STUDY ON THE ALTERNATIVE METHOD OF NON-DESTRUCTIVE TESTING FOR FIBER REINFORCED POLYMER

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SUMMARY

The usage of Fiber Reinforced Polymer (FRP) as a main construction material in ship's hull is increasing every year. Due to the combination of its lightweight characteristic and excellent mechanical properties, FRP materials can be used in speed boat, high speed craft, passenger ship, and any other fast ships. The excellent mechanical properties can be achieved during the shipbuilding process. However, on the recent years, there are many accidents happened on FRP Ships. In fact, many FRP ships are built without the supervision of Classification Society, so that its material properties and quality cannot be ensured. It is not easy to assess the quality of installed materials on an existing ship, since it is not feasible to conduct a destructive test to determine mechanical properties; on the other hand, it is very important task. Hence, non-destructive test method is more preferable to determine quality of materials, considering its practicability for portable examination, and only small damage caused by this method. Modal Testing (Vibration Test) is one of the promising non-destructive test method to assess material properties. Furthermore, the material properties resulted from Modal Testing were compared with Tensile Testing as a conventional testing method. The comparisons then being analyzed and presented in this paper. Recommendations for further works were also included.

***Keywords** : fiber reinforced polymer, modal testing, vibration testing*

1. INTRODUCTION

Composite is a combination of two or more types of materials in order to achieve the desired properties of material. One of the most common composite used in the world is fiber reinforced polymer (FRP). In FRP, glass fibers are attached to polymers material, the combination resulting a material which possess a high strength but a lower density compared to steel. For the past years, it has been used as a construction material in ship's hull. Therefore, because of its lightweight characteristic, FRP is commonly used as a hull construction material for various small and high-speed crafts.

To ensure that the FRP material achieve the excellent mechanical properties on its application in a ship's hull, the supervision from Classification Society during shipbuilding process is important. Lack of materials quality may bring some drawbacks for the voyage, as well as ship's safety. Moreover, they may carry many passengers. The National Transportation Safety Committee (KNKT), an Indonesian government agency charged with the investigation of air, land, rail, and marine transportation safety deficiencies, published that some incidents and accidents on FRP ships are already happened in Indonesia.

An accident happened on MV. Dumai Express 10 on its voyage to Pulau Iyu Kecil, Tanjung Balai Karimun, Riau Island [1]. MV. Dumai Express 10's hull is constructed by FRP materials, and the accident is happened after 10 years of shipbuilding process. The shipbuilding process was not supervised by any Classification Society. The process was done, and supervised by its own shipbuilder. Moreover, all of materials used in the process did not have the approval from any Classification Society. In fact, both of materials used and the building process play an important role in ensuring the strength of construction. During its voyage, the big wave hit the side wall plate of the construction and the water gets into the ship through the damaged wall. After some investigations, it is known that the damaged wall materials possess a brittle characteristic due to the imbalance composition of resin and catalyst. The accident caused MV. Dumai Express 10 sank, 42 passengers died, and another 33 passengers were not yet found.

In order to ensure the safety during its voyage and prevent the damage of construction, a ship shall be inspected by Classification Society. The mechanical properties on the construction which represent the condition may be verified. The conventional tensile testing may not be used for examining the existing ships since it may damage some parts of ships construction and needs more time as well. On the existing ships, the unavailability