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Mechanical Characteristics and Corrosion Characteristics of Fly Ash Particulates of Bagasse Reinforced Al 6061 Composite Materials

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Abstract**: *Recently, composite materials are among the most prospective substances. The improved characteristics were possessed by Metal matrix composites (MMCs) but which is low in comparison to plain composites. Due to low cost and density, nowadays composite materials most trendy one. Therefore, composite materials reinforced with fly ash particulate of bagasse fly ash will probably overcome the barrier of expense in the applications of small motor and automobile industry. In the current study, a technique of stir casting has been utilized to prepare reinforcement of AL6061 alloy with 5 wt% to 25 wt% of fly ash particulate matter of bagasse fly ash. In this study, the identification of phase and characterization of structures was performed with the help of analysis of diffraction in the X-ray on the fly ash particulate matter of bagasse. The analysis of microstructure was performed with the help of optical microscopy and Scanning electron microscopy. The test like pitting corrosion, compression and hardness have been performed on composite materials and light metal. The analysis of SEM demonstrates that in the matrix stage, there is a homogeneous distribution of fly ash particulates of bagasse and also excellent adhesion is existing among reinforcement and matrix. The hardness, pitting corrosion and compressive strength were improved, and the density of the composite materials was decreased when there is an improvement in the number of fly ash particulates of bagasse. The enhanced pitting corrosion of reinforcement of aluminum alloy with fly ash particulates of bagasse is related to the initiation of the nobler second stage of fly ash particulate matter.***

Keywords: Stir casting, fly ash particulates of bagasse, MMC, aluminum alloys, light metals

I. INTRODUCTION

Composite has a low density, and these were inexpensive. In this study, the fly ash particulates of bagasse are utilized in the form of reinforcement which is inexpensive and widely available in large quantities. These fly ash particles of bagasse were a by-product of solid-waste substances from the burning of carbon in thermal power stations. Fly ash particulates are categorized into two kinds, cenosphere and precipitator. In General, monochromatic ball-shaped particulate matter of fly ash of bagasse is known as precipitator fly ash of bagasse and hollowed particulate matter of fly ash of bagasse with densities not more than 1.0 g/cm3 are referred to as the cenosphere fly ash of bagasse . The characteristics like resistance to wear, strength and stiffness were improved, and the density was decreased in the chosen matrix substances by utilizing a 2–2.5 g/cm3 density of precipitator fly ash of bagasse.

The traditional monolithic substances have some disadvantages to attain a good blend of intensity, resilience, stiffness, and strength. Recently, composites materials were one of the primary substances which improve the demand in modern technology. These materials overcome such drawbacks. A mixture of several substances results in Metal matrix composites (MMCs) where customized characteristics are accomplished. The improved specific strength, the capacity of damping and the characteristics of resistance to wear were possessed by MMCs in comparison to plain alloys.[1] Due to greatly improve in the MMC composite, the automobile industry utilizes these materials recently. Many types of research were performed on the MMC substance like reinforcement of aluminum with silicon carbide composites which are utilized in drive shafts, brake rotors, connecting rods, and so on. Due to inexpensive, these materials were utilized in the applications of the automobile industry. [2,3] Due to adding the high modulus and high strength particulates such as TiB2, SiC, Al2O3, TiC and so on, there are high mechanical characteristics in the reinforcement of particulates with MMC. At present, the most trending one is the reinforcement of particles with aluminum matrix composite materials due to its low price with the benefits like isotropic characteristics.4 The reinforced particles were injected into the liquid matrix by casting the liquid metallurgy to prepare the composite particles.[5] The method of stir casting is more preferable and most utilized process in comparison to another production process. The molten was produced with the chosen matrix substance was involved in the Stir casting of MMCs, followed by adding a reinforcing substance into the molten liquid and gaining an appropriate dispersal over the stirring.

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Due to the applicability, flexibility, and simplicity this process is most trending one but this process produces an uneven distribution of particles because of poor wetting and gravitational regulated separation.[6–9] One common form of fly ash particles of bagasse is commonly comprised of the crystalline mixtures like hematite, mullite, quartz, glassy mixtures like quartz glass, as well as other oxide compounds. Therefore, aluminum composites with fly ash particles of bagasse likely replace the cost-effective composite in the automobile industry.[10–14]

Generally, composite materials are a mixture of several substances with various characteristics of corrosion which results in the negative impact on the resistance to corrosive. The composite materials and Al alloys are susceptible to the pitting in the medium with a pH in close proximity to neutral, which effectively encompasses entire natural settings like humid air, marine water, and the surface water. The cavities which are in irregular form was formed on the surface of the metal. These formations were characterizing those concentrated form of corrosion.[15,16]

Due to higher yield and UTS with inferior elongation, Al 6061 alloy will be the most utilized aluminum reinforced copper alloys in the structure and studs for the aerospace industry, wheels in the truck and machinery products of the screw. Therefore, the current study was attempted to produce the Al 6061 alloy reinforced fly ash particulates of bagasse composites by utilizing the method of stir casting and concentrated to analysis the chance of a corrosive attack on such composite materials. The mechanical characteristics of Al 6061 reinforced fly ash particulates of bagasse were determined in standardized conditions at the time of the process of compression in ambient temperature.

