A STUDY ON COMPOSITE MATERIAL WELDS ON COPER AND ALUMINIUM ALLOYS

S. Sasanka Sricharan,
Research Scholar, GD Goenka University,
Gurugram, India.
sricharan.suri@gmail.com

Dr. Dipesh Popli
Assistant Professor, School of Engg & Sciences, GD Goenka university
Gurugram, India.
dipesh.popli@gdgu.org

ABSTRACT

Copper is used mainly for thermal and electronic packaging of industrial and usable metals, electrical contacts and resistance electrodes, as its electrical and thermal conductivity is very strong. One faces the problem of transfer during service of a wide class of machinery electricity from a stationary conductor to a relatively different conductor In recent years, the importance of particulate-reinforced MMCs, especially those based on existing copper alloys, is high. These alloys are very strong with a high wear resistance, good working properties, cold working strength, fatigue resistance, resistance to corrosion, etc. which can operate in very extreme conditions and temperatures of about 450^0 MMCs so they have many benefits for researchers. Their increased strength, stiffness and resistance to corrosion is becoming important in the fields of aerospace engineering in such composite materials. The paper addresses aircraft construction composites and explore advanced composites as structural materials. Advancements support their use in new fields in future.

Keywords: *Copper (Cu) Metal Matrix Composites, MMC, mechanical properties, aerospace applications*

1.0 INTRODUCTION

Aerospace Engineering is the maker of aerospace technical equipment. The further development of the material is based on its properties such as resistance, rigidity, harm tolerance, density and corrosion resistance at ambient and high temperatures. The cost of this life cycle was referred to as a tool to assess the financial acceptability of products. There are currently several systems that need different qualities and pleasant and stable features to comply with various operational requirements. Thus, in mechanical and electronic systems, the relation between different materials for applications. The requirement for these different joints has guided the rapid development of different materials connected with aluminium alloy technology to produce the ideal lightweight, lightweight, highly advanced structural materials, good plasticity and other materials, high thermal conductivity, high corrosion resistance and excellent electrical conductivity Copper (Cu). Mechanical joints the mechanical connexion increases the bolt attachment and the weight of the system rival by the addition of high-strength bolts and rivets, and the especially post-boiled boulder hole will cause stress and affect the structural fatigue.

Composite Materials:

The rapid development and use of composite materials from the 1940s were motivated by three important factors. Military trucks such as aviation's, helicopters and rockets placed premium on lighted materials of high intensity. While mechanical properties were definitely the work of the metal components used up to

this point, the heavy weight of the components was prohibitive. The greater the weight, the less weight the aircraft or helicopter itself can carry. Composite materials are a composite composed of solid carrying materials contained in a slightly weaker product. Fortifying is commonly known as the stronger material and the weaker material is commonly known as the frame. The refurbishment gives the force and rigidity required to sustain the structural load The matrix or binder adds to the reinforcement's location and orientation and is much more flexible.

Application Composite materials:

Composites are one of the most significant components of the manufacture of aircraft. Previous surveys, for example, have shown that the lowest cost and production facilities of glass fibres both in volume and in terms of value – remain the largest submarket for composites during the forecast era. A further consideration is the expensive, but often demanding use of carbon fibre components such as civil and militarily operational aviation. Additional research has shown that the production of other fibre composites and hybrids is forced to be important as advanced composites for new applications are required for advanced purposes.

