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EFFECT OF AL2O3, ALUMINIUM ALLOY AND FLY ASH FOR MAKING ENGINE COMPONENT

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ABSTRACT

In automobile sector and aerospace industries the Composite materials are widely used. In that composite materials, matrix based composites of Aluminium alloy plays a vital role in automobile sectors. Because, Aluminium alloy composite materials consists of thermal stability, more specific strength, resist to corrosion and wear resistance. In this project, testing of Aluminium alloy metal based matrix composites (MMCs) reinforced with Al2O3 and fly ash particles using stir casting method. Here the Aluminium alloy acts as a metal matrix and Al2O3 and fly ash acts as reinforcement. The resultant composite has to be tested for their hardness. The Al2O3 widely used for fly ash, Hard and wear-resistant. These composite materials are finding various applications in aerospace and automobile sectors. This is mainly due to increase the mechanical properties like hardness, impact strength, tensile and wears resistance.

***Keywords*:** Aluminium alloy, Metal matrix composites Al2O3 and fly ash, stir casting.

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ABBREVIATIONS

MMC	Metal based Matrix Composites
Al	Aluminum
CC	Combustion Chamber

1. INTRODUCTION

The Composite materials are widely used in engineering fields due to its better mechanical properties. The Composites materials having the desirable characteristics of various materials are combined by the help of mechanically binding them together Panigrahi et al. (2010). The each component retains their structure and characteristic. The composite materials are basically possesses good properties additionally having excellent properties in conventional alloys for several applications which have more stiffness, wear resistance and strength. The composite materials development started with continuous-fiber-reinforced composites production. The difficulty of processing with more cost and composites restricted its application and tends to the development of discontinuously reinforced composites Fadhalah et al. (2014).

Al (Aluminum) is a ductile member of weak metal group in chemical element and silvery white and also an abundant and light metal has used in various applications. The composite of Al provides good thermal conductivities, more shear strength, better resistance in abrasion, capable of withstand high temperature, minimal attack by the fuel and non-flammability.

Zeng et al. (2013) Al_2O_3 is most suitable for high temperature applications, more corrosion resistance ceramics, translucent ceramics and electronic packaging. These Al_2O_3 powders have hydrated state, even produced by the same production method. Due to this the water may be incorporated with Al_2O_3 in crystal structure which shows the aluminum hydroxides production namely as gibbsite. Even though many research had shed light in Al_2O_3 properties. In this research method, the basic of crystal structural characteristics, methods of manufacturing of Al_2O_3 and its surface characteristics are introduced Ihn et al. (1994).

The fly ash mostly used as secondary cementations materials in the concrete, by combustion product of the pulverized coal in power plants. The major carbon in the coal and volatile matter are burned off. Due to combustion process, mineral impurities fuse in the suspension and passed away from the cc due to exhaust gas Natarajan et al. (2009). In this method, the bonded material cool and freezes into spherical polished particles named as fly ash. This fly ash is received from the exhaust gases by electrostatic precipitators.

1.1 Composite Technology

The Composite material is prepared from two or more essential materials with considerably physical and chemical properties which remain separate and different on a macroscopic level. In advanced research the composite materials are mostly used fiber glass. It is the modern composite and 65 % of composites are produced for swimming pool linings, sporting goods, surfboards, boat hulls, car bodies and building panels. The different materials work together to give the composite unique properties Nemati et al. (2015).

Light, strong and corrosion-resistant, the composite materials are being used in increase number of products as more manufacturers discover the benefits of these versatile materials.

The Composite materials have high-performance that helpful to be a strong and harsh loading condition namely bicycle frames, aerospace parts, racing car bodies, scull hulls and boat. Other uses include storage tanks and fishing rods Prasad et al. (2014). The MMC is a composite material and consists of at least two basic parts namely metal and other one is organic compound.

2. ALUMINIUM OXIDE

The Al_2O_3 is an electrical insulator but has a high thermal conductivity (30 W/mK) for a ceramic material. The Aluminium oxid is an unsolvable in water. The most frequently occurring crystalline form, known as aluminium oxide and its hardness creates it appropriate for the abrasive and cutting tools Mahendra et al. (2007).

Figure 2.1 Aluminium oxides in its powdered form

An Aluminium oxide is most suitable for the resistance and this metallic aluminium is very volatile with oxygen, and thin layer of aluminium oxide forms on surface Wang et al. (2016). These layers are used to protect the metal from further oxidation. The properties and thickness of this oxide layer can be enhanced by anodizing process.

2.1 Structure

The crystalline aluminium oxide structure is also named as corundum, which is the thermodynamically stable in the method. The oxygen ions mostly procedure a hexagonal close-packed structure with an aluminium ions filling 2/3 of the octahedral interstices Casati et al. (2014).

