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BOOK OF ABSTRACTS

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Influence of the arrangement of segmented electrodes on the performance of a pilot scale RED unit

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Introduction. Reverse Electrodialysis (RED) is a membrane-based technology that exploits the different salinity level between two salt solutions to produce green energy. Cationic and Anionic Exchange Membranes (CEMs and AEMs) are used to selectively allow the passage of only cations and anions. Several studies were focused on the process intesification of RED units aiming at maximizing the produced power density. An interesting strategy is the use of segmented electrodes. Specifically, each electrode is divided in more segments allowing the use of proper external resistances for each couple of them, thus, eventually, optimizing RED performance [1,2]. In the present work the performance of a RED pilot scale unit, equipped with segmented electrodes, was investigated to assess the influence of multiple external loads configurations. The activities were carried out in the framework of the SEArcularMINE European Project.

Experimental/methodology. The active area of membranes was 10 cm x 80 cm. Fujifilm® type 10 CEMs and AEMs were employed. Deukum woven spacers, with a thickness of 270 μm, created the fluid channels between AEMs and CEMs. Solutions flowed in co-current configuration. Segmented electrodes (Titanium coated with iridium) were divided in 4 equivalent parts, each one covering 20 cm of the channel length. The influence of (i) NaCl content of concentrated solutions, employing synthetic and real brines; and (ii) the velocity of the solutions, from 0.5 to 2 cm/s, was investigated. In each test a 0.017 M NaCl solution was the diluted solution. Three electrode configurations were analyzed: (i) one external load connected to only the first segments of the electrodes, thus limiting to the first 20 cm of channels (exploitation of the maximum axial driving force); (ii) one external load connected to all the 4 segments of the electrodes (exploitation of the whole length of the stack); (iii) two external loads connected to the 4 segments.

Results and discussion. Figure 1 shows the comparison between the maximum gross power density achieved for the three electrical arrangements. For the sake of brevity, only the results obtained at a flow velocity of 2 cm/s with synthetic solutions with different NaCl concentration are reported.

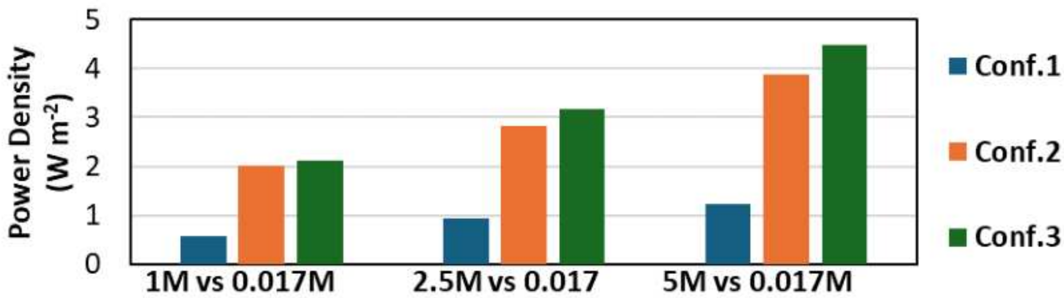

Figure 1. Gross power density at a flow velocity of 2 cm/s.

The use of the two external loads provided the maximum power density values. Starting from these results, several other investigated configurations will be reported to get insights on scale-up benefits.

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