2.0 LITERATURE REVIEW

Mingshen Li, Chaoqun Zhang [1] The better plasticity, high thermal conductivity and excellent electricity are the reasons why aluminium (Al) and copper (Cu) were commonly used in many industrial fields. An appropriate combination of different materials Al and Cu will completely exploit the special characteristics of both of these metals. **Garg, A.; Bhattacharya [2]** The welding tool size is also a significant factor in the intensity of the Al-Cu F SSW Joint, in addition to the geometry. When the upper plates do not penetrate, the joint depends primarily on the metallurgical attachment of the superficial interface, and the relative high pressure and welding temperature may result in a strengthened joint. **A.M. Hassan, M. Almomani et al, [3]** Due to their attractive mechanical properties and their high potential for aerospace applications, advanced materials such as aluminium matrix composites (AMCs) have received great attention. They are also considered the ideal candidate for the new lightweight and high strength materials generation **R.Y. Huang, S.C. Chen [4]** The use of AMCs in the aviation industry, however, is limited and is not widely used partly by the problems related to their unification by conventional welding processes. **V. K. Parikha, A. D. Badgujar [5]** This research is an attempt to investigate a particular field of FSW, that is, the adhesion of MMCs. A detail introduction to the FSW process was given in the initial part of the report, which included a summary about the reported FSW literature of alloys. **Prabu, S. B.; Karunamoorthy [6]** The current situation of emerging trends and diverse technology means that novel materials with the requisite features at a low cost have been required in various industries for their superior mechanical and thermophysical properties. **Kumar, et al, [7]** It has investigated the impact of welding speed on the wear of equipment. Constant turning speed and an independent cross speed experiment were conducted. The increase in welding speed led to lower wear. **Bhaskar Chandra Kandpal, et al [8**] This study concerned composites of metal matrix, manufacturing technology

connected to MMCs. Here we discuss the latest development in metal matrix composites technology. Composite material is usually shortened into composites or natural material made up of two or more materials with significantly different physical or chemical properties, separate and distinct in the size of the finished structure quantum mechanically or micro sceptically. **J.W. Kaczmar, K .Pietrzak, W [9]** Reinforcement and matrix stimulation leading to the formation of fragile secondary phases in a soldering bowl or the breakdown of reinforcing motten metal can not achieve an effective combination of AMC resistance using melting methods.. **Galvão, I., Leal, R. M [10]** Composites commonly in use in engineering applications are the aluminium matrix. The composites with aluminium matrix have these superior characteristics that no current monolithic material is able to achieve. The essence of reinforcement which can be either continuous or discontinuous fibre is a powerful influence on the properties of aluminium matrix composite **Mohammad Arif [11**] Developing advanced and specialised materials, for example composites. Composite material in aerospace engineering is currently becoming relevant because of its rising weight strength, steepness and corrosion resistance.

3.0 THE USAGE OF COMPOSITE MATERIALS IN AEROSPACE INDUSTRY

Maria MRAZOVA [12] This improved material properties have helped us fly around the world quickly and cheaply, enhancing modern aviation performance and service. The author presents in the first part of this analysis composites with their advantages and disadvantages. **T. Edwards [13]** The less weight leads to less fuel consumption and reduced emissions, as plastic structures require less riveted joints, better efficiencies in aerodynamics and lower production costs. Naturally, when composites first came to light, the air industry was attracted by these advantages, but it was the aircraft manufacturers who took the opportunity to use their aircraft first to improve the speed and manoeuvrability of their products. **SukritiYadav**, **[14]** In a specific element-based study the implementation of a progressive damage predictor resulted in the conclusion that the failure of the composite panel starts as a result of matrix cracking within the grid interfaces. If these cracks spread and meet interfaces with ply, they are responsible for breakdown in skin. The delamination causes a lack of rigidity in the area and overwhelms the grid-skin interface **G.V.Mahajan [15]** In the automobile service tailored architecture, structural dynamic characteristics are altered to achieve higher aircraft speed without float. The stiffener bending mode is often affected by this method. Lower natural frequency and thus higher loading amplitudes of tiredness on flight. **Shivi Kesarwani [16]** Polymer composites materials, their properties and their applications in the aerospace industry. Polymer composites are very effective and friendly to the climate. Traditional materials are prone to fatigue and corrosion while composites give both resistance and substantial reduction in weight **Roxana NEDELCU [17]** In commercial and leisure aviation the use of composite components as part of maintenance cycles instead of metal is rising rapidly. Carbon fibres are the composite fibre that is most common in aeronautical applications. **Nikhil V Nayak**

