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A Novel Mass Transport Model for Direct Contact Membrane Distillation Flux Prediction

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Owed to its promising permeate flux production, direct contact membrane distillation (DCMD) has been promoted as competitive substitute for conventional water purification and desalination technologies. In DCMD, a porous hydrophobic membrane is placed in partition between a hot feed and fresh cold permeate channels. Water vapor transports through the porous membrane from the feed side to the permeate side due to pressure gradient. This mass transport phenomenon is typically explained by the Kinetic Theory of Gases which suggests Knudsen diffusion, molecular diffusion or Poiseuille flow [1]. The non-uniformity of fabricated membrane pores can lead to the occurrence of more than one transport phenomenon, and thus, a combination of the previously mentioned models is also possible. Deciding which one of these options is appropriate to describe vapor flow in the porous membrane is challenging. Deep understanding of membrane morphology and operational conditions is crucial for accurate description of mass transport. So far, several attempts of mass transport combination models were spotted in literature to predict the actual DCMD membrane permeability. Nevertheless, a wide discrepancy is still present between the available models when tested for the same experimental setup and operating condition [2]. This is due to the marginalized impact of DCMD operating conditions, e.g., inlet feed and permeate velocities. In this work, a unique combination model is proposed to predict permeate flux of DCMD taking into account different inlet conditions. Assessments are performed utilizing a validated steady non-isothermal computational fluid dynamics (CFD) model. Eventually, the proposed model is compared with existing models to assure a reliable estimation of the permeate flux under a wide range of operating conditions.

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References

- [1] M. Khayet, M. Godino, J. Mengual, Modelling transport mechanism through a porous partition, J. Non-Equilib. Thermodyn., 26 (2001) 1–14.
- [2] K. El Kadi, I. Janajreh, Comparison of different mass transfer models for direct contact membrane distillation flux evaluation, Desalination and Water Treatment, 194 (2020) 379-388.

Time Block Preference

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

Participation

In person

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