AQ: 1

AQ:au

Study the formation of mechanically mixed layer and subsurface behavior of worn out surfaces of aged hybrid metal matrix composites

Viswanatha B.M.
Department of Mechanical Engineering, Kalpataru institute of Technology, Tiptur, India
M. Prasanna Kumar and *S. Basavarajappa*
Department of Mechanical Engineering, University BDT College of Engineering, Davangere, India, and
T.S. Kiran
Department of Mechanical Engineering, Kalpataru Institute of Technology, Tiptur, India

Abstract

Purpose – This paper aims to investigate the wear behaviors of aged metal matrix composites and of the as-cast Al-Si alloy by using a pin-on-disk wear testing machine at room temperature.

Design/methodology/approach – Hypoeutectic (Al-7Si) alloy reinforced with low volume fractions of SiC particles (SiC_p) and graphite (Gr) particles were prepared by the stir-casting process. It was found that the addition of 9 Wt.% of SiC_p and 3 Wt.% of Gr particles conferred a beneficial effect in reducing the wear rate of the composites.

Findings – The worn-out surfaces of the specimens were examined using scanning electron microscopy (SEM); the extensive micro cracking occurs on the surface of the Al-7Si alloy tested at lower loads. The growth of these microcracks finally led to the delamination of the base alloy surface. The reinforcements (SiCp and Gr) particles tended to reduce the extent of plastic deformation in the surface layer, thereby reducing extensively the occurrence of micro cracking in the composites.

Originality/value – From the results, it is revealed that the quantity of wear rate was less for aged specimens compared to the as-cast specimens. The worn-out surfaces were studied using electron dispersive spectroscopy, and wear debris was analyzed using SEM.

Keywords Hybrid metal matrix composites, Mechanical mixed layer, Subsurface, Wear debris, Wear

Paper type Research paper

1. Introduction

A composite is a macroscopic combination of two or more multiphase distinct materials having an interface between them. A composite exhibits significant properties of both constituent phases such that a better combination of properties is realized. Composites are commonly classified into two distinct levels. The first level of classification is usually made with respect to the matrix constituents, and the second level is based on the type of reinforcements (Rohatgi, 1993; Prasad and Asthana, 2004; Anthony, 2006). The matrix is to provide a stiff structure to the composites. The function of the matrix is to bind the reinforcements collectively by the virtue of its cohesive and adhesive characteristics. Further to distribute the load to and from reinforcements and to protect the reinforcements from environmental condition (Miracle, 2005; Breval, 1995). AQ: 2

Metal matrix composites (MMCs) are attractive as they offer the possibility of attaining a combination of properties that are not obtained in monolithic materials. For tribological applications, MMCs must be able to support a load without undue deformation or fracture during performance and to minimize the friction and wear over long periods without seizure during working conditions (Lee *et al.*, 1992; Narayan and Surappa, 1995; Rohatgi and Guo, 1997). Particle-reinforced MMCs cost less owing to the easy availability and lower cost of the particles, and these have found to have the most tribological applications (Howell and Ball, 1995). Fabrication of particle-reinforced MMCs by using liquid metallurgy technique, which is simple, economical and easily applicable in foundries, is gaining wide popularity (Tung and McMillan, 2004; Surappa, 2003; Taha, 2001).

Al-Si alloy is known for its good castability and corrosion resistance. In this alloy series, A356 (Al-7per centSi-0.3per centMg) has superior properties and is used to produce parts

The current issue and full text archive of this journal is available on Emerald Insight at: **www.emeraldinsight.com/0036-8792.htm**

Industrial Lubrication and Tribology
70/4 (2018) 000
© Emerald Publishing Limited [ISSN 0036-8792]
[DOI 10.1108/ILT-04-2016-0084]

Received 11 April 2016
Revised 2 February 2017
Accepted 30 November 2017

Available online at www.sciencedirect.com

ScienceDirect

Materials Today: Proceedings 5 (2018) 25165–25173

materialstoday: PROCEEDINGS

www.materialstoday.com/proceedings

ICONAMMA_2017

Studies on Relationship between Wear Behaviour and Microstructure of a Hypereutectic Al-Si Alloy

Basavaraj Ganiger[a*], T.M.Chandrashekharaiah[b], T.B.Prasad[c] and V.R.Kabadi[d]

[a,b,c] *R & D Centre, Mechanical Engineering Department,* Sri Siddhartha Institute of Technology, Tumkur-572105, *Karnataka, India*
[b] *R & D Centre, Mechanical Engineering Department, Kalpataru Institute of Technology, Tiptur-572201, Karnataka, India*
[d] *R & D Centre, Mechanical Engineering Department, Nitte Meenakshi Institute of Technology, Bangalore-560064, Karnataka, India*

Abstract

A commercial grade hypereutectic Al-Si alloy (LM-28) has been modified by adding P in the form of Cu-14P master alloy. The microstructures of unmodified and modified were examined under SEM. The mean size of the primary silicon in unmodified alloy is 24.87μm and the same observed in modified alloy containing 0.06% P is 12.53μm. The volumetric wear rate and COF at high temperature have been studied using pin-on-disc wear testing machine. It has been observed that the wear resistance of modified alloys is noticeably improved when compared to the unmodified alloy. The worn surfaces were characterized by confocal microscopy and observed wear mechanisms are explained in the background of their microstructures.

Selection and/or Peer-review under responsibility of International Conference on Advances in Materials and Manufacturing Applications [IConAMMA 2017].

Keywords: LM-28 alloy; Cu-14P Maste alloy; SEM; High temperature; Worn surfaces; Confocal micoscopy; wears behaviour; Primary Silicon.

1. Introduction

Wear is the continuous loss and deformation of a metallic component as a consequence of its relative motion about the mating parts. It leads to the worn parts replacement cost and also involved the expenses of machine downtime, loss of manufacture etc. The wear performance of Al-Si alloys be governed by material's mechanical

* Corresponding author. Tel.: +91-080-28372800; fax: +91-080-28372797.
E-mail address: Ganiger2011@gmail.com

Selection and/or Peer-review under responsibility of International Conference on Advances in Materials and Manufacturing Applications [IConAMMA 2017].

