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FABRICATION AND MECHANICAL PROPERTIES OF AL5457 AND CORN COB ASH

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Abstract:- The automobile industry needs metals or composites with properties such as lightweight, and an uncompromising strength & specific stiffness with higher wear-resistant and coefficient of thermal expansion. Various other areas like aerospace engineering need far more traditional material characteristics to maintain severe environmental conditions. The above-said qualities led to the use of Aluminium Matrix Composites (AMCs) which are a specific type of MMCs that are replacing conventional engineering materials in various engineering fields. In the current examination, Aluminium based metal grid is reinforced with 1%, 2%, 3%, 4%, weight percentage of Corn Cob Ash nanoparticles, powder metallurgy technique is used to fabricate to achieve the desired composites

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I INTRODUCTION

1.1METAL MATRIX COMPOSITES (MMCS)

MMCs are inventions during early60‟s, composed of baCCAally a metallic Matrix reinforced with generally ceramics. MMCs exhibit a combination of metallic (toughness and formability) and ceramic (high strength and hardness with load bearing capacity) properties. These are tailor made materials to suit to particular requirements like reduction in density or improvement in stiffness, yield strength, ultimate tensile strength, which can be translated to improved specific properties. Depending on the application, a wide range of composites with different combinations of matrix materials and diaper solids are being produced. Table1.1 give glimpse of the type so matrices and disappear solids used for various applications (2)

It is a material consisting of a metallic matrix combined with a ceramic (oxides, carbides) or metallic (lead, tungsten, molybdenum) dispersed phase.

Aluminum Matrix Composites (AMC)

Magnesium Matrix Composite

Titanium Matrix Composite

Copper Matrix Composites\

1.2PROCESSING OF COMPOSITES

Depending upon the application in service, a variety of composites with different combinations of matrix materials and reinforcements are being produced through different fabrication methods, Table1.2.briefs various systems and processing routes Proper mixing method scan minimize the agglomeration of the reinforcement and settling of the particles can minimized by the quick pouring and employing chill casting technique. Secondary processing like rolling, forging, and extrusion gives better distribution of reinforcements.

Though there are many applications with MMCs; fabrication, secondary processing compatibility between the matrix and reinforcement and characterization are still the major problems in the manufacturing of these composites. B4c in various forms has been the most widely used reinforcement, in aluminum alloy. Other reinforcements are A12O3, SIO2, TIC, TIO2, ZRO2, TIB2, borate whiskers, quartz, diamond, graphite, fly ash etc. Among the various metal matrix composites (MMC), aluminum alloy metal matrix composites have successfully demonstrated their potential for even high volume applications.

1.3PROCESS VARIABLES IN MILLING:

To achieve the adequate product phase, micro structure, particle size and/or properties, the optimization of a number of variables involved during mechanical alloying has to be considered. The following variables have an important effect in the final product after ball milling.

1.4.1 MILLING CONTAINER (Vial, Jar, Vessel, and Bowl):

Hardened steel, tempered steel, Stainless steel, Tungsten carbide are most common types of materials used for the grinding vessels. The material of the alcantara the composition of the material to be mechanically milled because of the high impact and wear. The internal design of the container is important to avoid dead zones, or where the composition does not get milled; flat ended or round ended jars are used

1.4.2 MILLING ATMOSPHERE:

To avoid contamination and to minimize oxidation of the milled powder, mechanical alloying can be conducted under vacuum or under an inert atmosphere (Nitrogen/Argon). The atmosphere influence the kinetics of alloying behavior of transformation and new compound formations

1.4.3 MILLING SPEED:

Milling intensity or milling energy as terms used to describe the velocity of the milling process. The faster rotation of the milling the higher input energy into the material being processed i.e., higher kinetic energy of the grinding medium imparted to the composition upon the ball milling.

Where mass and the relative velocity of the gravity medium. Increasing the milling speed results in excessive wear of the milling tools leads to the contamination of the material composition. Additionally the temperature jar may reach a high value accelerating the transformation process by forming supersaturated solid solutions are metal stable phases. When a critical speed occurs, the balls are pinned to the inner walls of the jar and do not fall down to exert any impact force, so the maximal speed should be below the critical value to ensure the maximal collision energy. The high speed can promote higher degree of plastic deformation and cold welding so the material gets stuck to the inner walls of the container. The milling intensity or speed can be described as a function of the ball to powder weight ratio (BPR) = (BM/PM), the velocity and frequency of the balls as follows.

