Hygroscopic Behavior of Unidirectional Carbon Fiber/Epoxy Composite Laminates

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Key Words: Composite Materials (복합재료), Carbon Fiber (탄소섬유), Epoxy (에폭시), Glass Transition Temperature (유리전이온도), Moisture Diffusion Coefficient (수분확산계수), Coefficient of Moisture Expansion (CME : 수분팽창계수), Free Water (자유수분), Bound Water (결제수분)

Abstract

In this paper, effects of such parameters as water temperature, matrix volume ratio $V_m$, void volume ratio $V_v$, specimen thickness, lay-up sequence, internal stress existence, change of water temperature and fiber angle on the moisture absorption behavior have been considered through the moisture absorption test of the unidirectional composite laminates. It is shown that thickness of specimen, lay-up sequence have little effect on the hygroscopic behavior of unidirectional laminate, while the other parameters have affected the moisture absorption behaviors of the composite in different ways and intensities, respectively. For the specimens reached different saturated moisture contents in the various water temperatures, decrease of glass transition temperatures has been observed through dynamic mechanical analysis. Also a characteristic length of moisture path in the unidirectional composite laminate has been modeled as a function of angle $\theta$ between the direction normal to the surface of laminate and the axes of fibers in the laminate. In the modeling the fibers forming an angle $\theta$ are considered acting as a barrier to the diffusion of moisture into the laminate and the results are compared to Shen and Springer’s and current experimental test results.

1. 서 론

항공기용 구조물의 주 재료로 널리 사용되고 있는 복합재료의 구성 요소인 고분자 물질 내부로 수분이 침투, 확산(diffusion)해 들어갈 때 무재료 구성하는 고분자 물질 고유의 물리적 특성은 침투된 수분에 의해 변화하는 것으로 알려져 있다. 격은 무재료에 비해 고강도 성능을 갖는 소재로 항공, 우주, 스포츠 등의 절단 분야에 널리 사용되는 고기능성 섬유보강 복합재료(advanced fiber reinforced composites)의 기저(matrix)재료로 많이 쓰이는 열교화성(thermosetting) 수지의 일종인 에폭시