II. MATERIALS AND METHODS

A. Synthesis of Al 6061 reinforced fly ash particulates of bagasse

In this study, a method of the vortex was utilized to synthesize the aluminum based MMC that contains 5 wt to 25 wt% of fly ash particles of bagasse. The matrix substance utilized in the current research was Al–Cu-Mg alloy (Al 6061) whose chemical content is listed in Table 1. The fly ash particles of bagasse were collected from the thermal power station of Rashtriya Ispat Nigam Limited (RINL), which is the steel plant in Visakhapatnam. Table 2 demonstrates the chemical content of the obtained specimens of fly ash particles of bagasse.

A 500 g the mass of a sample of fly ash particulates of bagasse was inducted into a graphite crucible and made it possible to warm up in the muffle oven for 3 hrs at 800 C to discover the ignition loss which was 2.4%. The heated fly ash particulates of bagasse were cooled at ambient temperature and then cleaned with purified water. During cleaning, there is a blending in some of the coal. So those coals were removed. Then the particles were dried for 48 h at 110 C to obtain water rid. The sun-dried samples of fly ash particles of bagasse have been filtered for 15 m by utilizing BSS mesh objects varying among 100 and 350 by utilizing Rotap Sieve shaker.

Figure 1 demonstrates the magnitude of the mesh and the mass fraction scattering of powder of fly ash after sieving for 15 minutes. Findings indicate that the median grain size of the fly ash bagasse particles powder is 60 mm; therefore, this magnitude was selected as strengthening for the synthesis of reinforcement of Al with fly ash particles of bagasse .

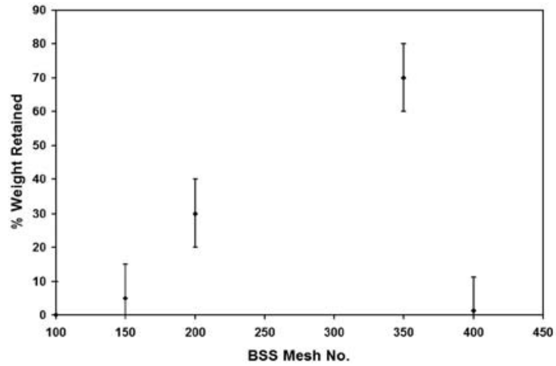

Figure 1. Dissemination of fly ash particulate matter of bagasse on sieving for 15 min.

After the completion of the process of combustion, fly ashes are composed of inorganic compounds residue of the coal. They have a complicated microstructure, with a combination of fluid (normally predominant) and crystal-clear stages. The main stage in fly ash is a glassy element, which is mainly obtained from dihydroxylation of clays in parental carbon. Dihydroxylation is the chemical process that breaks down into several hydroxyls (OH) groups in the clay minerals and thus diminish them. Other stages that exist in the fly ashes particulates of bagasse are mullite, quartz, hematite, magnetite, and minor amounts of the plaster.

Figures 2 and 3 demonstrate the scanning electron micrograph of the fly ash particles of bagasse after thermal processing. Such figures make clear that most fly ash particulates of bagasse are globular in shape and precipitator kind of fly ash particles of bagasse. The morphological structure of fly ash particulates of bagasse is operated by temperature in the combustion and cooling velocity at the thermal power station.

Table 1. Chemical ingredients of Al – 4.5 wt%, Cu – 2 Mg alloy, wt%

Cu	Mg	Si	Fe	Mn	Ni	Pb	Sn	Ti	Zn	Al
4.52	1.938	0.066	0.663	0.131	0.075	0.029	0.021	0.013	0.118	balance

Table 2. Chemical content of obtained fly ash, wt%

SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	Loss on ignition
58.41	30.40	8.44	2.75		1.3	1.53	1.0	1.98

Figure 4 signifies the XRD ie X-ray diffraction pattern of fly ash particles of bagasse after thermal processing, washing, and sieved state. that illustrates the various stages that exist in the fly ash particles of bagasse are mullite (3Al2O3.2SiO2), aluminum oxide (Al2O3), and silica (SiO2), and a small amount of hematite (Fe2O3).