International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS)
Volume VII, Issue III, March 2018 | ISSN 2278-2540

Studies on the Effect of Al-1Ti-3B and Al-10Sr Master Alloys on Fracture Toughness and Fractographical Analysis of Binary Al-10Si Alloy

Devappa[1], T. M. Chandrashekharaiah[2]

[1]*Assistant Professor Department of Mechanical Engineering, JSS Academy of Technical Education Bengaluru, Karnataka India*
[2] *Professor and Head, R&D Centre, Department of Mechanical Engineering, Kalpataru Institute of Technology, Tiptur-572201, Karnataka India*

***Abstract*:- In the present study an experimental investigation was carried out to determine the effect of grain refiner (Al-1Ti-3B) and or modifier (Al-10Sr) on the microstructure, hardness, tensile properties, impact strength and fracture toughness of near eutectic (Al-10Si) Al-Si alloy. The microstructures and fractured surfaces of tensile test specimens of Al-10Si alloy before and after melt treatment are characterized by optical metallurgical microscope /SEM analysis. The results suggest that, improvement in mechanical properties, fracture toughness and strength of Al-10Si alloy was observed with the addition of (Al-1Ti-3B) grain refiner and or (Al-10Sr) modifier when compared to the as cast condition.However, maximum improvement in mechanical properties and fracture toughness were observed with the combined addition of grain refiner and modifier to Al-10Si alloy.**

***Keywords*: Al-10Si, Al-1Ti-3B, Al-10Sr, Grain refiner, Modifier. Fracture toughness etc.**

I. INTRODUCTION

The applications of aluminium and its alloys for the machine parts are increasing day to day. Among the commercial aluminium casting alloys perhaps Al-Si alloys are the most common particularly due to some very attractive characteristics such as high strength to weight ratio, excellent castability, and pressure tightness, low co-efficient of thermal expansion, good thermal conductivity, good mechanical properties and corrosion resistance [1-5].

Al-Si alloys find wide applications in marine castings, motor car and lorry fittings (pistons), engine parts (casing etc), cylinder blocks and heads, cylinder liners, axles and wheels, rocker arms, automotive transmission casings, water cooled manifolds jackets, piston for internal combustion engines, pump parts, high speed rotating parts and impellers etc. [1-5]. The binary Al-Si alloys belong to the simple eutectic system, the eutectic temperature being 577°C. But the composition of the eutectic point has been reported ranging from 11.7% - 14.5%Si with the most probable value at 11.7%Si [3]. The eutectic composition in binary Al-Si system is known to shift depending on the alloying elements and cooling conditions or casting processes involved. Eutectic (12%Si) and near eutectic (10%Si) Al-Si alloys are cast to produce majority of pistons and are known as piston alloys which provide the best overall balance of properties [6-8].

It is well known that the mechanical property (toughness, ductility, hardness and UTS) of these alloys depends on the microstructural features such as eutectic silicon morphology, secondary dendrite arm spacing, grain size, chemical composition. In as cast condition, eutectic and near eutectic Al-Si alloys are likely to consist of α-Al dendrites and irregular eutectic as the rate of cooling is faster than the equilibrium cooling. In order to improve the properties of such alloys modification treatments (by the addition of Sr) have been practiced in the fast to produce fine eutectic Si [4-6]. Recently some effort has been made to refine the columnar α-Al dendrites (by the addition of Ti and B) present in the near eutectic (9-11%Si) and eutectic (12%Si) Al-Si alloys [8-10]. However, there is a lack of information regarding the effect of minor addition of Ti, B and Sr in the form of master alloys on the fracture toughness and fractographical analysis of near eutectic (10%Si) and eutectic (12%Si) alloys. Hence, an attempt has been made to investigate the effect of minor addition of (Al-1Ti-3B) grain refiner and or (Al-10Sr) modifier on the fracture toughness and fractographical analysis of near eutectic (Al-10Si) alloy.

II. EXPERIMENTAL DETAILS

Binary Al-10wt%Si alloy was prepared using commercial purity Al and Al-20wt%Si master alloy. Melting of the alloy was carried out in a resistance furnace (Silicon Carbide heating element, M/s Industrial furnace and Control, Karnataka, India) under a cover flux (45%NaCl+45%KCl+10%NaF) and the melt was held at 720°C. After degassing with solid hexachloroethane (C_2Cl_6), the melt was poured in to a cylindrical graphite mould with its top open for pouring (for macrostructural studies, microstructural studies and hardness test). Also the melt was poured into split type graphite moulds to prepare as cast ('0'

Dome with dripping lateral pipe-fabricated solar water heater

D.N. Mallikappa*

Department of Mechanical Engineering,
NMAM Institute of Technology,
Nitte, Karnataka, India
Email: mallikappadodderi@gmail.com
*Corresponding author

Vishwanath Nayak and Eshwa Raih

Department of Mechanical Engineering,
MMCT, Mangalore,
Karnataka, India
Email: vishwanathnaayak@gmail.com
Email: eshwarmmct@gmail.com

Abstract: This work deals with the design and fabrication of the semicircular solar water heater to use non-conventional energy to obtain hot water. The solar water heater has been made by using locally available materials like dripping lateral pipe, coconut coir, plastic drum, galvanised iron sheet, hose pipes etc. Work has been done on three types of set-ups. Experimentation has been carried out for the period two months. In the performance evaluation, inlet, outlet temperature of the water and the drum water temperature has been measured. Experimental investigation has been carried out by using three different trial setups, Semicircular setup without insulation and heat absorber plate, Semicircular setup with insulation and galvanised iron cover as a absorber, results are not favourable for getting hot water in both the cases. The setup with insulation blackened galvanised iron cover and transparent plastic cover which covers the pipes gives good amount of hot water. The maximum temperature attained in this set-up is 72 degrees. The water flow takes place due to thermo siphon effect.

Keywords: lateral pipe; dome with semicircular solar water heater; design fabricated solar water heater.

Reference to this paper should be made as follows: Mallikappa, D.N., Nayak, V. and Raih, E. (2018) 'Dome with dripping lateral pipe-fabricated solar water heater', *Int. J. Renewable Energy Technology*, Vol. 9, No. 3, pp.359–367.

