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Continuous fabrication of composite hollow fiber membranes for humidification

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Membranes with good water vapor permeability and high selectivity towards air are interesting for external humidifier of polymer electrolyte membrane fuel cells, dehydration of gases or heating, ventilation and air conditioning systems. To optimize water vapor transport through the membrane, composite structures with a very thin selective layer are a preferred membrane type. A manufacturing process was established, where poly (vinylidene fluoride) (PVDF) hollow fibers were fabricated via non-solvent-induced phase separation. Subsequently thin layers of polyvinyl alcohols (PVA) were coated with a continuous dip coating process and crosslinked by glutaraldehyde. Influencing parameters on the coating process, like surface tension and viscosity of the coating solution and coating velocity were investigated and correlated with resulting layer thicknesses according to the theory of Landau, Levich and Derjaguin, the so called LLD law. Furthermore the impact of the layer thickness on crosslinking, water vapor permeability, nitrogen permeability and thermal stability was studied. According to the coating parameters PVA layers were produced in a range of 0.3 µm–4.29 µm in good accordance with the LLD law. By coating the membranes the nitrogen permeance was reduced down to 0.01 m³/ (m² h bar), which indicates, that dense layers were formed. For the water vapor permeability values up to 4160 Barrer could be achieved at 80 °C and selectivity towards nitrogen of 289 at 25 °C was reached. Due to the manufacturing process thicker coating layers received a lower degree of crosslinking. As shown in Fig. 1 this phenomena causes a linear increasing water vapor permeability over the layer thickness. With a thermal stability test, which most membranes withstood, the usability of the composite membranes was proven. Coated hollow fiber membranes were continuously manufactured with a simple and fast process for humidification applications and these membranes showed very promising separation properties.

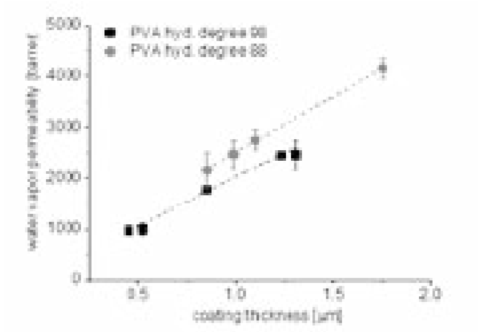

Fig 1: Water vapor permeability at 80 °C of PVDF hollow fiber membranes with different PVA coating layers.

Biography

Isabel Jesswein studied Process Engineering at the University of Stuttgart (Germany) with focus on Plastics Engineering and Interfacial Process Engineering. After receiving her Master degree, she started working at the Institute for Interfacial Engineering and Plasma Technology IGVP in Stuttgart as PhD-Student. Her research focuses on the production of hollow fiber membranes and their surface modification through dip coating processes for different fields of application.

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