I=MV (f/p) M

Where b M is the mass of the balls

P M is the mass of the material to be milled in the jar matrix.

V is the maximum velocity of the balls F is the impact frequency

1.4.4 GRINDING MEDIUM:

The parameter affected directly the efficiency of the alloying. The impact force on the powder should be high enough to promote mixing and mechanical alloying, and is affected by the size, density and material of the balls. High density of the grinding medium

Represents high kinetic energy to be transferred to the powder. Materials commonly used are hardened steel hardened chromium steel, stain less steel, and WC-Co. Small ball sizes (Soft Milling) promote intense frictional action benefits information of solid solutions and amorphous phases in the final constitution. Also the attained grain size is final with smaller balls. Large ball sizes (Hard milling) result in only the mixing of components and produce high temperature which leads to the decomposition of detestable solid solutions. To randomize the motion of the balls and produces hearing forces a combination of small and large balls can be used.

1.4.5 EXTENT OF CONTAINER FILLING:

To permit the moment and energy of impact force exerted on balls and powder particles, enough free space in the jar is essential. A bout 50% of the vial is left empty.

1.4.6 BALL-TO-POWDER WEIGHT RATIO (BPR):

Sometimes BPR is referred as the charge ratio, an important variable that affects the time of process. It varies from a value as low as 1:1 to one as high as 100:1. Those ratios depend on special desired feature, crystalline sizes, particular face formation, micro hardness and other final results. The higher the BPR, shorter the milling times and faster the mechanical alloying. At a high BPR, the mean free path decreases, and the plastic deformation increases by increment in number of collisions per unit time; some or energy and temperature is transferred to the powder resulting in a faster alloying. Higher BPR can be obtained also without changing the number of balls but increase in the diameter of them or by using higher density of materials such as WC rather than steel. Lower ball to powder weight ratio results in longer times of processing to reach specific properties but increase the amount of material processed and its crystalline size.

1.4.7 MILLING TIME:

This is one of the most important parameters and is chosen to achieve at easy state between fracturing and cold welding of the materials in the container to facilitate the alloying. Times of process are short for higher BPR values and extended for low BPR values as explained previously.

1.5 EQUIPMENT FOR BALL MILLING

There are different machines available for mechanical alloying. These different their capacity, speed of operation, efficiency of milling and additional arrangement for cooling and heating among others.

1.6 HIGH ENERGY PLANETARY BALL MILL:

Specimens for X-Ray diffraction characterization were prepared by using high energy planetary ball mill (Retch, PM100, and Germany). The high energy planetary ball mill PM 100 plus varies and mixes soft, medium, hard to extremely hard, brittle and fibrous materials. It is used where vertex highest of fineness‟s required. Dry and wet grinding jars with a nominal volume of 12 to 500ml. The planetary ball mill was employed in the present research. This type of ball milling equipment is used to produce less that hundred grams of powder.

2.1MECHANICAL PROPERTIES OF AL 5457

Aluminium Matrix Components (AMC) The requirement for designing materials in the space of aviation and car businesses had prompted a quick advancement of metal lattice composites (MMC)/ Researchers are going to particulate-supported aluminium metal network parts (AMC) due to their generally minimal expense and isotropic properties. In AMC one constituent is aluminium/aluminium combination named as network stage. The other constituent is installed in this aluminium/aluminium compound framework and fills in as support. For the most part clay materials like CCA, Al2O3, B4C, and so forth are utilized support. The significant benefits of AMCs contrasted with unreinforced materials are, it gives more prominent strength, further developed firmness, decreased thickness (weight), further developed high temperature properties, further developed scraped spot and wear obstruction and upgraded and custom-made electrical execution, and so forth

2.2CCA (Corn Cob Ash): Corn Cob Ash (CCA) is a very hard clay which has superb warmth conductivity, oxidation strength and protection from mechanical disintegration. CCA is also a reasonable electrical conductor, so it can be used as a cathode material in aluminum smelting and can be shaped by electrical discharge machining.

Fig.1 powder CCA

3.EXPERIMENTAL WORK

3.1EXPERIMENTAL PROCEDURE AND EQUIPMENT:-

AL5457 POWDER CCA POWDER

Fig-2

Aluminum powder of 50µm size are mixed with CCA in above given table powders are prepared.