Biographical notes: D.N. Mallikappa is a Professor at the Mechanical Engineering Department, NMAM Institute of Technology, Nitte-574110. He holds a PhD from the N.I.T.K Surthkal India (a deemed university). He has 17 years teaching experience, six years in industry and five years for research. His research areas are alternative fuels, manufacturing science. He has published eight research papers in international journals, two in international conferences, two in national conferences and reviewer of the international

Preparation and Characterization of Aluminium-Silica Metal Matrix Composite

G B Mallikarjuna[1], E Basavaraj[2]

[1]Assistant Professor, Kalpataru Institute of Technology, Tiptur, Karnataka, India

[2]Professor, Jawaharlal Nehru National College of Engineering, Shivamogga, Karnataka, India

Email: [1]mallikarjun.gb06@gmail.com, [2]eswarappabasavaraj@gmail.com

ABSTRACT:

Aluminum alloys are widely used in aerospace and automobile industries due to their low density and good mechanical properties, better corrosion resistance and wear, low thermal coefficient of expansion as compared to conventional metals and alloys. The excellent properties of these materials and relatively low production cost make them a very attractive for a variety of applications. In this present work, Al alloy LM13-SiO_2 composites were produced by stir casting method. The reinforcement SiO_2 particle size used for preparation of composites are 106µm, 150µm, 250µm and 355µm with varying amount of 3 to 12 wt% in steps of 3. The prepared composite specimens were machined as per test standards. Effects of weight percentage of SiO_2 particles on wear, tensile strength of Al alloy LM13-SiO_2 composites have been investigated. The microstructures of the composites were studied to know the dispersion of the SiO_2 particles in matrix. Experimental results shows that there is enhanced mechanical properties, when silica weighing 9% was added to the base aluminium alloy and also similar trend exists in all four different micron size of silica and also it has been observed that addition of SiO_2 particles significantly improves wear resistance properties as compared with that of unreinforced matrix.

Keywords: Al alloy composite, SiO_2 particles, Mechanical and Wear properties, Stir casting.

1. INTRODUCTION:

Industrial technology is growing at a very rapid rate and consequently there is an increasing demand and need for new materials. Particulate reinforced composites constitute a large portion of these new advanced materials [1]. Metal matrix composite (MMC) is engineered combination of the metal (Matrix) and hard particle/ceramic (Reinforcement) to get tailored properties. MMC's are either in use or prototyping for the space shuttle, commercial airliners, electronic substrates, bicycles, automobiles, golf clubs, and a variety of other applications [2-3].

A good combination of high strength and ductility of the Aluminum based metal matrix composites (MMC_s) have introduced the material to a wide area of possible advanced applications. In general stir casting of MMCs involves producing a melt of the selected matrix material, followed by introducing reinforcement material into the melt, obtaining a suitable dispersion through stirring. Its advantages lie in its simplicity, flexibility and applicability to large quantity production. It is also attractive because, in principle this method suitable for engineering application in terms of production capacity and cost efficiency [4]. Aluminium is the most popular matrix for the metal matrix composites. Aluminium is quite attractive due to its low density, their capability to be strengthened by precipitation, good corrosion resistance, high thermal and high electrical conductivity and damping capacity. The demand for structural materials to be cost effective and also to provide high performance has resulted in continuous attempts to develop composites as serious competitors to the traditional engineering alloys [5]. In the recent years, usage of ceramic particle - reinforced metal matrix composites (MMCs) is steadily increasing because of their advantages like isotropic properties and the possibility of secondary processing facilitating fabrication of secondary components [6].

Al alloy composites have the potential to replace other costlier material in many significant engineering applications. The requirements concerning safety and reliability are always increasing and therefore the mechanical properties are ever more crucial [7].

2. MATERIALS & METHODOLOGY:

In this research work aluminium alloy LM13 used as a matrix material and different micron size of silica (106, 150, 250 and 355µm) as particulate reinforcement with different percentages (in wt.% 3, 6, 9 and 12) based on the variation in weight. The composites were preared by using stir casting method. Cast iron permanent mould is used for preparation of metal matrix composite castings.The prepared specimens of the composites was tested according to ASTM standards. The toughness and formability of Aluminum –12% silicon alloy can be combined with the strength of quartz particles.

Table.1: Al alloy LM13 Chemical Composition by Wt. %

Elements	Zn	Mg	Si	Ni	Fe	Mn	Al
Wt. %	0.5	1.4	12	1.5	1.0	0.5	Balance

Advances in Mechanical Design, Materials and Manufacture
AIP Conf. Proc. 1943, 020105-1–020105-5; https://doi.org/10.1063/1.5029681
Published by AIP Publishing. 978-0-7354-1638-3/$30.00

Journal of Engineering Research and Application www.ijera.com
ISSN : 2248-9622, PP 32-35

RESEARCH ARTICLE OPEN ACCESS

Studies on Mechanical Properties of Al LM13-Al_2O_3 Composites

G B Mallikarjuna*, E Basavaraj**
*Department of Mechanical Engineering, VTU University, Belagavi
** Department of Mechanical Engineering, VTU University, Belagavi

ABSTRACT : *In this study, Al alloy LM13-Al_2O_3 composites were produced by stir casting method using Al_2O_3 powder as reinforce particles with 150 micron average diameter and Al alloy as the matrix metal. The melt composites were stired, then casted into a metallic mold. Different samples of 3, 6, 9 and 12 weight percent of Al_2O_3 were prepared. The casted composite specimens were machined as per test standards. Effects of weight percent of Al_2O_3 particles on hardness, tensile strength and compressive strength of prepared composites have been investigated. The microstructures of the composites were studied to know the dispersion of the Al_2O_3 particles in matrix. The highest tensile and compressive strengths were achieved in the specimen containing 9 weight percent of Al_2O_3, which shows an increase in comparison with the unreinforced Al alloy. It has been observed that addition of Al_2O_3 particles significantly improves hardness, tensile strength and compressive strength properties as compared with that of unreinforced matrix.*
Keywords *- Al_2O_3 particles, Al alloy composite, mechanical properties, Resistance furnace, stir casting.*

I. INTRODUCTION

The possibility of taking advantage of particular properties of the constituent materials to meet specific demands is the most important motivation for the development of composites. A composite is a material made with several different constituents intimately bonded. This definition is very large, and includes a lot of materials such as the Roman ways (constituted of different layers of stones, chalk and sand), wood, human body etc... A more restrictive definition is used by industries and materials scientists: a composite is a material that consists of constituents produced via a physical combination of pre-existing ingredient materials to obtain a new material with unique properties when compared to the monolithic material properties[1]. Industrial technology is growing at a very rapid rate and consequently there is an increasing demand and need for new materials. Particulate reinforced composites constitute a large portion of these new advanced materials [2]. Metal matrix composite (MMC's) is engineered combination of the metal (Matrix) and hard particle/ceramic (Reinforcement) to get tailored properties. MMC's are either in use or prototyping for the space shuttle, commercial airliners, electronic substrates, bicycles, automobiles, golf clubs, and a variety of other applications [3-4].