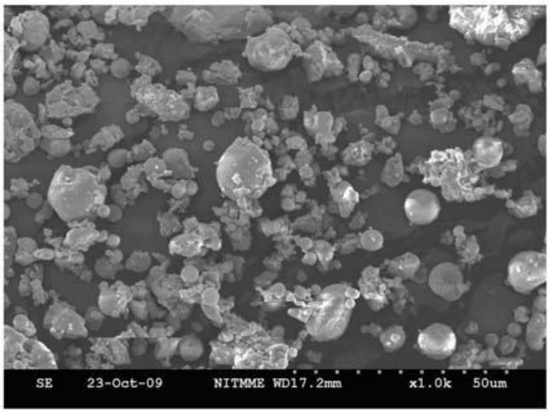

Figure 2. SEM of fly ash particulates of bagasse utilized in the manufacture of reinforcement of aluminum alloy with fly ash particulates of bagasse composites

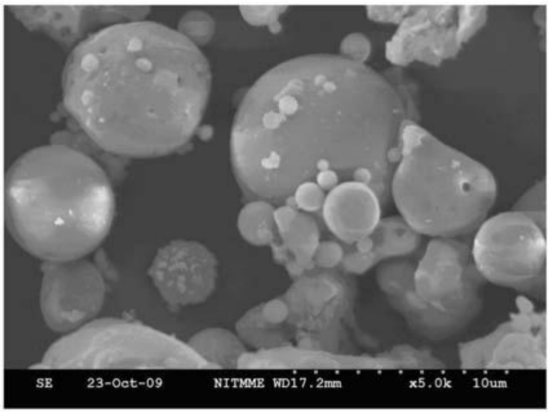

Figure 3. SEM of fly ash particulate of bagasse at larger magnification.

The method of stir casting was utilized to perform the synthesis of Al 6061 reinforced fly ash particulates of bagasse composites. Cylinder-shaped fingers of Al 6061 alloy have been placed into a graphite crucible and molten in the electric oven. After keeping the temperature at 770 C, a vortex was produced by utilizing the power agitator that consists of graphite. Though stirring was in development, the heated fly ash particles of bagasse for 2 h at 800 C were established. The melted metal was mixed under argon gas lid at 400 rpm; stirring was carried for approximately 5 m after adding fly ash particulates of bagasse to obtain an even distribution in molten. Small chunks of magnesium with 0.5 wt% have been put into the liquid metal in the process of stirring to strengthen the wetting of fly ash particulates of bagasse with molten. The homogenizing treatment has been performed for a day at 200 C in order to mitigate the internal stress and minimizing chemical heterogeneity, that maybe appear in the casting alloys.

The method of polishing has been utilized to prepare samples for the observations of metallography. Keller's reagent with the synthesis of H2O ¼ 95 cc, HNO3 ¼ 2.5 cc, HCL ¼ 1.5 cc, and HF ¼ 1.0 cc, has been utilized as etching reagent and the specimens have been subjected to 5 seconds of etching. Morphology changes detected in the composite materials and fly ash particulates of bagasse has been evaluated by utilizing SEM with EDAX energy dispersive X-ray spectroscopy (EDS). Leco Vickers hardness tester was utilized to evaluate the hardness of the composite materials and alloy and composites at 2 kg of applied load for 15 S. Medium of ten measurements was measured for every single hardness level.

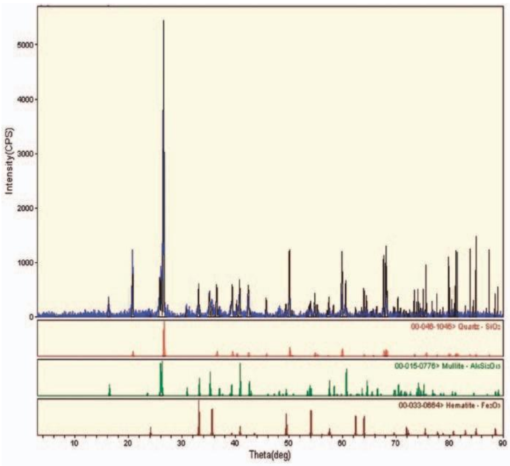

Figure 4. X-ray diffractogram of fly ash particulates of bagasse utilized in the fabrication of reinforcement of aluminum alloy with fly ash particulates of bagasse composites.

B. Porosity and Density tests

The density of raw fly ash particles of bagasse utilized in producing the composite materials was determined. Initially, a measurement flask was filled with 100 ml of purified water. It was positioned into a bell jar and evacuated among 86 kpa and 96 kPa of pressure till the bubbling in the water get stops to remove the voids. The flask was then withdrawn and filled with 100 ml of purified water. The full mass of the water filled flask was then recorded as WT2.

A flask is filled with 50 gms fly ash particulates of bagasse (WT1). The 100 ml purified water is poured into the flask ensures that the complete specimen is submerged. Then position these arrangements below a bell jar and evacuated among 86 kPa and 96 kPa of pressure until the bubbling stops in specimens. It has been removed and filled with 100 ml of purified water. The full mass of the flask with specimens and purified water was subsequently documented as (WT3). The intensity of the fly ash particulates of bagasse was then computed by using

The intensity of fly ash

$$= WT_1/(WT_2 - (WT_3 - WT_1))$$

The method of Archimedes drainage was utilized to measure the density of the composite materials and alloy by using

$$\rho_{MMC} = (m)/((m - m_1) \times \rho_{H_2O})$$

where m_1 is the weight of the identical specimen in purified water, m is the weight of the sample in air, and ρ_{MMC} is the intensity of the reinforcement of Al 6061 with fly as particulates of bagasse , and the intensity of the purified water (ρ_{H_2O}) is 0.998 g/cm^3 at 20 C.

