Oral SCF11

Diffuso-Activated Dilatation/Contraction of a Silicone Rubber/CO_2 System: Critical Analysis from Direct Observations

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Some special design applications require both low fluid permeability and other extremely high performance in severe environments, which only silicone rubber can provide. Applications asking for such characteristics cover a range of aerospace, petroleum, hydrogen transport, etc.

Even if low, the rate of permeation is a specific function of a given fluid, rubber and thermo-pressed confinement [Rubber Chem. Technol., 24, 109-131, 1951]. In liquid/gaseous/supercritical-pressed environment, dilatation/contraction of the elastomer is not instantaneous.

Within this context, the work carefully screens and critically evaluates the dilatation/contraction dynamics (mechanical effect due to fluid diffusivity) of a silicone rubber submitted to sorption/de-sorption of CO_2 (fluid diffusivity) from direct optical observation under coupled thermal and fluid stress. The in-situ observation enables running with clairvoyance especially in situations where the polymer is not exposed to uniform dilatation/contraction because of blister fracture.

Based on shape analysis of the sample submitted to fluid stress, a fine permeability calculation is setting up. It extracts the thermo-dilatation/contraction response to the diffuso-dilatation/contraction response of the polymer. The micro-mechanism of the thermo-diffuso-dilatation/contraction dynamics is ascertained without relying on any theoretical assumption at any stage of the property evaluation.