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Analysis of the transport of the individual gas mixture components in polymers of intrinsic microporosity and PIM-based mixed matrix membranes

Due to the increasing need for sustainability in all industrial sectors, membrane operations are gaining territory over energy demanding and less environmentally friendly traditional separation processes. Successful implementation of membrane technology requires the development of novel materials with enhanced performance. In the field of gas separation, polymers of intrinsic microporosity (PIMs) and mixed matrix membranes (MMMs) are two classes of such materials which are intensively investigated by the scientific community. PIMs have exceptional permeation properties owing to their stiff contorted polymer backbone that induces an unusually high fractional free volume, in combination with a modest size-sieving behavior. MMMs consist of porous materials dispersed in a dense polymer matrix and metal organic frameworks (MOFs) are often used as such fillers because of their generally good compatibility with the polymer and their specific pore structure. MOFs may further increase the selectivity of polymeric membranes, enhancing the permeability of certain gas species and blocking others, especially MOFs with a high aspect ratio. The use of novel materials also requires better characterization methods to analyze their performance. In this light, the present paper discusses the development of a novel method for the analysis of the individual permeability and diffusion coefficients of gas mixtures in polymeric membranes, using in-line analysis of the permeate composition by a Quadrupole Mass Spectrometer. A comparison is made with the so-called time lag method for pure gases and some peculiarities of the gas and vapor transport in PIMs and other high free volume polymers will be discussed.

Biography

Johannes Carolus Jansen has completed his PhD in the Department of Polymer Technology of the Delft University of Technology, Netherlands in 1996. After a short stay as a Visiting Researcher at DSM Resins, he has worked at the Agrotechnological Research Institute ATO-DLO, Wageningen, Netherlands from 1997-2000 and the CNR Institute of Macromolecular Chemistry, Milan, Italy from 2000-2001. In his current position as a Researcher at the CNR Institute on Membrane Technology, Rende, Italy, he is responsible for various national and international public and private research projects. He holds 2 patents and is the author of 1 book, over 80 publications and book chapters with an h-factor of 29.

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