As per the mixture rule, the hypothetical computations of density have also been utilized to define the concentrations of the composites. This was attained by using the equation

$$\rho_c = V_r \rho_r + (1 - V_r)\rho_m$$

where ρ_m is the intensity of the plain Al 6061 alloy, ρ_r is the density of fly ash particles of bagasse, Vr is the mass ratio of fly ash particles of bagasse, and ρ_c is the intensity of the composite. The porousness of the testing substance was computed by using

$$\text{Porosity}(\%) = (1 - (\text{measured density}/\text{calculated density})) \times 100.$$

Figure 5. Cylinder-shaped specimens utilized for upset tests before deformity.

Figure 6. Cylinder-shaped specimens that that displays after deformity.

C. Compression tests

The cylindrical samples were utilized to perform compressive of Al 6061 alloy and reinforcement of Al alloy with 5 wt% to 25 wt % of fly ash particulates of bagasse composites. These cylinder-shaped samples of standard sizes have been prepared by utilizing traditional machining processes of drilling, facing and transforming. The edges of the samples were blunted in order to reduce collapsible. Coaxial v- grooves of 0.5 mm in depth have been performed on flat surfaces to have reduced friction among die and workpiece at the time of the compression process. Reference samples have been compressed with the positioning among the platens which is flat at 0.5 mm/min of a constant velocity of crosshead in the dry state by utilizing UTM. The lower friction was attained by producing smooth finishing by utilizing cold work die steel.

Figures 5 and 6 demonstrate cylinder-shaped models prior to and after deformities, respectively. Web-based plotting of load and displacement was carried out on a continuous basis using a DAS ie data acquisition system.

D. Corrosive tests

The method of potentiodynamic was utilized to perform the experimentation on the resistance to corrosion through the electrochemical analysis on Al 6061 alloy and reinforcement of Al alloy with 5 wt% to 25 wt % of fly ash particulates of bagasse composite materials. The measurements of potentiodynamic have been produced in the disintegrating media of a carbonated solution of 3.5 wt% of sodium chloride and 4 to 5 pellets of caustic potash (KOH) aqueous solution which is 3g to 4g in weight and whose value of pH is 10.0 at 25 C. Carbon electrode and SCE ie Saturated calomel electrode have been utilized as an auxiliary electrodes and reference respectively. According to the ASTM G5-94 standard, polarization testing has been performed by utilizing a system of ACM Instruments Gill which is made in the UK and well-connected to a personal computer and is monitored by commercial computer software. The specimen of the cylinder was cut into 10 mm of height and16 mm of diameter from the composite castings and alloy. Specimens were mechanically refined by SiC as abrasive media to obtain the finishing of the mirror and completely washed away by purified water and when it is wet, it was positioned in the measuring vessel. The potential scan has been performed at 0.166 mV s^{-1} with the original possibilities of 0.25 V (OC) SCE to the final pitting possibilities. Specimens that undergo experimentation contains a 1 cm^2 of the active area of the surface. The potential in which the current has risen significantly was seen as critical pitting resistance to corrosive E_{pit}. Before beginning experimentation, the value of E_{corr} has been measured for 30 min. Samples demonstrating comparatively more passive potential (or lower negative potentials) were thought to have an improved pitting resistance to corrosive. Specimens have been removed and carefully washed with purified water and sun-dried. The optical microscope was utilized to perform the analysis of metallography.

III. RESULTS AND DISCUSSION

A. Microstructure of reinforcement of Al 6061 with fly ash particulates of bagasse composites

Figure 7 illustrates the optical micro-structures of the Al 6061 alloy. These alloys are hypoeutectic alloy and is comprised of a gentle aluminum strong solution in the form of a matrix (a) and tough CuMgAl2 in the form of reinforcement. Consequently, the microstructure is comprised of white (a) basic particles and darker eutectoid (a þ CuMgAl2).

Figure 8 demonstrates the optical micro-structure of reinforcement of Al 6061 alloy with 15 wt% of fly ash particulates of bagasse composite. It showed the availability of fly ash particulates of bagasse in the Al 6061 alloy and confirms that there is consistent spreading of fly ash particulates of bagasse in the parent matrix of Al-6061 alloy.

Figures 9 and 10 demonstrate the SEM micrograph of 15 wt% of fly ash particulates of bagasse composite. Figure 9 makes it clear that there were no gaps and breaks in composite material and Figure 10 makes it clear that there is good interfacial adhesion among the reinforcement of Al 6061 with fly ash particulates of bagasse composites.

