

Thin liquid films for gas separation

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Gas and nanoparticle filtration is generally performed via complex and expensive porous membranes facing clogging issues; breaking these current technological limitations relies on decreasing the costs and simplifying the existing protocols. A good alternative lies in specific liquid materials such as thin liquid films [1]. The permeability of soap films to gas depends on their thickness, the gas solubility in the liquid, and the surfactant monolayers' structure and mutual interactions. Understanding the properties of such systems remains challenging due to their inherent complexity. We want to understand and predict the phenomenon of gas permeation through a soap film, and how the film properties (thickness, surfactant nature and concentration) affect its performances as a gas filter. We study the evolution of a system of two gas compartments (air + non soluble C_6F_{14} | air) in a glass syringe, separated by a soap film made of a 3g/L TTAB solution. Only the soluble gas (here, air) permeates through the membrane to balance both air concentrations (like osmosis phenomena in liquids).

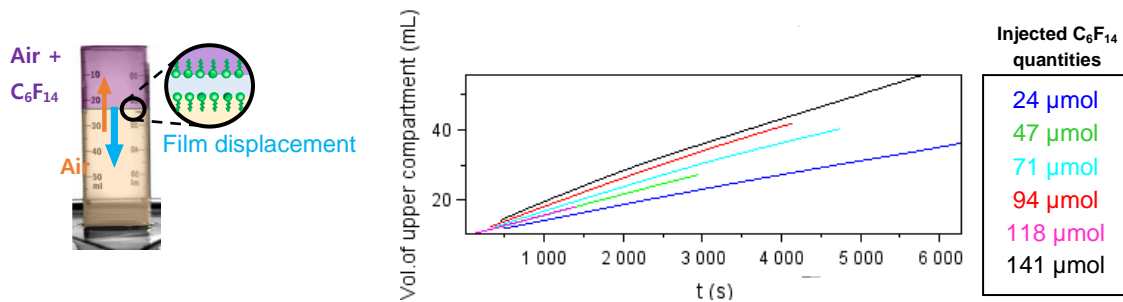


Figure 1: Time evolution of the volume of the compartment containing C_6F_{14} .

We develop a physical model to describe the evolution of the air + C_6F_{14} compartment and extract the film permeability k ($\text{cm}\cdot\text{s}^{-1}$), and establish a link between the film permeability and other properties of the system like the partial pressure of C_6F_{14} and adsorption phenomena.

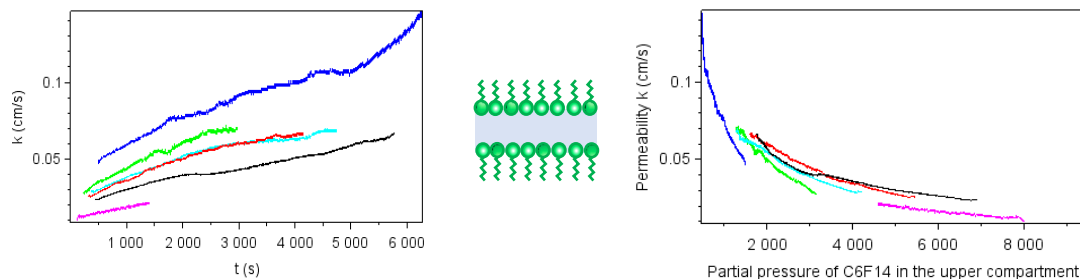


Figure 2: Evolution of the film permeability vs. time and the partial pressure of C_6F_{14} in the upper compartment. The observed increase of permeability with time is presumably linked to C_6F_{14} dilution along time, which limits its adsorption on TTAB film [2] (adsorption supposedly decreases with the partial pressure of C_6F_{14}).

[1] H. M. Princen and S. G. Mason, "The permeability of soap films to gases," *J. Colloid Sci.*, vol. 20, no. 4, pp. 353–375, 1965.

[2] A. W. Adamson and A. P. Gast, "Adsorption of gases and vapors on solid," in *Physical chemistry of surfaces*, 1997.