90,1 % by NF membranes and between 74,6 % and 95,5% by SWNF membranes. Although obtained 95,5% (0,33 mgL^{-1} in permeate samples), uranium concentration in permeat samples was higher than CONAMA recommended values (0,02 mgL^{-1}).

Figure 1 - Pictures of the permeation system with filtration cell with displacement type flow tangential

References

[1] Gonçalves, C.R.; "Remoção de Manganês e Recuperação de Urânio Presentes em Água Ácida de Mina", Tese de Mestrado- Centro de Desenvolvimento da Tecnologia Nuclear/ Comissão Nacional de Energia Nuclear/2006

[2] Macnaughton, S. J.; McCulloch, J. K.; Marshall; "Application of Nanofiltration to the treatment of Uranium Mill Effluent"; Proceedings of a Technical Committee Meeting in Vienna, November 1999, pp. 55 -65.

[3] Schafer, A I.; Fane, A G.; Waite, T. D. ;" Nanofiltration – Principles and Aplications", Elsevier Ltda, Inglaterra, 2005.

[4] Raff, O; Wilken, R. D.; "Removal of dissolved uranium by nanofiltration", Desalination,1999; v.122; pg. 147-150.

[5] Lin, K.L.; Chu, M. L."Treatment of uranium containing efluents with reverse osmosis process", Desalination, 61 (2) 1987 pg. 125-136.

[6] Favre, R. A.; Murat, D.; Foos, J.;Mansour, C. Draye, M.; "Selective removal of dissolved uranium in drinking water by nanofiltration", Water Research, 2008 (42) pg. 1160-1166.

[7] Conselho Nacional do Meio Ambiente. Resolução CONAMA nº 357/2005.