A good combination of high strength and ductility of the Aluminum based metal matrix composites (MMC's) have introduced the material to a wide area of possible advanced applications. In general stir casting of MMC's involves producing a melt of the selected matrix material, followed by introducing reinforcement material into the melt, obtaining a suitable dispersion through stirring. Its advantages lie in its simplicity, flexibility and applicability to large scale production. It is also attractive because, in principle this method suitable for engineering application in terms of production capacity and cost efficiency [5]. Aluminium is the most popular matrix for the metal matrix composites. Aluminium is quite attractive due to its low density, their capability to be strengthened by precipitation, good corrosion resistance, high thermal and high electrical conductivity and damping capacity. The demand for structural materials to be cost effective and also to provide high performance has resulted in continuous attempts to develop composites as serious competitors to the traditional engineering alloys [6]. In the recent years, usage of ceramic particle - reinforced metal matrix composites (MMC's) is steadily increasing because of their advantages like isotropic properties and the possibility of secondary processing facilitating fabrication of secondary components [7].

Al alloy composites have the potential to replace other costlier material in many significant engineering applications. The requirements concerning safety and reliability are always increasing and therefore the mechanical properties are ever more crucial [8].

II. MATERIALS AND METHODOLOGY

In this study aluminium alloy LM13 used as a matrix material and Al_2O_3 of average 150 micron size as particulate reinforcement with different percentages (in wt.% 3, 6, 9 and 12) based on the variation in weight. The composites were prepared

Materials Science Forum
ISSN: 1662-9752, Vol. 969, pp 794-799
doi:10.4028/www.scientific.net/MSF.969.794

Submitted: 2018-09-06
Revised: 2019-03-03
Accepted: 2019-03-06
Online: 2019-08-30

Effect of Grain Refiners and/or Modifiers on the Microstructure and Mechanical Properties of Al-Si Alloy (LM6)

Satya Prema[1,a*], T.M. Chandrashekharaiah[2,b] and Farida Begum P.[3,c]

[1]Mechanical Engineering Department, J N N College of Engineering, Shivamogga - 577204, Karnataka, India.

[2]Research centre, Department of Mechanical Engineering, Kalpataru Institute of Technology, Tiptur - 572 202, Karnataka, India.

[3]Karnataka Housing Board, K G Road, Bengaluru - 560009, India.

[a]spabraham1@yahoo.co.in, [b]chandrtm@gmail.com, [c]fari1078@gmail.com

Keywords: Al-Si alloy, Eutectic, Grain refiners, LM6, Modifier

Abstract. Grain refinement is one of the most important and popular melt treatment process for Al-Si alloy casting. Microstructure and mechanical properties of commercially available Aluminium Silicon alloy LM6 can be improved with the addition of grain refiners and modifiers as these provide technical and economic advantages. This paper is an effort to study the effects of addition of grain refiners and modifiers to the eutectic Al – Si alloy LM6. Commercially available Al - Si alloy LM6 (eutectic = 12% Si) is grain refined with Al-5Ti-1B and Al-3B; and modified with Al-10Sr master alloys. These were added individually and then tested for its unique mechanical properties such as ultimate tensile strength, hardness and wear; which are co-related with the machining tests such as turning, surface roughness and drilling. The test results are compared with microstructure of the alloys observed through SEM.

The mechanical properties of this alloy can be altered after addition of master alloys, which in turn alter the grain size. Thus the results conclude that the mechanical properties of Al-Si alloys in general are controlled by a number of principal microstructural features. A fine grain size is desirable, leading to improvement of mechanical properties.

1. Introduction

A eutectic system is a mixture of two distinct solid phases which separate simultaneously and at constant temperature to form a single liquid phase. In a binary alloy system a eutectic mixture has the lowest melting point within that alloy system [1]. The Al – Si binary alloy system is extensively used for casting owing to its excellent fluidity and casting characteristics, and the eutectic is formed at 11.7 wt % Si. The coarse flakes of eutectic silicon present in the eutectic Al-Si alloy can be modified to produce a very fine eutectic with dendrites of aluminium solid solution. This alloy is widely used for automobile castings, since it has a high degree of fluidity and its low shrinkage on solidification enables castings of intricate sections to be made dense and free from cracks [2]. In general, eutectic Al-Si alloy has a more uniform distribution of eutectic Si with uniform grain size as compared to hypoeutectic (with Si content $\leq$ 12 wt%) and hypereutectic (with Si content $\geq$ 12 wt%) alloys [3].

This uniform distribution of eutectic Al and Si in the alloy can be further refined with the

Iranian Journal of Materials Science & Engineering Vol. 14, No. 2, June 2017

The Effect of Various Parameters on Dry Sliding Wear Behavior and Subsurface of Aged Hybrid Metal Matrix Composites Using Taguchi Technique

B. M. Viswanatha[1*], M. Prasanna Kumar[2], S. Basavarajappa[2] and T. S. Kiran[1]
* vishwanathabm@gmail.com
Received: April 2016 Accepted: April 2017

[1] **Department of Mechanical Engineering, Kalpataru Institute of Technology, Tiptur, India.**
[2] **Department of studies in Mechanical Engineering, University BDT College of Engineering, Davangere, India.**
DOI: 10.22068/ijmse.14.2.71

