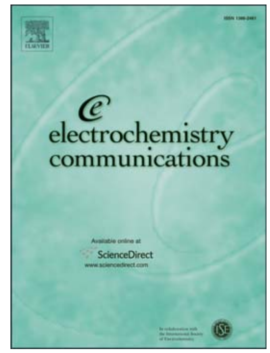

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Short communication

Single module flow-electrode capacitive deionization for continuous water desalination

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Abstract

The search for novel desalination technologies has recently led to the introduction of flow-electrodes to capacitive deionization (CDI) processes, named as flow-electrode capacitive deionization (FCDI). Unlike classical CDI, which is a discontinuous or semi-continuous process due to the need for regeneration of the electrodes within the same module, flow-electrodes offer new design opportunities which enable fully continuous desalination processes as well as easily scalable systems.
Here, we describe a novel system for the continuous desalination of water based on FCDI using a single flow-electrode and a single module. The flow-electrode is based on activated carbon powder suspended in water. During continuous operation of the system, a desalination rate of a 1 g/L NaCl solution of up to 70 % is achieved at water recoveries of up to 80 %. Additionally we report very good current efficiencies: in case of 80 % water recovery, the current efficiency is 0.93. The single flow-electrode single module process might reduce energy and investment costs and lowers the threshold to a large scale implementation.

Keywords: Capacitive Deionization, Water desalination, Flow electrodes, Electrosorption, Suspension electrodes

1. Introduction

The sufficient supply of safe drinking water is essential. Many countries have only very limited natural fresh water sources facing severe water scarcity. It still remains a major challenge for researchers worldwide to develop environmentally friendly and cost effective technologies for the desalination of water. The current state of the art for water desalination is reverse osmosis (RO). [1, 2] An emerging technology for the desalination of water or generally for the removal of ions from aqueous solutions is capacitive deionization (CDI). Potential advantages of CDI over RO are first the potential to become a more energy efficient technology, especially for brackish waters, and second the potential to reach higher water recoveries compared to RO, which has typical water recoveries of about 50% [1, 3, 4].

CDI uses an electric field as driving force for the salt separation from water. The ions present in the solution are drawn towards the oppositely charged electrodes and are then adsorbed in the electrical double layer of the electrode-solution interface [5, 6, 7]. In classical CDI systems usually stationary porous carbon materials are applied as electrode materials. In case of membrane capacitive deionization (MCDI) ion-exchange membranes (IEM) are added in between

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