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Optimizing porous material in shock electrodialysis unit

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ABSTRACT

Shock electrodialysis (SED) is a new electromembrane process for water desalination. The principle is similar to electrodeionization – the product should be ultrapure water, but the inlet water can be the same quality as the inlet to electrodialysis. The ion exchange resin is substituted by porous media and used ion exchange membranes are just of one type (i.e., two cation exchange membranes or two anion exchange membranes). The use of porous media is essential. Many physical and chemical phenomena including electroosmotic flow, electroconvection, surface conduction combined in the moment lead to the phenomena of a "–shock wave" and SED, respectively. The mechanism of the wave is represented by the formation of a sharp border in the water stream between the highly concentrated and ion-free zone. The whole process was studied by Prof. Martin Bazant's group at MIT, Department of Chemical Engineering. The aim of this particular study is characterization and experimental testing of porous material as an essential component of SED. A variety of organic and synthetic porous materials were tested by various analytical methods and in the SED laboratory unit itself. The work reports an overview of commonly available and appropriate materials analogous to the glass frit used in the first prototypes developed by Bazant's group. Considering the physical properties and behavior in experimental conditions and based on the results exhibiting stable desalination, we suggest the optimal porous material as well as the housing for this media. Finally, it is represented by quality of products, hydrodynamic resistance, prize of the porous material, availability and also by workability (machinability) for appropriate shape and also construction stability.

Keywords: Water treatment; Shock electrodialysis; Porous media; Desalination

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