Abstract: *The effects of applied load, sliding speed and sliding distance on the dry sliding wear behavior of aged Al-SiC_p-Gr composites were investigated. The specimen were fabricated by stir-casting technique. The pin-on-disc wear testing machine was used to investigate the wear rate by design of experiments based on L_{27} using Taguchi technique. Sliding distance was the most important variable that influenced the wear rate followed by sliding speed and applied load. The worn out surfaces were analyzed by SEM and EDS to study the subsurface mechanism of wear. The addition of reinforcements showed improved tribological behavior of the composite than base alloy.*

Keywords: *Composites, Aged, Wear, Subsurface, Taguchi Technique.*

1. INTRODUCTION

Aluminium Metal Matrix Composites (AMMCs) are prominent material to attain high specific strength, high stiffness, low density and good wear resistance compared to the monolithic materials. These are potential replacements for conventional materials in automobile and aerospace applications [1-2]. Several researchers have worked on the improvement of the tribological properties of AMMCs by addition of single ceramic particles viz., SiC_p, Al_2O_3, Gr etc. A few researchers have carried out the research using the combination of the above reinforcements. Increase in the content of SiC_p in aluminium matrix material exhibits good wear resistance. Tjong et al. [3] worked on wear behavior of Al-12% Si alloy reinforced with low volume fraction of SiC_p. The results showed that the addition of low volume fraction of SiC_p is very effective in increasing the wear resistance. Pramila Bai et al. [4] studied the dry sliding wear test of A356 reinforced with 15-25 wt. % of SiC_p. The result revealed that, increase in the content of SiC_p reduced wear.

Ravikiran and Surappa [5] studied the wear behaviour of A356-30 wt. % SiC_p composite as a function of sliding speed. The wear rate of specimen decreases with increasing speed, as the SiC_p is exposed to the specimen surface is increased. Natarajan et al. [6] studied the wear behavior of A356-25SiC_p sliding against automobile friction material. They concluded that the wear rate of MMCs was lower than the cast iron. That makes it a suitable material for brake rotor applications. Wilson and Alpas [7] studied the wear mechanism of A356 alloy and A356-20SiC_p composite. They reported that the addition of SiC_p to A356 aluminium alloy leads to mild wear regime at higher speed and loads, there by inhibiting sever wear. The SiC_p assists the retention of oxide transfer layer on composite sliding surface. It prevents metal to metal contact and keeps wear behavior within the mild wear regime.

The graphite (Gr) used as second reinforcement has to a possible reduction of friction, as solid lubricant imparts good wear resistance to the composites [8]. Akhlaghi and Bidaki [9] studied the effects of addition of lower wt. % (2-5 wt. %) of Gr which exhibited good wear resistance against a higher wt. % (5-20 wt. %) of Gr. Yang et al. [10] studied the tribological properties of A356 alloy with varying Gr of 2, 4, 6 and 8 wt. %. The result showed that 4 and 6 wt. % of Gr particles exhibit

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

STATIC ANALYSIS OF COMBINATION BOILER

Anil K*[1], S M Aradhya[2], Dr. Kiran T S[3], Dr. Viswanatha B M[4] & Pruthwiraj J M[5]
[*1&5]Assistant Professor, Kalpataru Institute of Technology, Tiptur
[2]Associate Professor, Kalpataru Institute of Technology, Tiptur
[3&4]Professor, Kalpataru Institute of Technology, Tiptur

ABSTRACT
Now-a-days combination boilers are most widely used equipment for boiling water. The existing design has direct connection between outer cylinder and inner coil that are connected by welding. The critical region of failure is found at the weld portion by static analysis. Combination boiler under static loading conditions must be assured for its structural integrity during design stage. In the present study a static analysis of combination boiler is carried out in both Normal operating and Maximum operating pressure conditions

KEYWORDS: Combination Boiler; Static analysis; Ansys; Hypermesh

INTRODUCTION
Combination boilers are type of boilers in which gas is used for both maximum efficiency domestic heating purpose. Majority of people in UK use these types of boilers in houses as it requires small area. They are durable, reliable, convenient, easier to install, simple to use and it can run economically producing a continuous stream of boiling water, whenever it is needed. Installing a combination boiler might be a onetime hassle but other boiler needs to be serviced every now and then, especially if there are strange noises or temperature fluctuations[1].

Proven technology is used for manufacturing these kinds of boilers, making them reliable and durable. They result in smooth operation for switching on and off with less wear and tear of components. Combination boilers are generally available in 24 to 40 kW output[2].

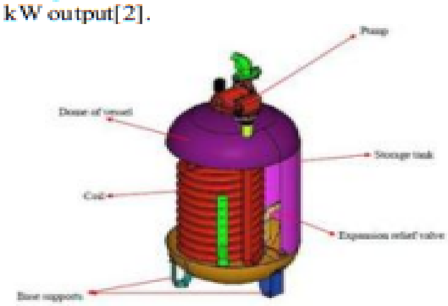

Fig 1: Combination boiler

The present work involves creation of 3D model of combination boiler considering the desired dimensions. Structural characteristics of combination boiler for the loading conditions are analyzed. Static Pressure analysis of the fitting, weld, and surrounding sheet metal to predict material failure due to Normal operating pressure and Maximum operating pressure is carried out in without reinforcement case. Combination boiler consists of six parts namely, pump, coil, storage tank, expansion relief valve, base supports and dome vessel as shown in Fig 1.

FINITE ELEMENT MODELLING, MATERIALS AND ANALYSIS
Modelling of combination boiler is created by CATIA, and its analysis has been carried out by ANSYS 15 applying boundary conditions to the imported model and results are obtained by post processor[3].

THOMSON REUTERS ENDNOTE

[ICAMS-2017: March, 17]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

STATIC ANALYSIS OF TRAILING ARM

Pruthwiraj J M[*1], Dr. Viswanatha B M[2], Dr. Kiran T S[3], Anil K[4] & Dileep H B[5]

[*1,4&5]Assistant Professor, Kalpataru Institute of Technology, Tiptur

[2&3]Professor, Kalpataru Institute of Technology, Tiptur

ABSTRACT

Independent suspension is the most important part of any automobile suspension system that leads to move each wheel vertically on the same axle and independently of each other. Rear suspension system consists of several parts, trailing arm is one of the components in the suspension system, it can also be referred as trailing link in a vehicle suspension design. One or more arms are connected between the axle and a pivot point. Rear wheel assembly is directed by the trailing arm wheel suspension system. The arm is quite bigger than other type of suspension arms. It is much rigid at the wheel point which stops its false movement. To design the existing trailing arm and in order to carry out the finite element analysis the model is discritised by using HYPERMESH tool. After completion of meshing, the arm is subjected to static analysis by applying the load. The result revealed that the stress concentration was observed near the junction of welded joint and trailing arm.