Figure 7. Optical microscopic structure of as-cast Al 6061 alloy, at 200 (scale: 100 mm) with etchant: Keller's reagent.

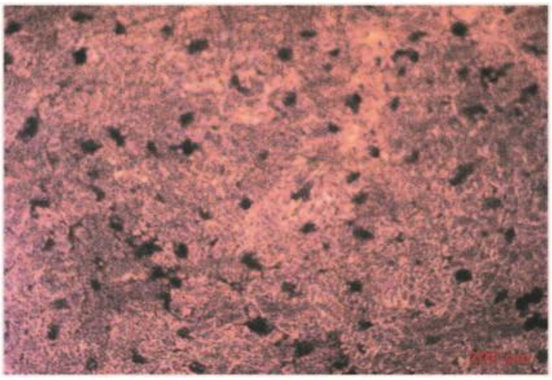

Figure 8. Optical microscopic structures of as-cast Al 6061-15% (by wt) fly ash particulates of bagasse, at 100 (Scale: 200 mm) with etchant: Keller's reagent.

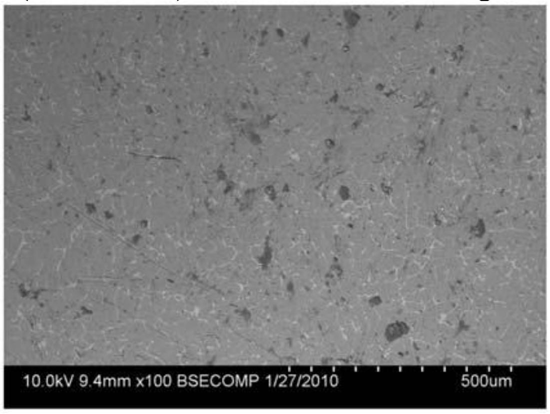

Figure 9. SEM of Al 6061 alloy–15% fly ash particulates of bagasse composite

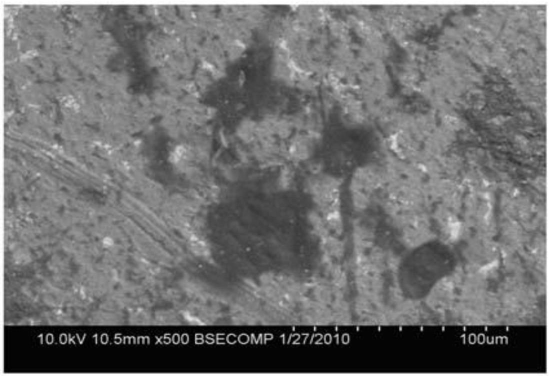

Figure 10. SEM for a closer view of interface among the matrix and fly ash particulates of bagasse

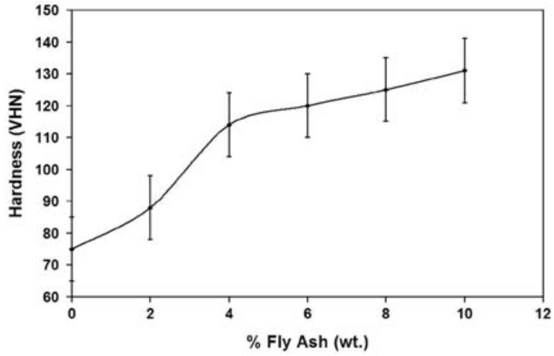

Figure 11. Comparison graphs of hardness for Al 6061 alloy and reinforcement of Al 6061 with fly ash particulates of bagasse composites

B. Mechanical characteristics of reinforcement of Al 6061 with fly ash particulates of bagasse composites

Figure 11 demonstrates the hardness of the Al 6061 alloy and reinforcement of Al 6061 with fly ash particulates of bagasse composites. The improvement in the number of fly ash particulates of bagasse improves the hardness of the composite. Such an expansion was detected among 75 VHN for Al 6061 alloy and 131 VHN of reinforcement of Al 6061 with 20 wt% of fly ash particulates of bagasse composite materials. This might be because of the availability of fly ash particulate matter of bagasse that consists of the most part of aluminum oxide and silica that are naturally difficult.

The intensity of the fly ash particulates of bagasse composites were discovered to be 2.42 g/cm3. Table 3 demonstrates a hypothetical and the calculated density of Al 6061 alloy and reinforcement of Al 6061 with fly ash particulates of bagasse composites in conjunction with the % porosity in their respective composite materials and alloy. From table 3 it was detected that the improvement in the % of fly ash particulate matter of bagasse decreases the intensity of the composite materials. The intensity of composite was reduced to 2.422 g/cm3 by adding 20% of fly ash particulates of bagasse, in comparison to the intensity of the alloy 2.680 g/cm3. The calculated density was smaller in comparison to the density which is acquired from hypothetical computations. The magnitude of the variance is improving by enhancing the content of fly ash particulates of bagasse. This may be due to an improvement in the porous with the content of fly ash particulates of bagasse as revealed in Table 3.

