

## **Challenges in Membrane Characterization Due to Microflow Measurements**

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**Abstract-** The term “microflows” is often associated with microfluidics, which is a multidisciplinary field intersecting engineering, physics, chemistry, microtechnology and biotechnology that has emerged in the beginning of the 1980s. On the other hand, microflows also originate from a diffusive transport of fluids, typically gases, through seemingly non-porous media, such as perm-selective membranes. Characterization of the materials for gas separation membranes, which involve the determination of the diffusivity, permeability and solubility coefficients of different gases in these materials, relies on accurate measurement of microflows. Microflows are measured directly using the constant pressure (CP) technique, or indirectly using the constant volume (CV) technique. The former is limited to flow rates greater than 0.01 cm<sup>3</sup>/min, while the latter allows measurements of the flows much lower than that limit. In addition, the CV technique is commonly applied for the determination of the diffusivity and solubility coefficients in a dynamic gas permeation test by using the time-lag method. Consequently, the CP and CV techniques allow gaining an understanding of the transport phenomena taking place inside the tested membrane. On the other hand, very little attention is given to transport phenomena taking place downstream from the tested membrane. The latter may have a profound effect on the experimentally determined membrane properties, which may deviate significantly from the actual properties of the membrane.

In this presentation the focus is given to two specific phenomena, back diffusion and back permeation of atmospheric gases that occurs in microflow measurements by the CP technique and the resistance to gas accumulation under high vacuum, which may occur in microflow measurements by the CV technique. Starting from first principle the conditions, at which these phenomena occur, and quantification of ensuing systematic errors will be presented and discussed.