CONTEMPORARY METALLIC MATERIALS

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Chapter 015

Reverse Engineering of Automotive Piston

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Keywords: Reverse engineering; Automotive piston; Tensile strength; Microstructure.

Abstract: To be aware of the present operating conditions of the automotive piston which are depended on mechanical and tribological properties, composition, microstructure and morphologies a comprehensive study of reverse engineering on an automotive piston is very essential. Therefore, the main aim of this work is to investigate and analyze a conventional automotive piston by performing the mechanical test, wear test and microstructure analysis. A piston was destructed for various experiments and investigations. Tensile test was performed using universal tensile testing (UTM) machine whereas hardness test was done on Vickers hardness tester. Microstructure and chemical analyses were performed using optical microscope (OM) and energy dispersive x-ray spectroscopy (EDX) analyzer respectively. The wear test was performed using pin-on-disk (POD) machine. The tensile test results showed that the ultimate tensile strength and modulus of elasticity of the piston were 215 MPa and 73 GPa respectively, whereas the Vickers hardness number of this material was found to be 155 $HV_{0.5kgf}$. The micrograph shows the phases of Si plate with ~17% of Si surrounded by α-Al matrix referring to the hypereutectic Al-Si alloy which was proven by the EDX analysis as well and the wear test results showed the moderate specific wear rate (with the range of 1.81 to 3.1 $x10^{-6}$ mm^3/N-m). The current reverse engineering analysis provides a guideline to replace or introduce a new material especially metal matrix composite for the application of new generation automotive piston with better properties, lighter weight and higher performance.

Introduction

The engine is the most crucial part of an automotive car and piston may be considered as the heart of engine which is wholly dependent on an engine crankshaft for power and movement. Automotive engine piston is one of the most complex components among all other parts. In order to understand the existing direction of materials, present design, working details and manufacturing process of automotive piston and also for the future direction in new materials with new design, a comprehensive study on the reverse engineering is essential [1]. Study shown that the aluminum–silicon eutectic or hyper eutectic alloys are cast to produce majority of pistons and are known as _piston alloy', which provides the best overall balance