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An Enhancement of Mechanical Properties of Aluminium/Diamond Composite Using Stir Casting Process

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ABSTRACT: Aluminum based Matrix Composites (AMCs) possess tremendous potential for number of applications in addition to their present uses in different engineering fields. Since the initial research leading to the production of diamond composite materials, there have been several important developments leading to significant improvements in the properties of these super hard composite materials. Apart from the fact that diamonds, there some are the hardest and most wear-resistant materials commonly available, they have other mechanical properties that limit their industrial application. These include the low fracture toughness and low impact strength of diamond. The results of such studies should assist in the design of new, innovative diamond tools as well as leading to radical improvements in the productivity of cutting, drilling and sawing operations in the exploration, mining, civil construction and manufacturing industries.

KEYWORDS : Diamond composite, super hard materials, cutting brittle material, Raman, XRD, Minescence, Aluminium composites, Fly-ash, Stir casting.

I. INTRODUCTION

Aluminium matrix composites (MMCs) have developed in the last few years, in order to reduce the weight of components in structural applications and to improve their mechanical properties and physical properties. Metal matrix composites are a class of material with the ability to blend the properties of ceramics (high strength and high modulus) with those of metals or alloys (ductility and toughness) to produce significant improvements in the mechanical

performance of the composite Aluminium/Diamond has a merit properties of High Rigidity light weight, High strength to weight ratio, High Thermal conductivity, High impact components such as wings, Fuselage and Automobile components Such as Carboy, Frame and Chassis. Boron /Aluminium composites are have been in Aerospace structures. The fabrication methods to produced structural elements exist, some of them are making tubes and shell

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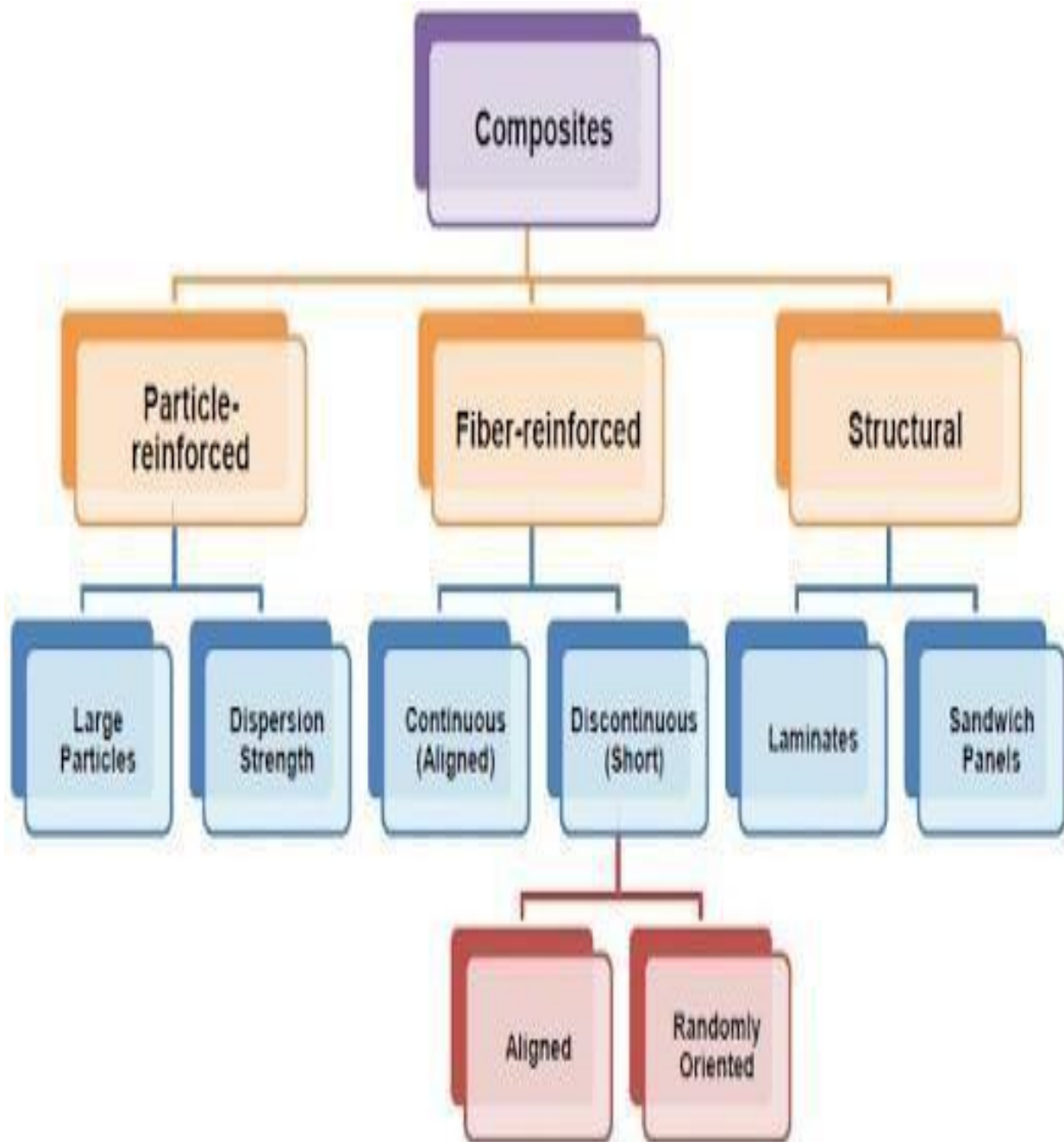
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II. CLASSIFICATION

