Validation and characterisation of mass transfer of 3D-CFD model for twisted feed spacer

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ABSTRACT

3D-CFD simulations of a membrane channel with several variations of twisted feed spacer geometry are performed for a Re_h range of 50–200 using a fine meshing approach. Although previous studies could not accurately simulate its performance, the current CFD model shows good agreement with previous experimental data. The validated model reveals that twisted spacers present higher Sherwood number (~55 %) and lower friction factor (~8 %) than conventional ladder-type spacers because the twisted features promote vortex generation and minimise the appearance of stagnant zones. Furthermore, the RR-twisted spacer outperforms the LL- and LR-twisted spacer types in terms of *Sh* because the concave surfaces of the spacers face towards the centre of channel, causing stronger vortices downstream of the filaments. With respect to the number of twists, *Sh* reaches a minimum at l_m/l_{twist} = 3 due to relatively stagnant zones. However, *Sh* increases at l_m/l_{twist} = 4 due to the formation of strong vortices in the region between the filaments. In terms of attack angle, *Sh* reaches a maximum at α = 45° due to the formation of stronger vortices behind the filament intersection. This paper shows that CFD modelling tools have evolved to a stage that they can be used to understand membrane phenomena with complex spacer designs.

KEYWORDS

Twisted spacer; Spiral wound membrane; CFD; Mass transfer characterization

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