

A Study on the Degradation Mechanisms of Honeycomb Structure by Moisture Absorption

Yun-Hae Kim, Joong-Won Han, Kyung-Man Moon

Division of Mechanical and Materials Engineering, Korea Maritime University
Busan, Korea

Kook-Jin Kim, Sung-Youl Bae, Young-Dae Jo

Department of Materials Engineering, Korea Maritime University
Busan, Korea

ABSTRACT

Honeycomb structure, which are composed of FRP panels and a honeycomb core, are the superior materials because of their high specific characteristics and outstanding properties. Although the structures have advantages for applications, some failures of structures have been repeatedly reported by moist absorption. Therefore, it is necessary to find out the degradation mechanisms of honeycomb structure in order to ensure their reliability.

In this study, two types of specimens (non-hole specimens and hole specimens) were manufactured, and immersed for 16 weeks in the water bath. In addition, Flatwise tensile (FWT) testing and fractographic analysis were conducted to find out the degradation mechanisms of honeycomb structure. The different behavior associated with the strength reduction between non-hole specimens and hole specimens could be observed by FWT testing. In case of non-hole specimens, the resin types of their FRPs were the most important factors in mechanical degradation of the bonding strengths. Moreover, relatively fast FWT reductions and continuing reductions could be observed in hole specimens.

KEYWORDS: honeycomb structure; moist absorption; FRPs panel, honeycomb core; epoxy resin; CFRP, GFRP

INTRODUCTION

Fiber reinforced plastics (FRPs) are widely used for marine, infrastructure, leisure, and many other applications because of their high specific characteristics and superior properties. Moreover, Honeycomb structure, which consist of FRP panels and a honeycomb core, are also used to reduce weights and to prevent corosions in various applications. Because there is an interface between FRP panels and the honeycomb core delamination failures between two materials frequently occurs. Particularly, delaminations between FRP panels and the honeycomb core have frequently been reported due to moisture absorption in the bonded regions. Although these kinds of component failures commonly occur, it is very difficult to repair the structure

because of high costs and complex processes required for repairing a structure.

In previous research, there have been reports of FRP components failing in F/A-18 aircrafts, due to moisture exposure.¹ Moreover, there have been previous research activities to find out the mechanical degradation behavior of FRPs in moisture environments. For example, Shen. C. H and Springer. G. S studied the influence of moisture absorption on the mechanical properties of FRPs. Moon (1998) also investigated the property degradation of the interface between fibers and resins in FRPs. Although there have been various research activities to find out the mechanical strength reduction in honeycomb structures and FRPs in the moist environments, the research attempts, which were focused on degradation mechanisms and mechanical degradation behavior of honeycomb structure, were difficult to determine. Also, it is necessary to investigate what is the most important factor of mechanical degradations for honeycomb structures in the hot / wet environments. Therefore, the objective of this study is to determine the effects of moisture absorption on honeycomb structures and understand the degradation mechanisms involved.

In this study, two types of laminated specimens (non-hole specimens, hole specimens) were laid-up and cured in the autoclave system. The specimens were then immersed in an 80°C water bath for 16 weeks. Moreover, Flatwise tensile (FWT) testing and the fractographic analysis were carried out at 0, 4, 8 and 16 week time periods to find out the degradation mechanisms and mechanical degradation behavior of honeycomb structures in the moist environments. Lastly, FWT tests were conducted after specimens were dried 4, 8 and 16 week time periods to find out their recovery behavior.