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Characterization and investigation of performance of Sn–Bi alloy used as a thermal interface material

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ABSTRACT

The proliferation of electronic technology has resulted in the miniaturization of electronic devices while simultaneously leading to a huge increase in the power density of gadgets. Due to this, the devices need to have better heat dissipation system to provide a high level of performance. Additionally, the compactness and performance characteristics of high speed and high power electronic components require efficient heat dissipation for the development of electronic equipment with high reliability. One of the most important issues in meeting the aforementioned difficulty is thermal control. The Thermal Interface Material, also known as TIM, is an important component in the process of thermal regulation. In comparison to traditional thermal interface materials (TIMs) like thermal grease, thermal gel, adhesive and solder, liquid metal (LM) TIMs offer a number of benefits due to their fundamentally high thermal conductivities, flexibility, and low melting points. These characteristics make LM TIMs ideal for use in thermal management applications. In the study, Low melting alloy (LMA) Sn60Bi40 is utilized as a filler material at the interfacial region between copper substrates in order to improve heat transfer performance. In this work, thermal contact resistance and temperature distribution of TIM are explored experimentally. Additionally, the characterization of Sn–40Bi using Scanning Electron Microscope (SEM), differential scanning calorimetry (DSC), and X-ray Diffraction (XRD) analysis were carried out. The paper also reports the variation of thermal contact resistance (TCR) that occurs in response to heat flow, temperature distribution at the interfaces, and thickness.

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Interpretable ensemble machine learning framework to predict wear rate of modified ZA-27 alloy

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Abstract

This study investigates the impact of adding manganese (Mn) to ZA-27 alloy on microstructure and tribological properties. The Mn content varied from 0.2% to 1%. Volumetric wear rates were measured under different operating conditions. XRD and SEM were employed for phase identification and surface analysis. Ensemble Machine Learning (EML) regression models, including bagging, decision trees, random forest, ada boost, gradient boosting, and extreme gradient boost, were used to predict wear properties. Results indicate that the lowest wear rate occurred at 0.5% Mn content. Different wear mechanisms were observed for varying Mn contents. Among the EML models, extreme gradient boost showed superior performance with R^2 values of 0.999 and 0.985 in training and testing, respectively.

Introduction

In the automotive industry, mechanically propelled machine elements cause significant economic losses due to wear and friction [44]. As a result, materials are highly needed to extend the life of engineering machinery and parts by minimizing wear [38], [39], [42]. Zinc-aluminum (ZA) alloys with a distinctive blend of features are found to be a substitute for most aluminum casting alloys, bearing bronzes, cast iron, plastics, and steel fabrications [3], [2]. These alloys exhibit superior bearing capabilities than traditional bronze bearings, including energy-efficient melting, remarkable castability, intense power, and a variety of other features [1], [27]. However, the major problems suffered by these alloys are property deterioration at high temperatures (above 100 –120°C) and dimensional instability with rising temperatures [32]. The dimensional instability is caused by the rapid decomposition of the Al-solid solution into a Zn-base solid solution and $CuZn_4$ phases after aging. To overcome the problem of dimensional instability and improve the wear resistance, earlier attempts have been made by adding different alloys like copper [40], nickel [14], silicon [48], strontium [45], manganese [15] garnet [34], Titanium, Zirconium [49], graphite [28], SiC nano particles [46] etc., to the ZA-27 alloy.

Modern computer systems increased processing capability has facilitated the quick development of creative methods for data-driven analytics that can yield new insights [22]. The use of these methods has given rise to a brand-new branch of tribology called "Triboinformatics" [47]. Artificial intelligence and machine learning (ML) algorithms th-t are data-driven have made it possible for us to study intricate higher-order correlations among several factors over a greater range, which is particularly challenging when using the conventional two-parameter analysis [23], [36]. In addition, it has been noted that minimal effort has been done to understand the wear behavior of materials through ML approaches [4].