The mixture was carried out in pestle mortar to ensure uniform distribution of CCA and graphite with AL 5457.

Fig-3 Ball milling machine Fig-4 Powders after mixing

A ball plant, a kind of processor, is a barrel shaped gadget utilized in granulating (or blending) materials like minerals, synthetics, fired crude materials and paints. Ball plants turn around a flat pivot, to some degree loaded up with the material to be ground in addition to the pounding medium Various materials are utilized as media, including artistic balls, stone rocks and tempered steel balls. An inner falling impact diminishes the material to a fine powder. Mechanical ball factories can work consistently, took care of toward one side and released at the opposite end. Huge to medium-sized ball factories are precisely pivoted on their hub, however little ones typically comprise of a barrel shaped covered holder that sits on two drive shafts (pulleys and belts are utilized to communicate rotational movement). A stone tumbler capacities on a similar rule. Ball plants are likewise utilized in fireworks and the production of dark powder, yet can't be utilized in the planning of some pyrotechnic blends, for example, streak powder due to their affectability to affect. Excellent ball plants are conceivably costly and can granulate combination particles to as little as 5 nm, tremendously expanding surface region and response rates. Then, at that point the composite powder blends were then pass on compacted by pressure testing machine (CTM) by applying a heap of 60KN on a kick the bucket of 15mm measurement.

Fig-5 At working position

Fig-14 Compression testing machine

- The pellets are then inserted in muffle furnace and temperature is gradually in steps until the temperature raise to 600˚C and pellets were maintained at this temperature for 4 hours approximately. The muffle furnace is switched off and pellets are allowed to cool in the furnace itself for 48 hours.

Fig. 7INSIDE VIEW OF MUFFLEFURNACE

F ig-8 MUFFLE FURNACE

Fig-9 AFTER PILLETS

3.2 DISC POLISHING PROCESS:

Grinding ought to be finished utilizing distinctive Grit emery papers all together.

First fix the coarseness pounding emery paper on the left side Aluminium circle and granulate.

Before cleaning, clean the example with water.

Fix the cleaning material utilizing holding spring on the right side plate. Fix spring on the section in the circuit of the circle subsequent to covering the plate with cleaning fabric