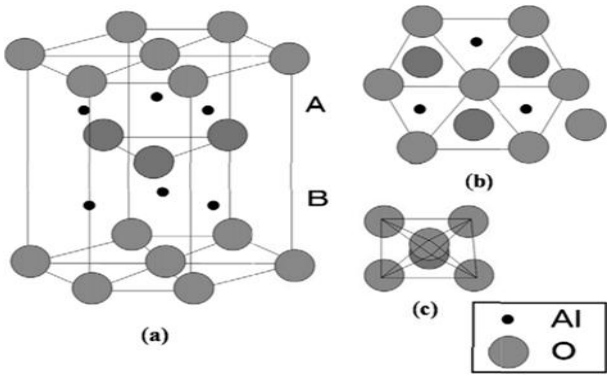

Figure: 2.2 Structure of Aluminium Oxide (Al2O3)

3. CHEMICAL COMPOSITION AND CLASSIFICATION

Table 3.1 Classification and Chemical Composition

Elements	Sub bituminous	Bituminous	Lignite
SiO_2 (%)	45 — 65	25 — 65	20 — 55
Al_2O_3 (A)	30— 45	10 —45	20 — 30
Fe_2O_3 (%)	5 — 15	5 — 45	5 — 20
CaO (%)	10— 35	2— 14	20 — 45
LOI (%)	5 — 15	5-15	5 — 10

The fly ash material solidifies when deferred in exhaust gas and is received by electrostatic precipitator. The freeze particles however suspended in exhaust gas, particles of fly ash are usually in spherical shape.

The fly ash additionaly encloses atmospheric toxins in major quantity with zinc (178 ppm), thallium (9 ppm), lead (56 ppm), manganese (250 ppm), chromium VI (90 ppm), cobalt (35.9 ppm), arsenic (43.4 ppm), barium (806 ppm), cadmium (3.4 ppm), strontium (775 ppm), beryllium (5 ppm), boron (311 ppm), selenium (7.7 ppm), copper (112 ppm), chromium (136 ppm), fluorine (29 ppm), nickel (77.6 ppm) and vanadium (252 ppm).

3.2 Basic molding process

The following steps involved during the process:

1. Keep the design in sand for creates mold.
2. Combine the pattern with sand in the gating system.
3. Remove the pattern.
4. Mold cavity is filling by molten metal.
5. Need to cool the metal.
6. Mold casting is removed from the sand.

3.3 Steps Involved

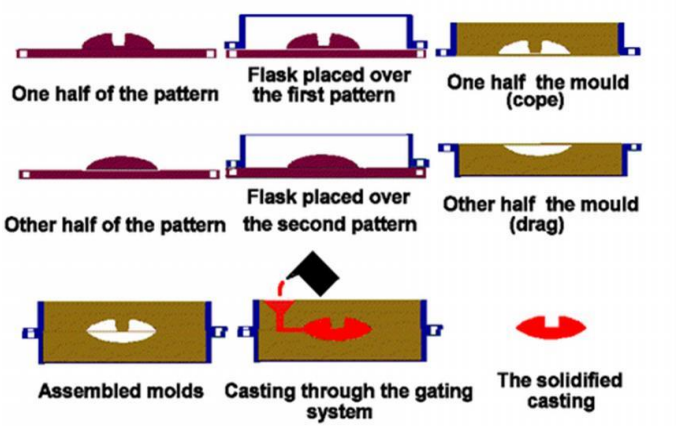

Figure: 3.1 Steps involved in moulding process

4. RESULT AND DISCUSSION

The microhardness of Al-Al_2O_3 and composite of fly ash, which has strong bonding without any interfacial reaction. Hardness observations ensured that the reinforced structures of MMCs are finer than the un-reinforced matrix alloy. Further due to rapid cooling of the composite melt, dispersoid particles doesn't get sufficient time to settle due to differences in density between the dispersoid (3.95 gm/cc & 0.86 gm/cc) and matrix melt (2.9 gm /cc) and result shows uniform distribution of Al_2O_3 and fly ash particles in matrix. The uniform distribution of the particles and structure of finer matrix lead to the higher mechanical properties.

5. CONCLUSION

Composite materials especially aluminum and Al_2O_3 and fly ash composites having good mechanical properties compared with the conventional materials. It is used in various industrial application, these materials having high hardness, good wear resistance along with high hardness .It withstand high load compare with the existing materials. Hence these composite materials are most applicable in the engineering products instead of existing materials. The density of the composite material will be increased, by the addition Al_2O_3 and fly ash on it. Because the Al_2O_3 and fly ash having high density compared with the Aluminium alloy. The percentage of Al_2O_3 and fly ash increases automatically the hardness. The addition of Al_2O_3 and fly ash particles may depend upon the material requirements and its functions.