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Emission Reduction Technology for Marine Engines: A Review

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Abstract-

Air pollution in ports is mostly caused by marine diesel engines, which are ships' primary power sources. A strengthening of the emission regulations for marine diesel is therefore becoming more and more necessary for engines, requiring investigation into alternative methods for reducing emissions. This evaluation focuses on emission laws, emission factors (EFs), consequences on the environment, and possible emission reduction techniques for diesel engines used in ships. Emission Control Areas (ECAs) are established under the legislation, although The Sulphur restrictions in crude, Oxides of Sulphur (SOx), and nitrogen (NOx) have raised significant issues in several trials. The release of (NOx). According to research, marine diesel engines emit 50% of the overall amount of NOx emissions. Harbors and coastal areas with NOx, Oil with a Sulphur concentration is reduced.

I. INTRODUCTION

Marine engine emission reduction is technology development is continuously researching the existing gas composition in low speed Marine Diesel engine existing mainly carbon monoxide it is formed by engine air fuel mixture in combustion chamber (12).In the marine 1960 have been with diesel engines. two & Four stroke main supplier for Greenhouse effect, Acid rain etc. (2). producing emission such a of Co_2 NOx, & Sox and 2-3% of Co_2 produce. but NOx, & Sox More effected to environmental so new technology's introduce for cleaner fuel with Lesser Sulphur contents (2).

1. From all those considerations resulting in improved and effective emission reduction technology and improved the engine fuel efficiency.

2. The 10 -august -2021 base on the shipping industry is producing 2.5% of Co_2 in the world (2)

3. The international maritime organization (IMO) introduced fuel quality. The Sulphur (SO) Compounds less than 0.1 percent for the reason cleaner fuel must be used.

4. Already existing shipping flex to balance the Green house gases. and promote the use of energy and less polluting engines in ship thus reduce Co_2.

5. In this paper overview in which fuel is better to used Marines technology of reducing the NOx & Sox emissions for environmental safety. (2)

6. Hydrocarbon -it formed type of fuel used in diesel engine adjustment of design (12)

7. Sulphur dioxide - formation is based on type of organic fuel using the ratio 15:1 is the existing during combustion (12)

Hydrogen oxide - formation based on combustion process within burning of fuel at temperature of burning in the nitrogen & oxygen inactive reactant forming the nitrogen dioxide (12)

A smooth transition from conventional engines to gas engines ensures a local route to ship coordination against the growing complexity of environmental regulations. In addition to technical measures to reduce ship NOx and particulate matter emissions It should also be noted that the combined application of diesel and different technologies will be the direction of research to reduce emissions from marine diesel engines in the future. Air emissions have been a major issue between politics and shipping for many years. Recently, however, the political situation has deteriorated, and this problem has developed from local pollution to 'global warming'. Emissions from land transportation and power generation are already tightly regulated with very low limits, resulting in significant reductions in absolute emissions. In contrast, shipping has not yet been significantly affected, with absolute emissions increasing as maritime trade expands. Shipping consumes about 5% of the world's oil consumption [1, 2], resulting in global NOX emissions of about 12.57 million tons/year and global SOX emissions of about 10.54 million tons/year. [1] In the United States, ports have been identified as major sources of pollution. In Los Angeles alone, the port emits about 31.5 tons of NOx per day. This equates to his NOX emissions of about 650,000 cars [3]. Clearly, air pollution control regulations for ships will become stricter. It is not yet known which types of emissions will be regulated, to what extent and when. The Kyoto Protocol on "greenhouse gases" (mainly CO2) entered into force on February 16, 2005. The IMO, the agency responsible for shipments under the Protocol, is already working on this issue. In this context, global shipping is reported to generate approximately 438 million tonnes of CO2 annually. This equates to about 1.8% of her global CO2 emissions[4]. On May 19, 2005, the first major regulation on air pollution from ships in Annex VI of MARPOL Convention 73/78, prepared by the IMO, entered into force. In addition to global limits on NOX emissions and caps on sulfur content in bunker

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To Study the Influence of Injection Timing, Injector Opening Pressure and Blend Percentage on Engine Performance and Emissions by the Integration of Taguchi and RSM for an Engine Fuelled with CAOME