[18] The high strength of composites depends primarily on fibre strengthening, but the matrix material 's value cannot not be avoided, as it supports the fibres, and equally distributes the fibres load. **P D MANGALGIRI [19**] In their analysis of some of these technologies, the issue with present generation composites and future innovations are discussed. While several applications are listed in the aerospace field, the focus of the analysis is on applications of composites as structural materials, where there has been considerable increase in use. **Zweben, C [20]** Simple analysis of the current status and features of the composite technology, with a specific focus on applications in the sphere, and a brief overview of some apparent and speculative trends. **Sanjay Kumar Sardiwal [21]** The difficulties and benefits, compared with other alloys, of using composites in airframe manufacturing. It also discusses the ways and means of ensuring that the use of composites does not compromise security and durability. **ReenaAntil , Amit [22]** A brief analysis of the use of composites is first provided in the aerospace field. The essence and special problems of composite materials actions in designing and working with them are emphasised. The subjects are impact risk and damage tolerance, total environmental loss and long-term sustainability. **Abhinav Swami et al [23],** Composite materials are widely being used in aerospace, automobile & constructions etc. Due to their light weight and high strength properties they have become essential parts of aerospace industry, up to 35-45 percent (weight ratio) composite materials are used in making of an aero plane frame. **Nikhil V Nayak [24]** Copper is the major element in high-corrosion resistant copper alloys. Bronze as a main alloying element and zinc as the alloying element are common types of copper alloys. The iron based aluminium alloy is also composed of 12% by weight of aluminium and has high strength and isolating properties.

DEVELOPMENTS IN METAL MATRIX COMPOSITES

The Aluminum-Copper (Al-Cu) alloys are high strength alloys that are used in structural applications with high strength where damage tolerance is a major design criterion Fig. This reflects a rich aluminium end of a diagram of equilibrium aluminium copper. Since maximum copper solubility in aluminium stands at 5,65% at 547 ° C and at least 0,45% at 300 ° C, the thermal treatment of aluminium alloys with an aluminium content from 2.5% to 5% is due to ageing hardening. The alliance is heated in the kappa single-phase area and then easily refrozen to increase the strength of the alloy.

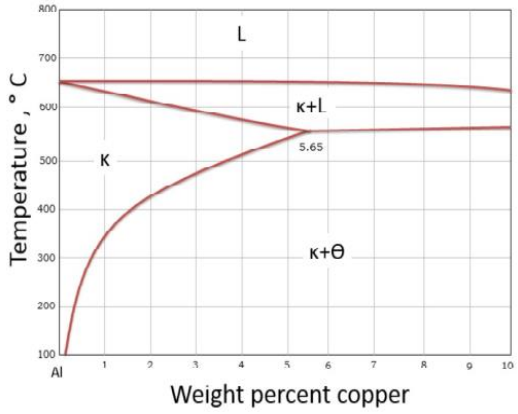

Figure: The aluminium rich portion of the aluminium copper alloy system, replotted from

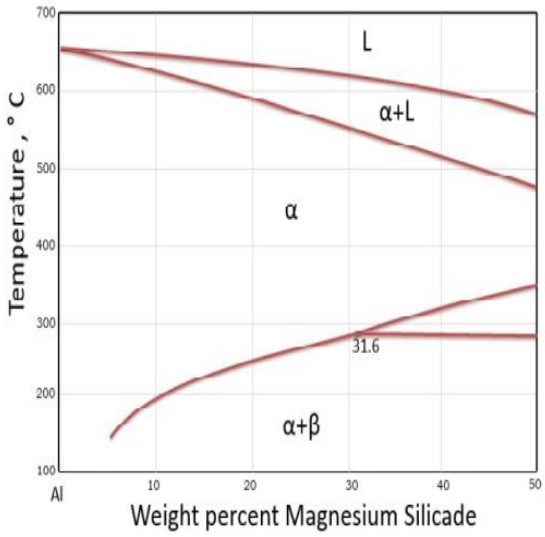

figure: the aluminium-rich portion of the Aluminium-Zinc alloy system, replotted from

