A new vacuum membrane distillation system using an aspirator: concept modeling and optimization

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\begin{abstract}

The aim of this study is to validate and optimize a new concept of implementing an aspirator as the vacuum generator for a vacuum membrane distillation (VMD) setup. Numerical models are developed for the aspirator, and its interconnectivity with the VMD chamber is demonstrated. A correlation to estimate the minimum aspirator pump size for a given permeate mass flow is deduced from these models. The dependence of the system’s specific power consumption (per unit permeate flow) on the feed flow rate, number of membrane sheets in the VMD module, and vacuum pressure is investigated. The gained output ratio (GOR) of the proposed system is comparable (GOR $\approx 0.8$) to conventional single-stage VMD with a vacuum pump, if brine heat is recovered using a regenerator to preheat the incoming feed. The theoretical power requirement for a vacuum pump is lower than that used by the aspirator system, if all vapor is condensed and only non-condensable gases are removed by the vacuum pump. At lower vapor pressures, when complete condensation is difficult, the vacuum pump power consumption is comparable to that of the aspirator system if about 60% of the vapor produced reaches the vacuum pump.

\textit{Keywords:} Membrane distillation; Aspirator; Vacuum membrane distillation; GOR; Energy consumption
\end{abstract}

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