The effect of multi-wall carbon nanotubes addition on the performance of P84 co-polyimide hollow fiber membranes

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The present work investigates the effect of the addition of Multi-Wall Carbon Nanotubes (MWCNTs) of various concentrations in polymeric hollow fiber membranes for gas separation; their performance and their mechanical properties will be analyzed. Polymeric BTDA-TDI/MDI (P84) co-polyimide hollow fiber membranes were prepared using the dry/wet spinning technique, a method which is based on a phase-inversion process [1, 2]. The concept of the present work is based on the use of MWCNTs as filler material. The purpose is to study the effect of these carbon additives (MWCNTs) on the gas permeances as well as in thermal and mechanical stability compared to pure polymer (single phase) [3]. The photos of all prepared HFMs (single and mixed matrix) as well as a characteristic SEM picture which depicts one of them can be seen in Figure 1. Four different types of hollow fibers were produced with different MWCNTs concentration on the polyimide matrix, namely 1, 2, 4 wp% and without nano-reinforcement. The mixed matrix hollow fiber membranes exhibit satisfactory gas selectivities and good gas permeances as well as increased mechanical and thermal properties.

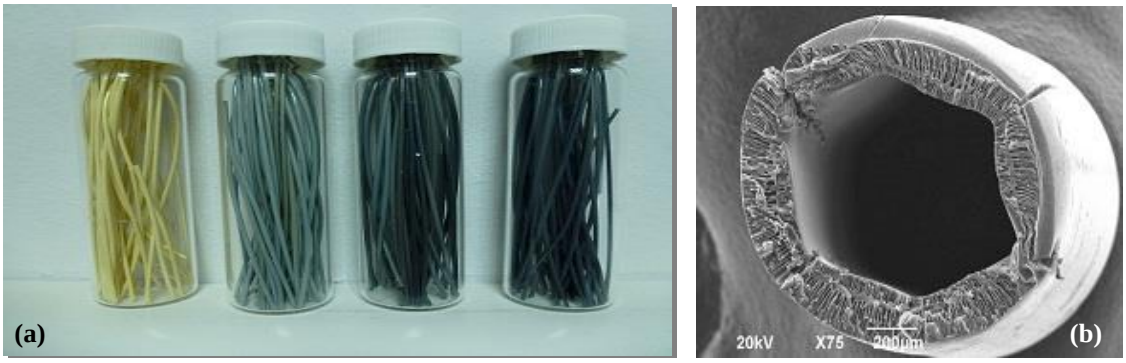

Figure 1: (a) Macro-photograph of the produced hollow fibers with different MWCNTs concentration (from left to right: MMHFM with 0, 1, 2 and 4 % fillers' concentration) and (b) SEM of the cross-section of the 0% MWCNTs hollow fiber [2]

Tensile and three-point bending tests were performed in an MTS-Insight 10 kN loading frame at a 0.005 mm/sec displacement rate. During the tests, time, force and displacement were continuously monitored and recorded. It was found that the addition of MWCNTs essentially increased the tensile and flexural modulus of elasticity; the enhancement in strength properties was not obvious and the results are discussed by taking into account the gas separation performance of the fibers, where at ambient temperature, the increase in permeance coefficients follows the increase in the filler concentration in a linear way.

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