CHARACTERIZATION OF HYDROLYTIC DEGRADATION OF U-F JOINTS THROUGH APPARENT DIFFUSIVITY

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ABSTRACT

The hydrolytic aging of an adhesive joint (wood-urea/formaldehyde resin) is characterized by measurements of the apparent diffusivity of two inert gases within the bond. This kind of measurement is of some interest, because it includes both chemical and geometrical changes in joint structure.

Apparent diffusivities are determined in a diffusion cell after various degradation times in a cold water bath. Our results show that diffusivity increases with aging time with an asymptotic trend. Nevertheless, when the joint undergoes cyclic aging (immersion/drying), chemical degradation occurs mainly during the first cycle, while mechanical degradation observed during the drying steps also appears during the following cycles. The values of apparent diffusivity show that the solute transport is a real diffusional transport phenomenon and that resin joints are not porous.

Keywords: Urea-formaldehyde, hydrolysis, aging, diffusivity, chemical degradation, mechanical degradation.

NOTATIONS

C_{A1}	concentration of A in cell 1 (mole·m^{-3})
C_{A2}	concentration of A in cell 2 (mole·m^{-3})
C^0_{A1}	initial concentration of A in cell 1 (mole·m^{-3})
C^0_{A2}	initial concentration of A in cell 2 (mole·m^{-3})
d	pore diameter (m)
D	diffusion coefficient (m^2·s^{-1})
$\mathbb{D}$	apparent diffusivity (m^2·s^{-1})
e	thickness of the sample (m)
k_1	local transfer coefficient in cell 1 (m·s^{-1})
k_2	local transfer coefficient in cell 2 (m·s^{-1})
K	global transfer coefficient (m·s^{-1})
Kn	Knudsen number (−)
m	partition coefficient (−)
M	(kg·mole^{-1})
R	gas constant (J·mole^{-1}·K^{-1})
S	transfer area of the sample (m^2)
T	absolute temperature (K)
V_1	volume of cell 1 (m^3)
V_2	volume of cell 2 (m^3)
ΔP	pressure drop (Pa)
λ	mean free path of the gas molecules (m)
σ	molecular radius (m)
Φ_A	specific flow of solute A (mole·m^{-2}·s^{-1})

INTRODUCTION

The urea-formaldehyde/wood joints commonly used for wood structures may deteriorate under some conditions and lead to the rupture of these works. Thus it seems impor-

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