The curves of load and displacement demonstrate the characteristics of compression of synthetized reinforcement of Al 6061 with fly ash particulates of bagasse composites. Figure 12(a) indicates the load and displacements curves for Al 6061 alloy and composite materials in the compressive testing.

Figure 12(b) demonstrates the impact of the content of fly ash particles of bagasse on the compression strength of Al 6061 alloy.

Figure 13 demonstrates the stress and strain curves of Al 6061 alloy and reinforcement of Al 6061 with fly ash particulates of bagasse composites. The improvement in the displacement of both composite and alloy improves the requirement of load requirement.

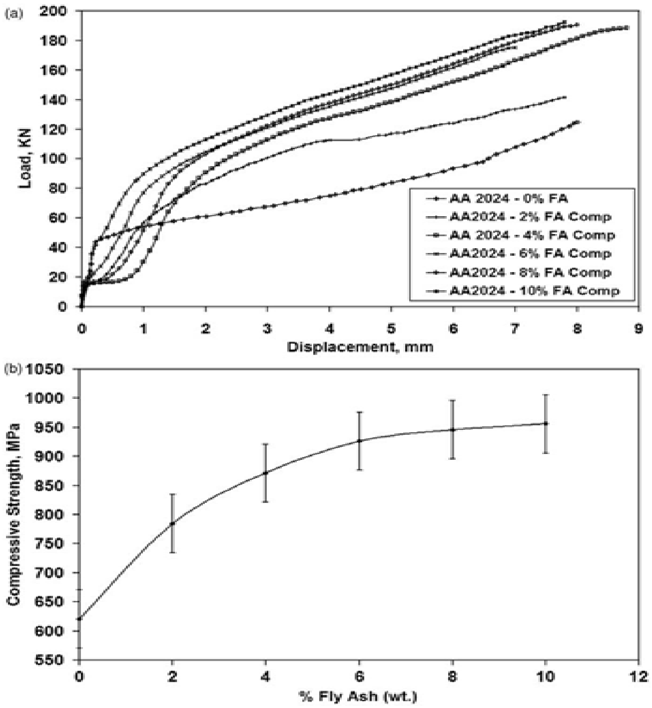

Figure 12. (a) Load and displacement curves for Al 6061 alloy and reinforcement of Al 6061 with fly ash particulates of bagasse composite materials. (b) The impact of the fly ash content at the compression strength of Al 6061 alloy

Table 3. Hypothetical and measured intensities of Al 6061 alloy and Al 6061–fly ash particulates of Bagasse composites in conjunction with the % voids that are present in the appropriate composite materials and alloy

		Density (g/cm^3)		
S. No	Specimen	Theoretical	Measured	%
1	Al 6061 alloy	2.68	2.68	0
2	Al 6061 alloy–5 wt% of fly ash composite	2.6748	2.61	2.42
3	Al 6061 alloy–10 wt% of fly ash composite	2.6696	2.57	3.74
4	Al 6061 alloy–15 wt% of fly ash composite	2.6644	2.51	5.80
5	Al 6061 alloy–20 w% of fly ash composite	2.6592	2.46	7.50
6	Al 6061 alloy–25 wt% of fly ash composite	2.654	2.42	8.75

From figure 12(b), it was detected that the composite materials illustrate greater load in comparison to the plain alloy and this results in the improvement in the compression strength when there is an improvement in the quantity of fly ash particulates of bagasse composite materials. The similar features were detected in figure 13. This shows that when adding fly ash particulates of bagasse there is an improvement in the composite's strength. Due to reinforcing effects that had taken place in the reinforcement of particles with composite material, there is an improvement in the strength of the MMC when adding solid ceramic particulate matter. Due to these effects, there is a transfer of stress among matrix and particles, the interaction among the separate dislocations and particles. Such impacts will contain a particle size reinforcement mechanism because of a decrease in compound matrix particle size, and the production of a higher density of dislocation in the array of the composite. Consequently, there is a difference in growth in heat among the particulate matter and metal matrix.

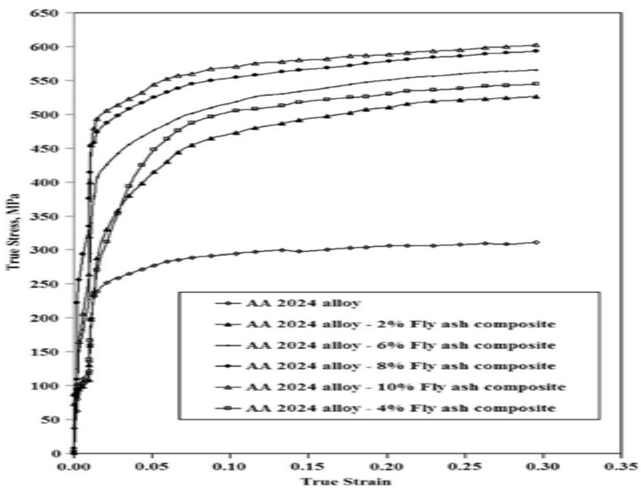

Figure 13. stress against strain curves for Al 6061 alloy and reinforcement of Al 6061 with fly ash particulates of bagasse composites