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REFERENCES

[1] Panigrahi, S.K.; Jayaganthan, R. Effect of annealing on precipitation, microstructural stability, and mechanical properties of cryorolled Al 6063 alloy. J. Mater. Sci. 2010, 45, 5624–5636.

[2] Al-Fadhalah, K.J.; Almazrouee, A.I.; Aloraier, A.S. Microstructure and mechanical properties of multi-pass friction stir processed aluminum alloy 6063. Mater. Des. 2014, 53, 550–560.

[3] Li, H.Y.; Zeng, C.T.; Han, M.S.; Liu, J.J.; Lu, X.C. Time-temperature-property curves for quench sensitivity of 6063 aluminum alloy. Trans. Nonferr. Met. Soc. China 2013, 23, 38–45.

[4] Natarajan, S.; Narayanasamy, R.; Babu, S.K.; Dinesh, G.; Kumar, B.A.; Sivaprasad, K. Sliding wear behavior of Al 6063/TiB2 in situ composites at elevated temperatures. Mater. Des. 2009, 30, 2521–2531.

[5] Nemati, J.; Majzoobi, G.H.; Sulaiman, S.; Baharudin, B.T.H.T.; Hanim, M.A. Effect of equal channel angular extrusion on Al-6063 bending fatigue characteristics. Int. J. Miner. Metall. Mater. 2015, 22, 395–404.

[6] Prasad, D.S.; Shoba, C.; Ramanaiah, N. Investigations on mechanical properties of aluminum hybrid composites. J. Mater. Res. Technol. 2014, 3, 79–85.

[7] Mahendra, K.; Radhakrishna, K. Fabrication of Al-4.5% Cu alloy with fly ash metal matrix composites and its characterization. Mater. Sci. Pol. 2007, 25, 57–68.

[8] Wang, Z.; Georgarakis, K.; Nakayama, K.S.; Li, Y.; Tsarkov, A.A.; Xie, G.; Dudina, D.; Louzguine-Luzgin, D.V.; Yavari, A.R. Microstructure and mechanical behavior of metallic glass fiber-reinforced Al alloy matrix composites. Sci. Rep. 2016, 6, 24384.

[9] Casati, R.; Vedani, M. Metal matrix composites reinforced by nano-particles—A review. Metals 2014, 4, 65–83.

[10] S. Baskar, M. Chandrasekaran, T. Vinod Kumar, P. Vivek & S. Ramasubramanian, "Experimental Studies on Flow and Heat Transfer Characteristics of Secondary Refrigerant Based CNT Nanofluids for Cooling Applications", International Journal of Ambient Energy, ISSN: 0143-0750 (Print) 2162-8246 (Online) Journal homepage: http://www.tandfonline.com/loi/taen20,02Apr2018.

[11] S. Baskar, M. Chandrasekaran, T. Vinod Kumar, P. Vivek & L. Karikalan, "Experimental Studies on Convective Heat Transfer Coefficient of Water/Ethylene Glycol-Carbon Nano Tube Nanofluids", International Journal of Ambient Energy, ISSN: 0143-0750 (Print) 2162-8246 (Online) Journal homepage: http://www.tandfonline.com/loi/taen20, 16 Mar 2018, DOI: 10.1080/01430750.2018.1451381.

[12] Baskar S, Karikalan L, "Performance Study and Characteristic on a Domestic Refrigeration System with Additive of Zirconium Oxide (Zro2) Nano-Particle as Nano-Lubricant", International Journal for Research in Applied Science & Engineering Technology (IJRASET), ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887 Volume 5 Issue X, October 2017.

[13] S.Jacob, L.Karikalan, S.Baskar and S.Venugopal, "Performance Analysis of Automobile Radiator Using Nano Fluid and Water Mixture as Coolant", International Journal of Modern Trends in Engineering and Research (IJMTER) Volume: 5, Issue: 03, [March– 2018] ISSN (Online):2349–9745; ISSN (Print):2393-8161.

[14] S.Jacob, L.Karikalan, S.Venugopal, C.Gnanavel, S.Baskar, "Thermal analysis of fatty acid in heat exchanger with the addition of Phase Change Materials" |International Journal of Recent Trends in Engineering & Research (IJRTER) | Volume 04 | Issue 03 | March- 2018 [ISSN: 2455-1457].

[15] L.Karikalan, M.Chandrasekran, S.Ramasubramanian, S.Baskar, "Hybridization of Composites using Natural and Synthetic Fibers for Automotive Application", IJSRST | Volume 3 | Issue 7 | September-October 2017 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X.

[16] Baskar, Karthikeyan, "Heat transfer characteristics of acetone/water mixture in a tubular heat exchanger with turbulator", International Conference on Advanced Nano-materials and Emerging Engineering Technologies (ICANMEET) 2013, pp.627 - 630, 24-26 July 2013.