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Analysis of the thermal conductance of polymeric ion-exchange membranes

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The interest on thermal conductance of polymeric ion-exchange membranes is increasingly important due to the growth of new energetic technologies based on transport processes through membranes. The relative importance of the thermal conductance is directly related to the desirability of isolating or enhancing the energy transfer to achieve the optimum performance of diverse membrane-based applications such as fuel cells or electrolyzers. Due to the components in these devices show different thermophysical properties and the junctions between them may be not perfectly flat, most of heat flow passes only through a limited number of pores. So, the actual area of contact is only a small fraction of the nominal or apparent area, and therefore a contact resistance must be taken into account. This thermal contact resistance is related to the thermal conductance.

The aim of this study is to calculate the thermal conductance of commercial polymeric ion-exchange membranes. Different membranes were considered to study the influence of some essential properties such as: the surface heterogeneity, external or internal reinforcement, density, thickness, the ion-exchange capacity or impurity contents, have on the thermal conductance values. For this purpose, a numerical simulation using Comsol Multiphysics® (Comsol Inc., Burlington, MA, USA) that implements the FE numerical technique, was performed using a simple experimental setup previously calibrated. The membrane is sandwiched between two copper cylinders and two probes measure the temperature at both sides of the membrane. The average heat flux along the membranes is also calculated. Thus, the thermal conductance is calculated from the ratio of the temperature drop at the interface to the average heat flux across the membrane.

The results confirm the surface heterogeneity, the reinforcement or the ion-exchange capacity as relevant factors on the thermal conductance value.

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Time Block Preference

Time Block A (09:00-12:00 CET)

References

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