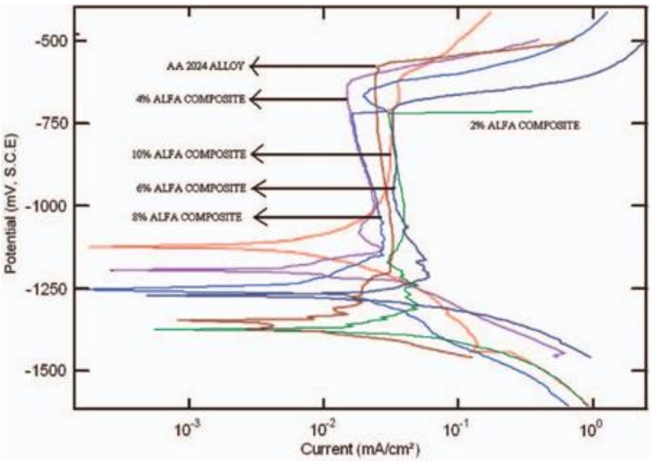

Figure 14. Potential and dynamic polarized curves of the Al 6061 alloy and Al 6061 alloy–fly ash particles of bagasse composites (5 wt%–25 wt% fly ash).

C. Pitting corrosion

The passive layer was disordered by corrosive environment components on the heterogeneous nature of metals. This disorder leads to pitting corrosion which is displayed primarily on metal and metal alloys in the passive state. The intermetallic stages in the structure were released by adding alloys and reinforcing components to the matrix which causes the formation of galvanizing pairs that are beneficial to corrosion. The infiltration of liquid metal was utilized to fabricate the MMC by using Al-Cu alloys. This results in the formation of intermetallic like $CuAl_2$ and improves the mechanical characteristics of the alloy and function as local cathodes or anodes, that induce high sensitivity to localize the kinds of corrosion such as an intergranular attack, pitting, and so on. Additionally, the factors like porosity, segregation of alloying components to the interface among the matrix and reinforcement, the availability of interfacial reaction among product, high displacement densities all over the reinforcement stage, voids at the interface among the matrix and reinforcement and conductance of the reinforced materials impacts the corrosion of the composite materials.[25,26]

The analysis of electrochemical and anodic polarized curves has been utilized to attain the pitting potential (Epit) and corrosion potential (Ecorr) which represents the characteristics of corrosion. Figure 14 signifies the polarized curves of the Al 6061 alloy and the reinforcement of Al 6061 with fly ash particulates of bagasse composites in 3.5 wt% of the water-based sodium chloride solution. Table 4 lists the values of the possibilities of E, Epit and E_{corr}. The E is a quantity of the breadth of the passive area on the polarized curve and gives an idea of sensitivity to the pitting.

Based on the findings of Fang et al. the MMCs and the polarized curves for monolithic Al have a similar form, but differ in the passive density of current and potential in the corrosive effects. Every Single curve demonstrates a passive area. Steady passive film existing at possibilities in corrosive effects because there is no passive/active peak has been detected. The active potential in corrosive effects and a peak passive density of current was attained by blending a higher proportion by volume of reinforced materials with MMC.

Figure 14 demonstrates the nature of the potential and dynamical polarized curves. These curves clearly signify that the passivation has occurred in the composite materials and the alloy. The structure of potential and dynamic curves of composite materials and alloy demonstrates a similar performance.

The 1347.4 mV and 1124.1mV of E_{corr} and 576.75 mV and 625.79 mV of Epit was attained for the Al 6061 alloy and the reinforcement of Al 6061 alloy with 10 wt% of fly ash particulates of composite respectively; indicating that the composite is much more active (a greater potential) in comparison to alloy (inferior potential). The 770.65 and 498.31 mV of values of E was attained for Al 6061 alloy and the reinforcement of Al 6061 alloy with 20 wt% of fly ash particulates of composite respectively. The angle of the straight-line portions of the anode curves regarding the x-axis located above the point of E_{pit}, along with a sudden improvement in the density of the current, shows the rapid growth in corroded pits.

