APPLICATIONS AND KEY ISSUES OF THE COMPOSITE MATERIALS IN THE AUTOMOTIVE INDUSTRY

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1 Introduction

Environmental regulations in automotive industry have been tightened up as a global strategy for reducing a green-house gas. The reinforcing regulation in EU is such that CO_2 emission is going to be restricted below 130g/km in 2012 and 95g/km in 2020, respectively. Meanwhile, the governments in the US, Japan, and Korea plan to impose a more stringent rule on the fuel-efficiency that is more than 40% by 2020 as a representative regulation index.

To achieve these goals, worldwide automotive companies have struggled to develop alternative fuels or improved power trains such as bio-ethanol, bio-diesel, a natural gas, a hybrid vehicle, an electric vehicle and a fuel cell vehicle.

However, it is necessary to reduce weight of a vehicle in order to achieve those goals through the improvement of fuel-efficiency. Unfortunately, the weight of eco-friendly vehicle tends to increase owing to additional components such as a motor, a battery, electric devices and so on. Many automotive companies are establishing plans for reducing the weights of vehicles to overcome these problems. It is Hyundai-Kia motor company's target that the vehicle weight should be reduced by 10% before 2015.

Although various metallic materials, including high tensile strength steel, aluminum alloy, have been introduced, it has already reached the limit for a further improvement. Therefore, composite materials are proposed as alternatives aiming a significant weight reduction in automotive parts.

2 Applications & Issues

2.1 Applications of Composite Materials

Composite materials are of high potential for vehicle component applications due to their excellent mechanical properties in addition to low densities. Glass-fiber-composite, for example, is applied for various automotive components such as a front end module, a cylinder head cover and an air-intake manifold, etc. Composite compounded with talc or clay is used in molding components to obtain improved dimensional stability. Automotive structural components and propeller shaft made of carbon-fiber-composite have been tried but those were not widely used due to their high cost and low productivity despite advantages in weight and performance. In spite of several trial for the application of MMC (Metal Matrix Composite), it has not yet been adopted for a mass production owing to the limitations in mechanical properties, complicated manufacturing processes.

Carbon-fiber-composite and metal-CNT-composite, have been improved gradually in cost competiveness and productivity through steady R&D activities by automotive companies. As the regulations regarding green-house-gas are expected to be reinforced gradually, the demand for composite components of light-weight will increase by successive stages.

2.2 Issues for Mass Production

The high material cost including that of carbon fiber is one of the major obstacles to overcome for the mass production of composite parts. The process cost reduction should be accomplished through shortening cycle time.

In addition, high reliability or durability should be maintained because the automotive parts could not be inspected periodically, which differs in the

applications in an aircraft. Considering current composite technologies, it is unavoidable that composite components are a little more expensive compared with those made of steel or aluminum. Therefore, specialized investigations maximizing the unique characteristics and advantages of composites are required. Remarkable improvements in fuel efficiency and NVH performance by use of composite materials are representative examples.

3 Summary

In order to extend the application of composite components in automotive industry, the remarkable functional improvement should be the goal rather than simply reducing weights by changing materials. Since improvements in fuel efficiency and NVH are directly related to the value of vehicles especially, it is expected that the developments of advance composite components will be accelerated leading to improved performances through innovated composite technology.