The classification of composites are clearly viewed through the following flow chart.



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APPLICATIONS

1. It's used to space craft (Antenna structures, solar reflectors, satellite structures, radar and rocketengine)
2. It's used to Aircrafts (jet engine, turbine blades, turbine shafts, compressor blades, airfoil surface, fan blades, fly wheels, engine bay doors, rotor shaftin helicopters, helicopters and transmissionstricter)
3. It's used to miscellaneous (Bearings materials, pressure vessels, abrasive materials, electrical machineries, truss members, cutting tools, and electrical brushes)
4. It's used to automobiles (Engines, Bodies,and Piston, Cylinder, connecting rod, crankshafts, and bearingsmaterials).

III. EXPERIMENTAL

A ball mill is a type of grinder used to grind, blend and sometimes for mixing of materials for use in mineral dressing processes, paints, pyrotechnics, ceramics and selective laser sintering. It works on the principle of impact and attrition: size reduction is done by impact as the balls drop from near the top of the shell.

A ball mill consists of a hollow cylindrical shell rotating about its axis.The axis of the shell may be either horizontal or at a small angle to the horizontal. Itis partially.

FABRICATION PROCESS

1. STIR PROCESS

Stir processing expands the improvement of FSW (friction stir welding).FSW is build up in welding institute of the United Kingdom in 1991. FSP is a new thermo mechanical technique to achieve good performance with less production cost in a min. Time and it's also achieve better microstructure &mechanical properties in a single pass.