The speed of the material cleaning ought to be under 600 rpM

Fig-10 Disc polishing process

Fig-11 Finishing Pillets

RESULTS AND DISCUSSION

4.1HARDNESS TEST

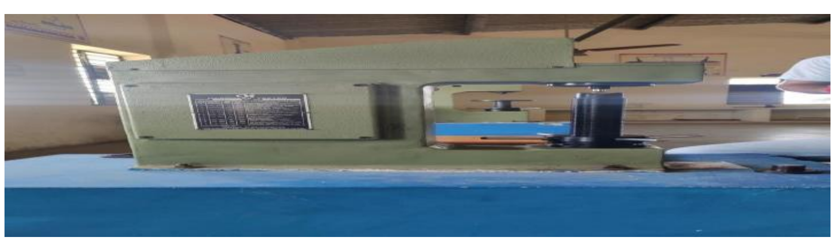
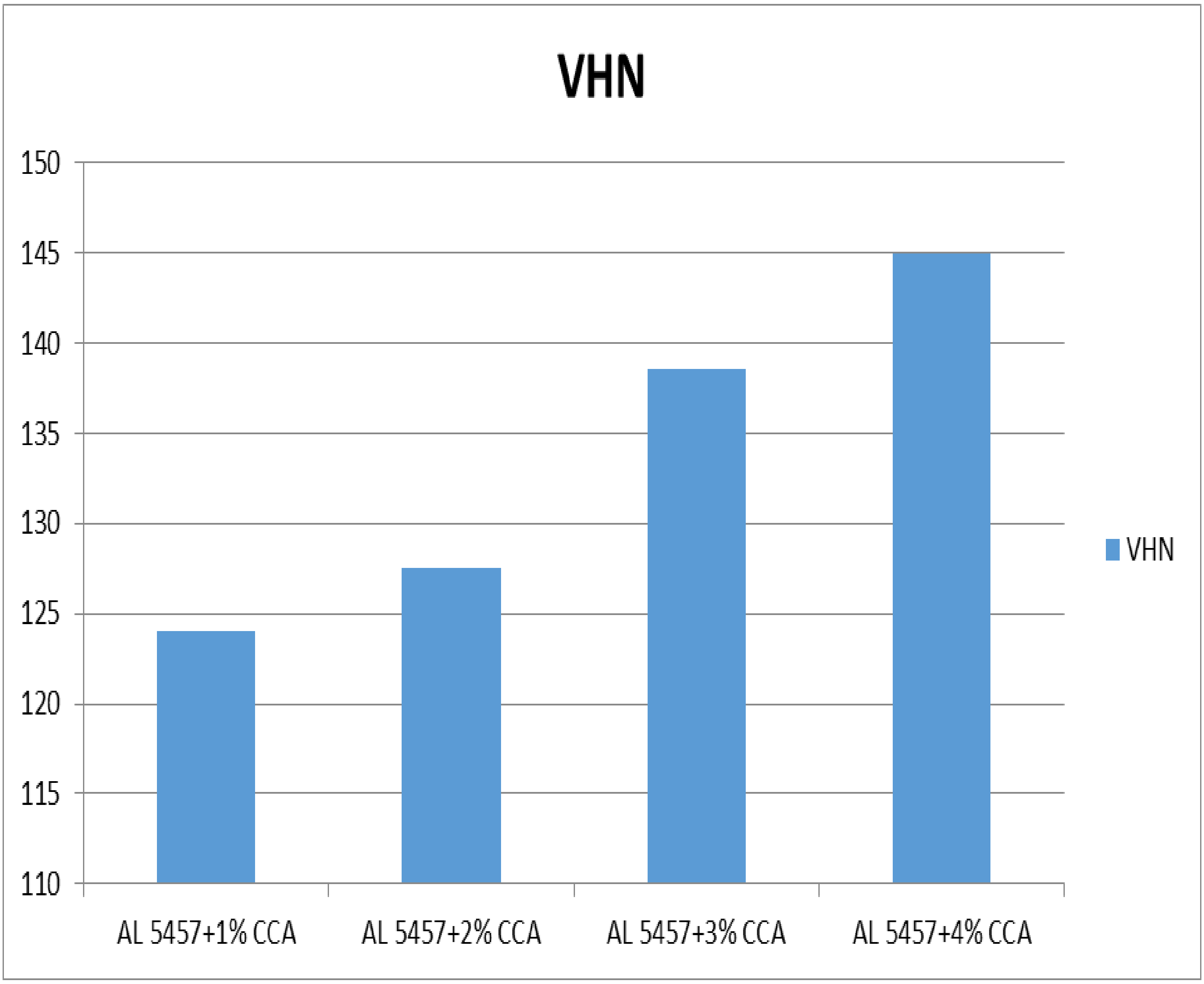


Fig-12 HARDNESS TEST

Hardness

Compositions	Trail 1			Trail 2			VHN
	D1	D2	VHN	D1	D2	VHN	
AL 5457+1% CCA	83	87	123	89	97	125	124
AL 5457+2% CCA	78	79	126	89	96	127	127.5
AL 5457+3% CCA	72	76	136	79	86	141	138.5
AL 5457+4% CCA	69	72	143	81	82	147	145