The precipitation of the theta stage results in increased strength of the alloy **Olayide R. Adetunji [25]** The precipitation of the Al2Cu and Al2CuMg stages resulted in higher force of these alloys. The resulting ageing processes are either normal or artificial. In contrast to other aluminium alloy series, these alloys often have very high crack resistance and superior damage tolerance. The procurement of aircraft material is a dynamic process with different material properties requiring a reliable design for different components. The wing of the aircraft functions like a beam that bends throughout the flight. The wing box consists of up and down skins, cords (large limbs) and spars forming the sides of the wing box and ribs, as well as strings. The aeroplane wing experiences many loads during flight for example loads while driving, loads during take-off and landing and trailing edge loads from the landing gear. The loads are transferred to the central fuselage attachment. The static material properties for the construction of the top skin stringer are compressing power, compression elasticity module and the tensile strength and tensile module are the static material properties for the configuration of the lower skin-stringer. Since these components experience alternating loads during flight, the material requires very high fatigue resistance and tolerance to impact.

CONCLUSION:

To conclude this analysis paper is the required selection of lightweight and solid aircraft structure building materials. Aluminum has a wide variety of features that make it the perfect option for aerospace applications. Made from aluminium alloys that best matches aviation industry requirements, chemical composition is modified and the best combination of properties is obtained. Al-Cu alloys, high-strength alloys, are used for the heat treatment by age hardening and are ideal for structural applications where damage tolerance is the key design criteria. With the rising demand from aircraft manufacturers aircraft aluminium alloys continue to develop. Developments in material technology are intended to deliver innovative results on material capabilities from high strength and lightweight aluminium alloys to the tremendous application of nanotechnology. Material production represents direct changes in its characteristics. These changes in material properties mean reduced use and dismantling of material, enhanced efficiency and improved aircraft life cycle.

Future scope:

The use of composite materials for different aerospace components has resulted in substantial savings in weight estimations of about 30 percent for current programmes. The technology developed

and the trust gained have prepared the way for a further propagation of composites into more complex aerospace components, such as aircraft fuselages, with more weight savings. Professional aircraft has sustained pressure to boost efficiency with rising fuel costs and environmental lobbying, and weight reduction is a key factor in the equation. Aircraft repair systems can be streamlined beyond regular running costs by reducing the components' count and reducing corrosion. The competitiveness of the aircraft construction industry guarantees that every chance to cut operating costs is pursued as much as possible.

REFERENCES:

