90

Research Article

B. Radha Krishnan* and M. Ramesh

Experimental Evaluation of Al-Zn-Al_2O_3 Composite on Piston Analysis by CAE Tools

https://doi.org/10.2478/mme-2019-0028
Received Dec 04, 2017; revised Jun 01, 2018; accepted Nov 20, 2018

Abstract: Today's automotive designers and material specialists regard lighter vehicles for less fuel consumption (economy and ecology) and higher safety to passengers. Metal matrix composites have been a large area of interest. Aluminium composite is potentially applied in automotive and aerospace industries, because it has a superior strength to weight ratio and is a light weight metal with high temperature resistance. Composites containing hard oxides and ceramics (such as alumina) are preferred for high wear resistance along with increased hardness. In this work, alumina and zinc are reinforced in Al-LM25 alloy through stir casting process, where alumina is varied 6% and 12% in Al-5%Zn. Various mechanical analyses were conducted and the effect of wear with different percentage of alumina reinforcement was studied. The resulting properties are imported in a piston, modelled using solid works, and analysed in ANSYS work bench. Imparting this new material for pistons could introduce deep design and improvements in engine operation of a vehicle.

Keywords: LM25 alloy, Zinc and alumina, Stir casting, Mechanical and wear behaviour, analysis in ANSYS

1 Introduction

Engine piston is the most complex part compared to other components in an automobile sector. Many research works have been conducted on piston with regard to material composition, geometry and manufacturing technique. The function of the internal combustion engine piston is to receive the energy from expanding gases during combustion and transmit it to the crankshaft by means of connecting rod. The piston expands appreciably when it gets heated during the operation; so actual clearances need to be given, otherwise it will lead to engine seize. This report is of replacing conventional piston material LM28 with a new composite [Al-LM25 +Al_2O_3 + zinc]. Zinc is added 5% throughout all three samples, and alumina is varied 6% and 12%, respectively. The addition of zinc and alumina reinforcement particles to the aluminium matrix improves the tensile strength, compressive strength and hardness behaviour. The reinforcement material has more factor of safety compared to un-reinforced alloy material because of more yield strength due to the presence of reinforcements in the matrix alloy. As per rule of mixture, the strength of the composite drops similarly, with decrease in matrix strength at increasing temperature. Composites produced at an industrial scale are used for manufacturing of pistons, cylindrical sleeves, disc sand brake drums. Specimens casting is done through stir casting technique.

To find the mechanical properties, specimens are subjected to various tests such as wear, hardness, tensile, radiography and impact tests, and interpretation of CAD/CAM/CAE is very helpful to design, analyse, optimize and interpret the data. Compared to traditional aluminium alloys, there can be better stiffness, wear resistance and creep resistance when the aluminium alloy matrix composites are reinforced with ceramic particles. Because of the properties of aluminium such as low melting point, low density, thermal conductivity and high specific strength, a wide range of reinforcement particulates such as SiC, Al_2O_3, B_4C, TiC and TiB_2. The objective of the present work was to evaluate alumina's influence on the densification, strength and hardness in Al–Zn composite. Krishnan (2013, IJMERR) fabricated composite plates subjected to mechanical properties like flexural strength, impact strength test of the various specimens are calculated by using computer-assisted universal testing machine and Charpy impact testing machine. From the results, it is found that pure basalt fibre combination maintains higher values in both flexural and tensile tests, but for impact test basalt fibre is slightly lower than jute fibre reinforced composite [17].

***Corresponding Author: B. Radha Krishnan:** Assistant Professor, Nadar Saraswathi College of Engineering and Technology, Theni, Tamilnadu, India; Email: radhakrishnancadcam@gmail.com
M. Ramesh: Assistant Professor, K. Ramakrishnan College of Engineering, Tiruchirapalli, Tamilnadu, India;
Email: sastra.ramesh90@gmail.com