Table:1

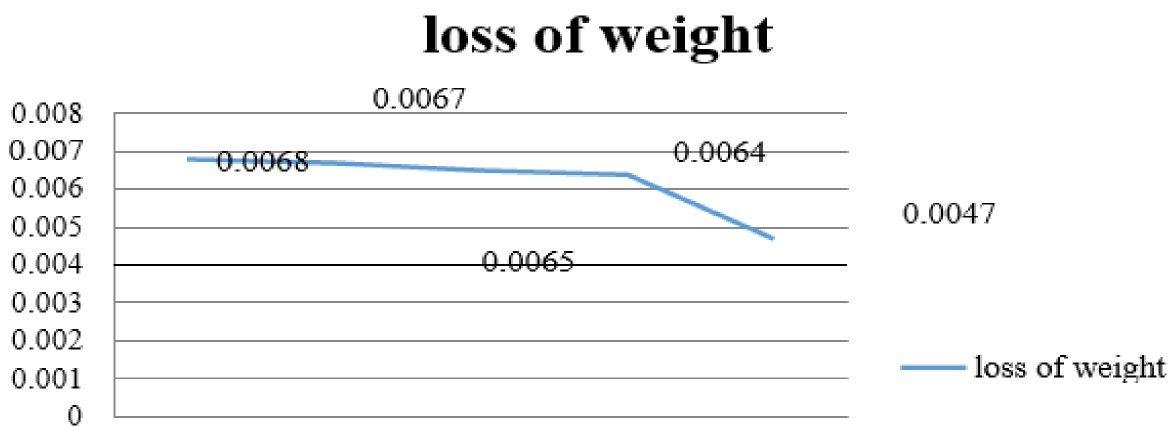


Graph-1

4.2 Wear

S.No	Material	Initial wt	Final wt	Loss of wt
1	AL 5457+1% CCA	11.949	11.9418	0.0072
2	AL 5457+2% CCA	11.968	11.9609	0.0071
3	AL 5457+3% CCA	11.468	11.4611	0.0069
4	AL 5457+4% CCA	11.548	11.5412	0.0068

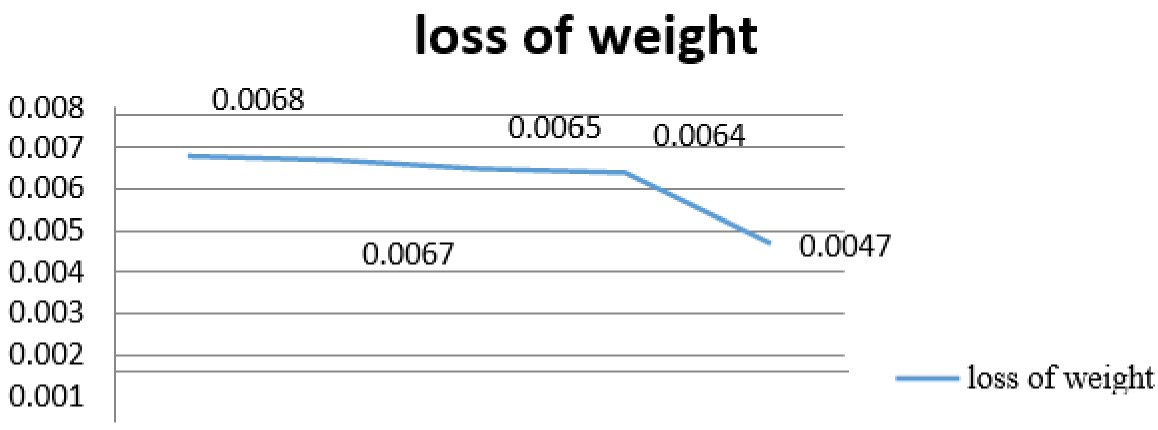
Table: 2Wear at 1kg load 200mts



Graph 2

S. no	Material	Initial wt	Final wt	Loss of wt
1	AL 5457+1% CCA	11.9418	11.9350	0.0068
2	AL 5457+2% CCA	11.9609	11.9542	0.0067
3	AL 5457+3% CCA	11.4611	11.4546	0.0065
4	AL 5457+4% CCA	11.5412	11.5348	0.0064