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Abstract

Carbon neutral fuels must have a control over global warming. Even through passenger vehicle can be replaced with electrical and hybrid vehicles, but it is extremely difficult to replace goods transport vehicles which uses hydrocarbon fuels. Biofuels are one that can be obtained from various feedstock's including grains and green matter with high starch and sugar content such as corn, sugar cane and sugar beets. The castor oil methyl esters, which is non-edible in nature fulfils the requirement of fuel for internal combustion engine. The conventional experimental scheme needs more time for optimization and substantial number of experiments need to perform as it is possible to vary a single operating variable at a time and is expensive. Mathematical models of Taguchi method using design of experiments (DOE) give superior results. By using DOE, Taguchi L9 orthogonal array is considered. Analysis of variance (ANOVA), The Regression Equation and signal-to-noise (S/N) ratio are obtained to predict the best parameters and to evaluate the influence of significant conditions on performance, emission and combustion characteristics. The mathematical model obtained by integration of Taguchi method and RSM is successfully validated with accuracy of 95%.

Keywords: *Taguchi, Performance, S/N ratio, ANOVA, Biodiesel*

1.0 Introduction

The nations growth mainly rests on the available energy reserves. With ongoing upsurge in energy utilization, severe pollution rules and exhaustion of fossil fuels resulted in massive outlay in energy division to satisfy the necessity and to find eco-friendly energy resources. Research on biofuels is considered to get enhanced engine output with minimum greenhouse gas emissions.

Energy sustainability plays a major role in overall progress of the nation in terms of industrial development, economic stability and well-being of the society. As of now the energy needs of the society are majorly fulfilled by using fossil fuels

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Study on Thermal Conductivity and Thermogravimetric Analysis of Glass Fibre Epoxy Resin Composites Modified with Silicon Carbide and Copper Nanoparticles

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1 Introduction

Composite materials are made with more than two or two components which are variance in shape and chemically non-similar composition. Most of the composite materials are made to obtain properties better than individual constituents. Manufacturing of polymer matrix composites is the reason for high strength low density in nature as compared to that of metals and their alloys. More temperature variable conditions polymer composites are failed to exhibit good thermal properties in different fields like automobile sectors, military weapons, aerospace parts and medical instruments. The solution to this kind of problem, try to use micro- or nano-sized filler particles in the polymer composites, to make them hybrid and are called hybrid polymer composites (HPCs). Adding filler materials in a small percentage to regular polymer composites vary the thermal properties overall and hybrid polymer matrix composites much stable under varied temperature conditions without changing the base strength of polymer matrix composite materials.

For different applications, a predefined desired properties and novel kind of materials are manufactured using fillers in polymer composites and are called hybrid composites. By varying the weight fraction proportion of fillers in epoxy resin glass fibres improve the mechanical, physical and thermal properties of composites. Due to high strength low density and economic compared to metals and metal alloys, hybrid polymer composites are used in various fields of applications like aerospace, marine, military weapons, automotive parts and windmill turbine blades. Requirement and use of hybrid composites have increased in many fields, communication sectors and electronics devices, where high thermal resistance low-density factors are predominant [1].

For many application fields like military, aerospace, wind power mills, automotive and construction, glass fibres are the most used fibres because of easy processing technique, low density, good resistance to corrosion, high strength sustainability, toughness and recyclable [2]. From several study approaches, it is noticed that the toughness and strength of polymer composites are closely associated with interface property improvement [3].

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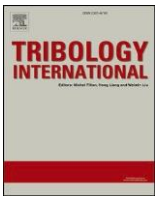

Interpretable ensemble machine learning framework to predict wear rate of modified ZA-27 alloy

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ABSTRACT

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The wear loss was estimated with the use of the linear regression (LR) technique [8]. Supervised machine learning models such as ANN, SVM, and KNN were created to evaluate friction and wear efficiency [17]. SVM and ANN algorithms were used to estimate wear resilience and the coefficient of friction [43]. The artificial neural network was used to investigate the wear performance of Al2219 reinforced with different weight percentages of TiC microparticles [10]. Several wear characteristics were investigated to look into the AZ91 alloy's wear performance

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