KEYWORDS: Trailing arm; static analysis; von-mises stress; FEM

INTRODUCTION

In this modern busy world humans are depended on transportation. Most commonly used transportation vehicle is cars. People sit in car comfortably due to suspension system. Automobile chassis is not directly connected to axial, in between there are spring placed. It is attached in order to avoid the road shocks to vehicle body such as pitch, sway, bounce, and roll. Suspension system is a form of linkage that allows wheels to move along with the vehicle body. The vehicle's frame, body, engine & power train are suspended above the wheels by the use of front and rear springs is referred as suspension [1].

When vehicle is having rigid axle suspension system that encounters the road irregularities in a longer period the wheels does not remain vertical, because of this effect the wheel, vehicle may tilt on one side. In order to avoid this effect, the wheels are sprung independent of each other; therefore tilt on one side of the vehicle does not have any effect to the other wheel.

Independent suspension system is an advantage over the rigid axle suspension system. In independent suspension system to reduce the rolling effect softer spring is used which will improve ride comfort. Even soft springs are used in anti-roll bar, in event of vehicle cornering, it will give necessary force to resist body roll [2].

The rear wheel does not have any connection with the steering geometry as the power has to be transmitted to the rear wheels. Trailing arm suspension is having two trailing arms both front edges are pivoted to the car body. Compared to other suspension's control arms these arms are relatively larger because it's a single piece and coil spring are supported on upper surface. Arm's of other end is rigidly fixed to the wheel.

The front wheel drives vehicles are most popularly use the trailing arm axle because it is relatively simple in design and assembly. The up and down movement of the wheel are to be taken care by the trailing arm in order to deal with the bump. Fig1 shows trailing arm system.

It restricts the lateral movement and chamber change but change of camber angle take place when car rolls into the corner. [3, 4] The trailing arm also rolls the same degree according to the road surface. Here under steer is observed because both wheels bend over the outside corner. This is the reason semi trailing arm are adopted than the pure trailing arm [5, 6].

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

REVIEW ON TRIBO MECHANICAL PROPERTIES OF PMMCS

Naveen kumari M.E*1, Kiran T.S2, Vishwanatha B.M3 and Pallavi B.A4

*1Research scholar, Department of Mechanical Engineering Kalpataru Institute of Technology, Tiptur, India

2&3Professor, Department of Mechanical Engineering Kalpataru Institute of Technology, Tiptur, India

4Assistant Professor , Department of Mechanical Engineering Kalpataru Institute of Technology, Tiptur, India

ABSTRACT

During the past few years, pmmcs have been used in substantial industrial use. Za alloys are used as an alternate alloy to aluminum, copper and cast iron. In recent years these alloys have found major applications in bearing industries, due to wear resistance, low weight, density, high strength and excellent castability.This paper reviews selection of material, fabrication techniques and behaviour of pmmcs for mechanical properties.

KEYWORDS: PMMCs, Tribo Mechanical properties

INTRODUCTION

Progress in the development of composite materials from many years till today is magnificent. Recognition of potential weight savings materials with reduced cost and greater efficiency is responsible for the growth of new technology of advanced materials. As there is ever increasing demand for newer, stronger, stiffer and light weight materials in the field of aerospace, transportation, automobiles, defense, constructions, mining etc. led to the development of new class of materials [1-3]. As a result of concentrated studies in fundamental characteristics of materials along with better understanding of mechanical and tribological properties a new material can be developed with improved physical and mechanical properties. If a composite is designed and fabricated in the approved manner it combines the strength of the reinforcement with the properties of the matrix to obtain a combination of desirable properties which is not available in single monolithic material [4].

SELECTION OF MATERIAL

In MMC's metals or alloys are used as matrix materials. Matrices act as a bonding material and distribute load to the reinforcement. Load transfer depends on the bonding strength between the matrix and the reinforcement and bonding depends on the type of matrix, reinforcement and fabrication techniques. Zinc aluminum alloys have extensive applications in automobile industries and commonly used as bearing materials due to their fluidity, wear resistant properties, availability and economical in nature. ZA 27 alloys show excellent tribomechanical properties at lower temperature. Latest investigations have done in developing ZA 27 MMCs by reinforcing with ceramic particles [5]

These alloys are alternative bearing materials for brass and bronze [6].Chemical composition and properties is shown in table 2.1 and 2.2 respectively.

Table 2.1: Chemical composition of ZA-27 alloy

Component	% Composition
Aluminium	25-30
Copper	2.06
Iron	0.065
Magnesium	0.012
Silicon	0.02
Zinc	Balance

IJERMS

International Journal of Engineering Researches and Management Studies

MODIFICATION PERFORMANCE OF THE Cu-P MASTER ALLOY ON COMMERCIAL HYPEREUTECTIC Al-24Si-Cu-Mg ALLOY

Basavaraj Ganiger1[*1], T.M.Chandrashekharaiah[2] and T.B.Prasad[3]
[*1]Associate Professor, M. E. Department, Kalpataru Institute of Technology, Tiptur, Karnataka, India.
[2]Professor, M. E. Department, Kalpataru Institute of Technology, Tiptur, Karnataka, India.
[3]Professor, M. E. Department, Sri Siddhartha Institute of Technology, Tumkur, Karnataka, India.

ABSTRACT

In the present study, Cu-14P master alloy has been used to modify a commercial grade Al-24Si-Cu-Mg/ LM-29 alloy. The influences of P content on the microstructure and mechanical properties of alloys were investigated. The P addition make the coarse polyhedral primary silicon particles obviously refined and the large needle eutectic silicon modified to the fine fibrous ones. The alloys with the additions of 0.4 %(Cu-14P) has the optimal microstructure and the highest mechanical properties compared with the unmodified alloy. The primary silicon of alloys can be refined from 51.88 µm to 21.53 µm. The ultimate tensile strength is improved from 174 MPa to 211 MPa. The elongation is improved from 0.94% to 1.56%. The hardness is improved from 138 VHN to 160 VHN.