1. *Mingshen Li, Chaoqun Zhang Dayong Wang Li Zhou Friction Stir Spot Welding of Aluminum and Copper: A Review Materials 2020, 13, 156*
2. *Garg, A.; Bhattacharya, A. Strength and failure analysis of similar and dissimilar friction stir spot welds: Influence of different tools and pin geometries. Mater. Des. 2017, 127, 272–286*
3. *A.M. Hassan, M. Almomani, T. Qasim, A. Ghaithan, Effect of processing parameters on friction stir welded aluminum matrix composites wear behavior, Mater. Manuf. Process. 27 (12) (2012) 1419–1423.*
4. *R.Y. Huang, S.C. Chen, J.C. Huang, Electron and laser beam welding of high strain rate superplastic Al-6061/SiC composites, Metall. Mater. Trans. A Phys. Metall. Mater. Sci. 32 (10) (2001) 2575–2584.*
5. *V. K. Parikha, A. D. Badgujara, and N. D. Ghetiya Joining of metal matrix composites using friction stir welding: a review, Materials and Manufacturing Processes ISSN: 1042-6914 (Print) 1532-2475*
6. *Prabu, S. B.; Karunamoorthy, L.; Kathiresan, S.; Mohan, B. Influence of stirring speed and stirring time on distribution of particles in cast metal matrix composite. Mater. Process. Technol.2006,171, 268–273.*
7. *Kumar, A.; Nayak, C. V.; Herbert, M. A.; Rao, S. S. Micro structure and hardness of friction stir welded aluminium–copper matrix-based composite reinforced with 10 wt-% SiCp.Material ResearchInnovations.2014,18,56–84*
8. *Bhaskar Chandra Kandpal, 2Jatinder Kumar, 3Hari Singh, "Production Technologies of Metal Matrix Composite: A Review" IJRMET Vol. 4, Issue 2, Spl - 2 May - October 2014*
9. *J.W. Kaczmar, K .Pietrzak, W. Wlosinski, The production and application of metal matrix composite materials, Journal of material processing technology, 106(2000), p 106:58-67*
10. *Galvão, I., Leal, R. M., Loureiro, A. & Rodrigues, D. M., 2010. Material flow in heterogeneous friction stir welding of aluminium and copper thin sheets. Science and Technology of Welding and Joining, p. 654 – 660.*
11. *Mohammad Arif Mohammad Asif, and Israr Ahmed Advanced Composite Material for Aerospace Application-a Review International Journal of Engineering and Manufacturing Science. ISSN 2249-3115 Volume 7, Number 2 (2017), pp. 393-409*
12. *Maria MRAZOVA Advanced composite materials of the future in aerospace industry INCAS BULLETIN, Volume 5, Issue 3/ 2013, pp. 139 – 150*
13. *T. Edwards, Composite materials revolutionise aerospace engineering, Ingenia Magazine Online, Issue 36, 24 p, September 2008*
14. *SukritiYadav," Micro/Nano Reinforced Filled Metal Alloy Composites: A Review Over Current Development in Aerospace and Automobile Applications," ICMDA 2016.*
15. *G.V.Mahajan, "Composite Material: A Review over Current Development and Automotive Application." International Journal of Scientific and Research Publications, Volume 2, Issue 11, November 2012 ISSN 2250-3153*
16. *Shivi Kesarwani Polymer Composites in Aviation Sector A Brief Review Article*

International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 6 Issue 06, June – 2017

17. *Roxana NEDELCU, "Composites Materials for Aviation Industry", INTERNATIONAL CONFERENCE of SCIENTIFIC PAPER, AFASES 2012, Brasov, 24-26 May 2012*
18. *Nikhil V Nayak, "Composite Materials in Aerospace Applications", International Journal of Scientific and Research Publications, Volume 4, Issue 9, September 2014, ISSN 2250-315*
19. *P D MANGALGIRI Composite materials for aerospace applications Bull. Mater. Sci., Vol. 22, No. 3, May 1999, pp. 657-664.*
20. *Zweben, C. (1981). Advanced composites for aerospace applications. Composites, 12(4), 235–240.*
21. *Sanjay Kumar Sardiwal, Md. Abdul Sami, B. V. Sai Anoop Advanced Composite Materials in Typical Aerospace Applications Global Journal of Researches in Engineering: D Chemical Engineering Volume 14 Issue 1 Version 1.0 Year 2014*
22. *ReenaAntil , Amit , Garvit , Ritesh Applications of composite materials in aerospace International Journal of Science, Technology and Management (IJSTM) Volume:4,Issue:11,2015.*
23. *Abhinav Swami, Akshay Sharma, Devesh mahawar, Jayesh Raj Singh, Pramod Kumar Verma Composite Materials in Aerospace Applications International Journal of Advance Research in Science and Engineering Volume:7, Issue :2,2018.*
24. *Nikhil V Nayak Composite Materials in Aerospace Applications International Journal of Scientific and Research Publications, Volume 4, Issue 9, September 2014 1 ISSN 2250-3153*
25. *Olayide R. Adetunji, Muyiwa L. Olukuade, Wojciech Simka Production and Characterization of Amorphous Aluminum-Copper Alloy for Aerospace Applications EJERS, European Journal of Engineering Research and Science Vol. 2, No. 2, February 2017*