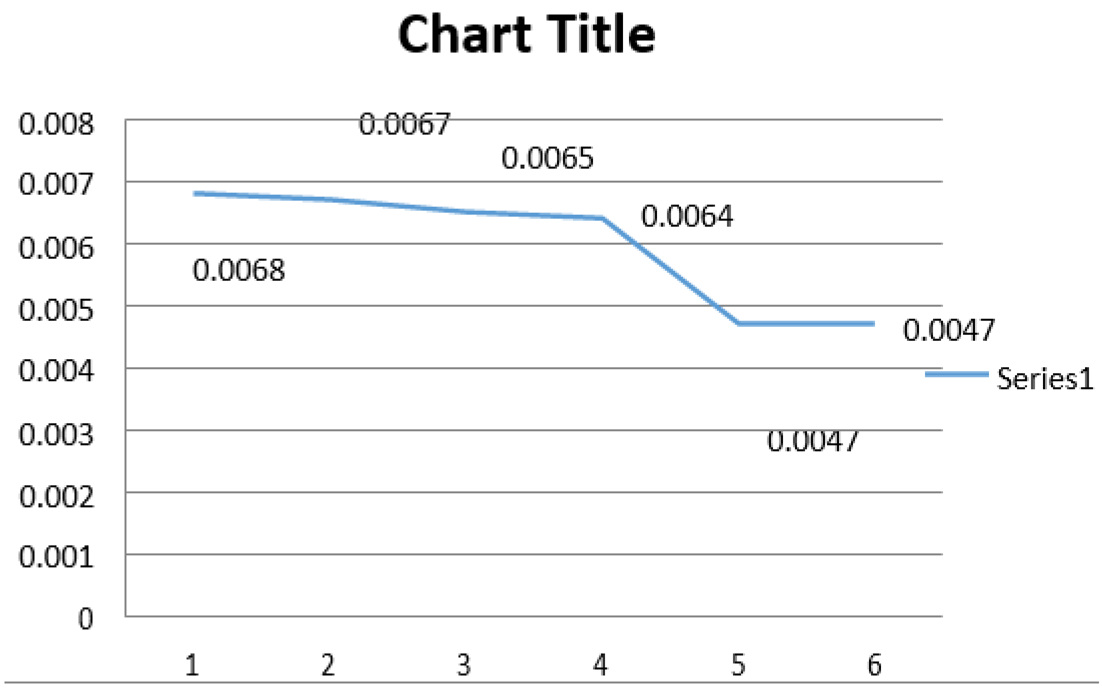
Table3- Wear at 1kg load 400mts



Graph 3

S. no	Material	Initial wt	Final wt	Loss of wt
1	AL 5457+1% CCA	11.9337	11.9204	0.0133
2	AL 5457+2% CCA	11.9530	11.9400	0.0130
3	AL 5457+3% CCA	11.4536	11.4409	0.0127
4	AL 5457+4% CCA	11.5339	11.5213	0.0126

Table-4 Wear at 1kg load 600 mts



Graph4

4.3 **corrosive**

Immersiontime (hrs)	Weight loss, gms			
	AL 5457+1% CCA	AL 5457+2% CCA	AL 5457+3% CCA	AL 5457+4% CCA
2	0.18	0.17	0.121	0.11
4	0.032	0.027	0.026	0.024
6	0.0017	0.014	0.009	0.007
8	0.02	0.018	0.01	0.008
10	0.034	0.03	0.026	0.024

Table 6Effect of corrosive media concentration on time (10% HCl)

Immersiontime (hrs)	Weight loss, gms			
	AL 5457+1% CCA	AL 5457+2% CCA	AL 5457+3% CCA	AL 5457+4% CCA
2	0.182	0.161	0.118	0.107
4	0.024	0.022	0.021	0.02
6	0.007	0.004	0.005	0.004
8	0.02	0.017	0.009	0.008
10	0.028	0.023	0.017	0.016

Table 7Effect of corrosive media concentration on time (20% HCl)

Immersiontime (hrs)	Weight loss, gms			
	AL 5457+1% CCA	AL 5457+2% CCA	AL 5457+3% CCA	AL 5457+4% CCA
2	0.193	0.14	0.143	0.132
4	0.071	0.065	0.049	0.0436
6	0.012	0.01	0.008	0.009
8	0.023	0.02	0.019	0.013
10	0.091	0.079	0.068	0.053

Table 8 Effect of corrosive media concentration on time (30% HCl)

5.CONCLUSION

•By using powder metallurgy technique hybrid composites were fabricated successfully.

•All the composites were exhibits higher hardness than base material.

•Hybrid composites the preference of graphite in hybrid composites will lose the strength because of soft and having much inability.

•Micro structure of all composites were shown.

•FESEM for the hybrid composites were shown.

•By using software based electro chemical weld tester system was used to carry out potential dynamic polarization tests conducted.

•All the composites were shown better corrosive resistive than the base material.

•All the hybrid composites were good corrosive resistive than non-hybrid composites because of AL5457 and CCA were forums a layer of protection to oxygen reaction.

5.1SCOPE OF THE FUTURE WORK:

There is an extremely wide degree for future researchers to investigate this space of exploration This work can be additionally stretched out to concentrate on different parts of such composites like utilization of other possible fillers for advancement of mixture composites also, assessment of their mechanical and disintegration conduct and the subsequent trial discoveries can be comparably examined

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