Keywords: Hypereutectic Al-Si alloy, Primary silicon, Modification, microstructure, mechanical properties.

I. INTRODUCTION

Hypereutectic Al-Si alloys have been extensively used because of their properties which include excellent wear and corrosion resistance, high temperature strength, low coefficient of thermal expansion, good cast performance and high specific strength. Therefore these are widely used in aeronautic, astronautic and automobile industries [1-2]. It has been noticed comprehensively that the microstructure of hypereutectic Al-Si alloys prepared by conventional casting practices usually consist of a uneven primary silicon phase in a fibrous eutectic matrix of aluminium [3, 4].

In order to refine the uneven primary silicon many methods have been put into execution such as high pressure casting, rapid solidification technique and melt overheating treatment [5, 6]. However, these processes are complex and difficult to control. The desired properties cannot be obtained or may even become worse. The microstructure control using minor element addition is the most popular method due to its ease and effectiveness. Phosphorous is the most effective refinement element of primary silicon in hypereutectic Al-Si alloys. The size of primary silicon can be refined to 20-30 µm by adding minor Phosphor [7, 8].It is noticed that there are two modification mechanisms; one is heterogeneous nucleation and refining of primary Si phase by Al-P particles and the other is P atoms modify the morphologies of Si phases [9, 10].

The mechanical properties of hypereutectic Al-Si alloys are affected by primary Si features such as particle size, shape, volume fraction and Si content. The presence of large Si cuboids in conventionally cast hypereutectic Al-Si alloys give rise to poor mechanical and wear properties. The brittleness of coarse Si crystals (both eutectic and primary silicon) is the main reason responsible for the poor properties of Al-Si alloys because coarse silicon crystals lead to premature crack initiation and fracture in tension [11]. It is well known that adding of small amounts of Cu, Mg or Ni strengthen Al-Si alloys and also the presence of Si provides good casting properties. Addition of copper to Al-Si alloys results in the formation of $CuAl_2$ phases and other intermetallic compounds, which increase strength of cast parts [12]. In the present study, modification performance of the Cu-14P for commercial LM-29 (Al-24Si-Cu-Mg) alloy microstructure and mechanical properties was investigated.

II. MATERIALS AND METHODS

CommercialLM-29 (Al-24Si-Cu-Mg) alloy was melted in a resistance heating furnace using a graphite crucible to a temperature of 720°Cunder a cover flux (45%NaCl+45%KCl+10%NaF).After degassing with solid hexachloroethane (C_2Cl_6), Cu-14%P master alloy chips packed in an aluminium foil added to the melt. The melt was stirred for 30seconds with zirconia coated iron rod after the addition of master alloy. Melts prepared with addition of calculated amount of master alloy poured into split type cylindrical graphite moulds to prepare specimens for tensile, hardness and microstructure after minutes of holding time.The details of amount of Cu-14P master alloy added to the base alloy (LM-29) is given in Table 1. The chemical composition of commercial LM-29 alloy and Master alloy was assessed using atomic absorption spectrometer (Model; Varian AA-240,

Available online at www.sciencedirect.com

ScienceDirect

Materials Today: Proceedings 5 (2018) 25165–25173

materialstoday: PROCEEDINGS

www.materialstoday.com/proceedings

IConAMMA_2017

Studies on Relationship between Wear Behaviour and Microstructure of a Hypereutectic Al-Si Alloy

Basavaraj Ganiger[a*], T.M.Chandrashekharaiah[b], T.B.Prasad[c] and V.R.Kabadi[d]

[a,c] *R & D Centre, Mechanical Engineering Department,* Sri Siddhartha Institute of Technology, Tumkur-572105, *Karnataka, India*
[b] *R & D Centre, Mechanical Engineering Department, Kalpataru Institute of Technology, Tiptur-572201, Karnataka, India*
[d] *R & D Centre, Mechanical Engineering Department, Nitte Meenakshi Institute of Technology, Bangalore-560064, Karnataka, India*

Abstract

A commercial grade hypereutectic Al-Si alloy (LM-28) has been modified by adding P in the form of Cu-14P master alloy. The microstructures of unmodified and modified were examined under SEM. The mean size of the primary silicon in unmodified alloy is 24.87μm and the same observed in modified alloy containing 0.06% P is 12.53μm. The volumetric wear rate and COF at high temperature have been studied using pin-on-disc wear testing machine. It has been observed that the wear resistance of modified alloys is noticeably improved when compared to the unmodified alloy. The worn surfaces were characterized by confocal microscopy and observed wear mechanisms are explained in the background of their microstructures.

Selection and/or Peer-review under responsibility of International Conference on Advances in Materials and Manufacturing Applications [IConAMMA 2017].

Keywords: LM-28 alloy; Cu-14P Maste alloy; SEM; High temperature; Worn surfaces; Confocal micoscopy; wears behaviour; Primary Silicon.

1. Introduction

Wear is the continuous loss and deformation of a metallic component as a consequence of its relative motion about the mating parts. It leads to the worn parts replacement cost and also involved the expenses of machine downtime, loss of manufacture etc. The wear performance of Al-Si alloys be governed by material's mechanical

* Corresponding author. Tel.: +91-080-28372800; fax: +91-080-28372797.
*E-mail address:*Ganiger2011@gmail.com

2214-7853
Selection and/or Peer-review under responsibility of International Conference on Advances in Materials and Manufacturing Applications [IConAMMA 2017].

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

A COMPARATIVE STUDY ON PROPERTIES OF FORGED AND HEAT TREATED D TYPE TOOL STEEL

T S Siddalingaprasad[1] and Dr. H S Shivashankar[2]
[1]Associate professor,Mechanical Engineering Department, KIT Tiptur.
[2]Professor, Mechanical Engineering Department, SIT Tumkur

ABSTRACT

In this work an attempt has been made to improve the properties of cutting tool like hardness, toughness & wear resistance by forging & heat treatment process. Here we have selected D-Series tool steel (D2,D3) for our project, These tool steels are used in forging dies, die-casting die blocks, drawing dies etc., hence we made an attempt to check whether these tool steel can be used as a cutting tool at high temperature. The experiment evaluates Rockwell hardness test, toughness test & wear test. The result reveals that, hardness of D-series tool steels improved by forging & heat treatment process than it was in raw material case & the heat treated D series-tool can be operated at high temperature without wear.