Table 4. Electrochemical data of AL 6061 alloy and AL 6061 alloy–fly ash particles of bagasse composites (5 wt%–25 wt% fly ash) from the corrosive testing

Material	E_{corr} (mV)	E_{pit} (mV)	E %
Al 1100 alloy	1347.4	576.75	770.65
Al 1100 alloy–5wt% fly ash composite	1377.2	719.69	657.51
Al 1100 alloy–10wt% fly ash composite	1193.7	621.52	572.18
Al 1100 alloy–15wt% fly ash composite	1273.4	703.26	570.14
Al 1100 alloy–20wt% fly ash composite	1251.8	722.1	529.70
Al 1100 alloy–25% fly ash composite	1124.1	625.79	498.31

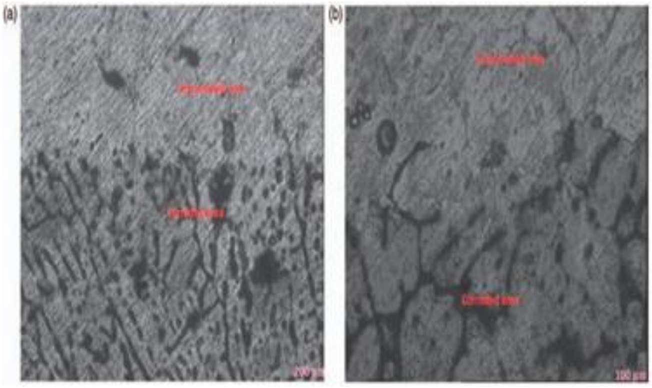

Figure 15. Optical microscopic structure of Al 6061 alloy differing among the corrosive and uncorrosive zones: (a) at 100; (b) at 200; etchant: Keller's reagent

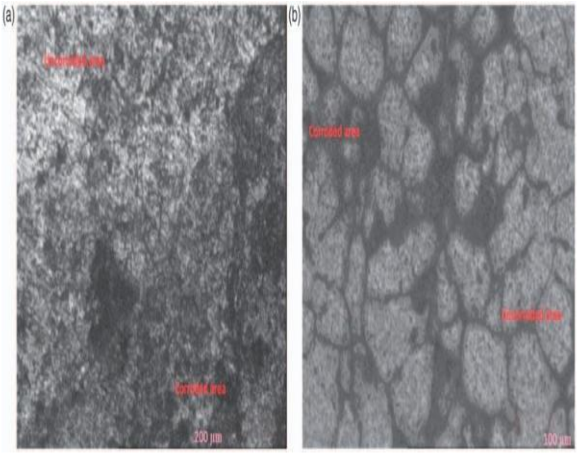

Figure 16. (a) The optical micro-structure of Al 6061 alloy reinforced with 20% of fly ash particles of bagasse composite differing among the corrosive and uncorrosive zones at 100 and (b) micro-structure of composite indicating the corrosive zone at 200; etchant: Keller's reagent.

Figures 15 and 16 demonstrate the optical micrographs of Al 6061 alloy and reinforcement of Al 6061 alloy with 20 wt% of fly ash particulate matter of bagasse composite after corrosion respectively. For the alloy, Figure 15(a) and (b) demonstrates the occurrence of pitting along its grain boundaries and the interface among a sturdy solution and y (CuMgAl2). Conversely, for the reinforcement of aluminum with fly ash particles of bagasse composite, Figure 16(a) and (b) demonstrates the concentration of pitting along the grain boundary zone and the interface among a sturdy solution and y ($CuMgAl_2$) and among the stages of matrix and reinforcement.

This microstructure of alloy and reinforcement of aluminum with fly ash particulates of bagasse demonstrates improved pitting corrosion in the composite. There is segregation and the intermetallic precipitants have occurred on the interface during the formation process of MMC. This will prevent the formation of a continual resistance-type layer of aluminum reinforced particulates all over the surface. The availability of fly ash particulates of bagasse functions as the locations in order to launch pits. Particularly, the interfaces among the matrix and reinforcement function as initiators to pit, in which the surface of the matrix is broken. Subsequently, the pits are initiated at flaws, and interface of reinforcement and matrix is a flaw, metallic aluminum is corroded by the carbonated NaCl solution. The concentrated aggressive anions of chloride have been improved in the process of corrosion. Due to impeding resupply of the solution, there is an occurrence of Hþ ions among the pores and pits. The stabilization of Hþ ions will turn into difficult while increasing the concentrated chloride. Consequently, the dissolution of metal was stimulated in the pits. Fast dissolution of aluminum takes place within a pit, while there is a decrease in the oxygen on neighboring surfaces. Fast dissolution of aluminum within pits has a tendency to produce an additional positive charge in those regions, which resulted in the migration of chlorine ions in order to keep electroneutrality. Consequently, there would be higher concentrations of hydrogen ions in pits because of hydrolysis, and this method is accelerating through time.

IV.CONCLUSION

In this study, stir casting technology was utilized to prepare the aluminum reinforced fly ash particulates of bagasse. The homogeneous distribution of fly ash particulate of bagasse has occurred in the matrix stage and there is a good adhesion that takes place among the matrix and reinforcement. In this study, the aluminum is utilized in the form of a matrix and the fly ash particulate matter is utilized in the form of reinforcement. The mechanical characteristics were improved by adding fly ash particulate matter.

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