***Keywords**: D-type tool steels, forging, heat treatment, hardness, toughness tests*

I. INTRODUCTION

D-type tool steels contain between 10% and 18% chromium. These steels retain their hardness up to a temperature of 425 °C (797 °F). Common applications for these tool steels include forging dies, die-casting die blocks, and drawing dies. Due to their high chromium content, certain D-type tool steels are often considered stainless or semi-stainless; however their corrosion resistance is very limited due to the precipitation of the majority of their chromium and carbon constituents as carbides. The heat treatment to which a tool has been subjected has a marked influence on cutting performance of tool steel. The general heat treatment schedules applied to tool steels are shown in figure 1.1.

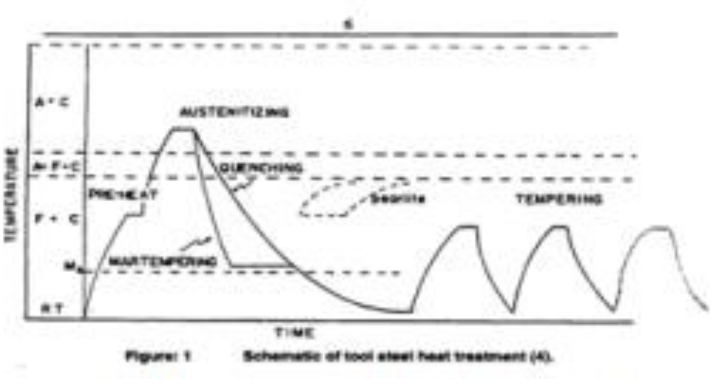

figure 1. Heat treatment schedules applied to tool steels

Austenitizing is a very critical step in the hardening of tool steel. It is in this step that the final alloy elements are partitioned between the austenitic matrix (which will transform to martensite) and the retained carbides. This partitioning fixes the chemistry, volume fraction, and dispersion of the retained carbides. The retained alloy carbides not only contribute to Wear resistance, but also control austenitic grain size. The finer the carbides and the larger the volume fraction of carbides, the more effectively austenitic grain growth is controlled. If during heating the austenitizing temperature is high, the carbide will dissolve to a large extent, and the precipitation of cementite on cooling will have a greater tendency to take place at coarse austenite grain boundaries. If, however, the carbide has not been completely dissolved and large quantities remain in the form of rounded particles throughout the matrix, carbide precipitation will take place on these preexisting points, and the network of cementite surrounding the grain boundary will not form. Thus, overly high austenitizing temperatures must be avoided so as to prevent grain growth

[ICAMS: March 2017]
ISSN 2348 – 8034
Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

DEVELOPMENT AND CHARACTRIZATION OF SILICA PARTICULATE REINFORCED ALUMINIUM METAL MATRIX COMPOSITE

Mallikarjuna G B*[1] & Dr. E Basavaraj[2]
*[1]Assistant professor, Deparment of Mechanical Engg., KIT, Tiptur, Karnataka
[2]Professor, Deparment of Mechanical Engg., JNNCE, Shivamogga, Karnataka

ABSTRACT

Composites materials are the most prominent materials for engineering applications. Metal matrix composites (MMCs) possess significantly improved properties compared to unreinforced alloys. Aluminium based MMC's find wide applications in aerospace, automobiles and marine sectors etc. The mechanical properties of aluminium matrix composites are strongly dependent on microstructural parameters like shape, size, volume fraction and distribution of reinforcement particles. Therefore, judicious selection of the variables is important to optimize the properties of the composites. Among various particulates used, silica is one of the most inexpensive and low density reinforcement available in large quantity in nature. In this study, aluminium alloy LM13 and 3%, 6%, 9% and 12% (by weight) silica of different micron size (106, 150, 250 and 355µm) composites were prepared by stir casting route. Optical microscope is used to identify the structural characterization of the prepared composites. It is observed that the uniform distribution of silica particles in the matrix and also exists in a good bonding between matrix and reinforcement. The hardness of the composites were increased with increasing the amount of silica in aluminium. Experimental result shown that there is enhanced mechanical properties, when silica weighing 9% was added to base aluminium alloy and also similar trend exist in all four different micron size of silica.

KeyWords: Al alloy LM13 , Silica, Mechanical properties, Stir casting.

I. INTRODUCTION

Industrial technology is growing at a very rapid rate and consequently there is an increasing demand and need for new materials. Particulate reinforced composites constitute a large portion of these new advanced materials [1]. Metal matrix composite (MMC's) is engineered combination of the metal (Matrix) and hard particle/ceramic (Reinforcement) to get tailored properties. MMC's are either in use or prototyping for the space shuttle, commercial airliners, electronic substrates, bicycles, automobiles, golf clubs, and a variety of other applications[2-3].

A good combination of high strength and ductility of the Aluminum based metal matrix composites (MMC's) have introduced the material to a wide area of possible advanced applications. In general stir casting of MMC's involves producing a melt of the selected matrix material, followed by introducing reinforcement material into the melt, obtaining a suitable dispersion through stirring. Its advantages lie in its simplicity, flexibility and applicability to large quantity production. It is also attractive because, in principle this method suitable for engineering application in terms of production capacity and cost efficiency [4]. Aluminium is the most popular matrix for the metal matrix composites. Aluminium is quite attractive due to its low density, their capability to be strengthened by precipitation, good corrosion resistance, high thermal and high electrical conductivity and damping capacity. The demand for structural materials to be cost effective and also to provide high performance has resulted in continuous attempts to develop composites as serious competitors to the traditional engineering alloys[5]. In the recent years, usage of ceramic particle - reinforced metal matrix composites (MMC's) is steadily increasing because of their advantages like isotropic properties and the possibility of secondary processing facilitating fabrication of secondary components.[6].

Al alloy composites have the potential to replace other costlier material in many significant engineering applications. The requirements concerning safety and reliability are always increasing and therefore the mechanical properties are ever more crucial [7].

II. METHOD & MATERIALS