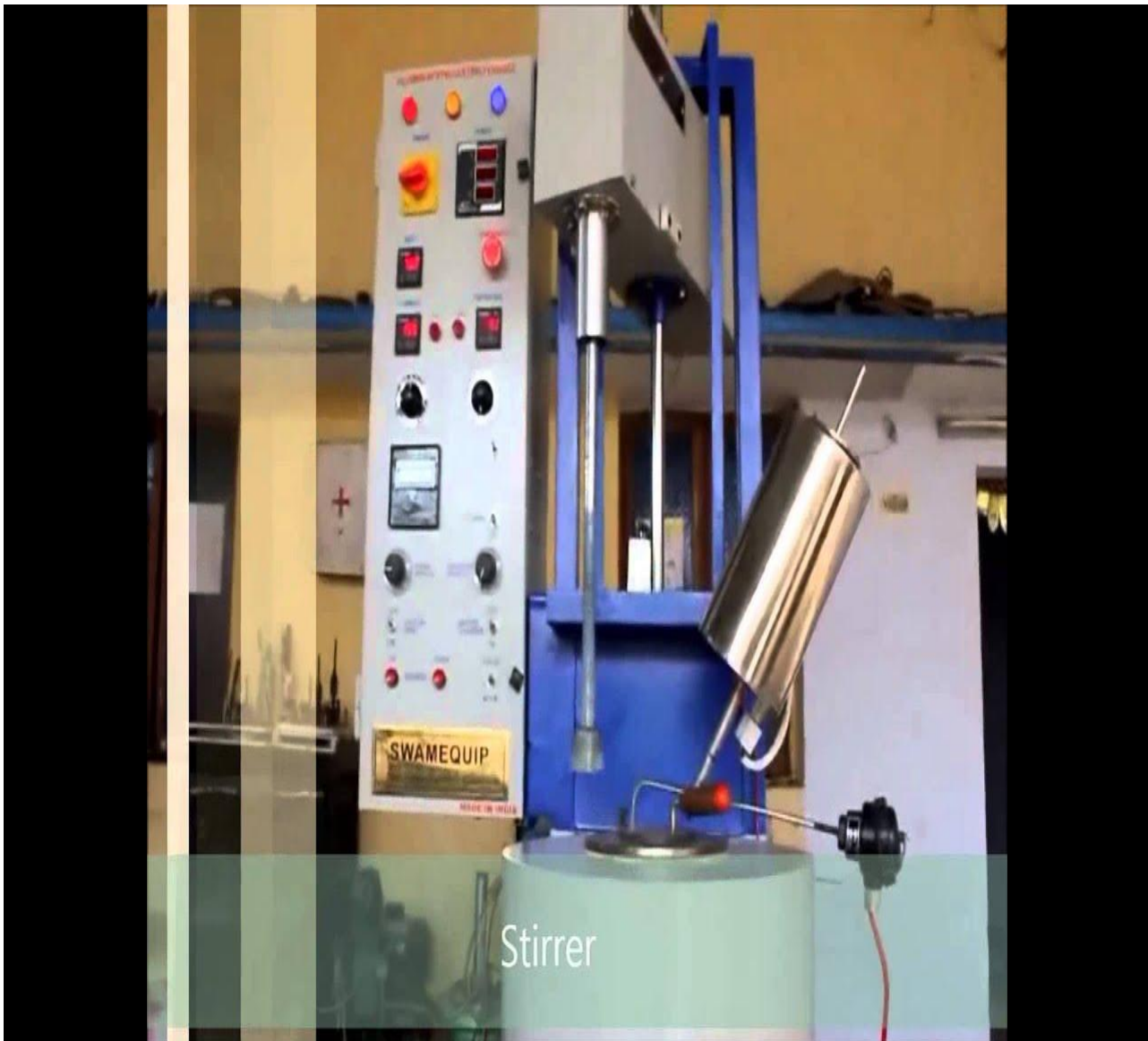
High strength to wear ratio and high ductility aluminum alloy is widely used in space industries, automobile companies, and, aircraft manufacturing and fabrication industries. The main disadvantage of aluminum from an engineering point of view is relatively low modulus of elasticity, about one –third of steel. Component made of aluminum defects three times as steel component at same

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IV. WORKING

The matrix material used for the current study was aluminium diamond alloy, having composition average values provided by the supplier (sargam metals ltd., india) .the aluminium diamond alloy has an excellent combination of mechanical properties in the cast condition. The matrix material was loaded in a graphite crucible and it was placed inside a top loaded resistance furnace at different temperature level (800). The aluminium reinforcement supplied by universal carborendum ltd, india) was preheated at 800°c for two hours before added in the matrix melt. The 98% by volume of preheated al powder was added in the liquid melt and the slurry was consciously stirred using a stirring. The four blade stirrer was designed in order to produce the adequate homogenous particle distribution throughout the matrix material. Four blades stirrer setup is s. The axial and radial flows are provided to avoid different stagnant zones in the

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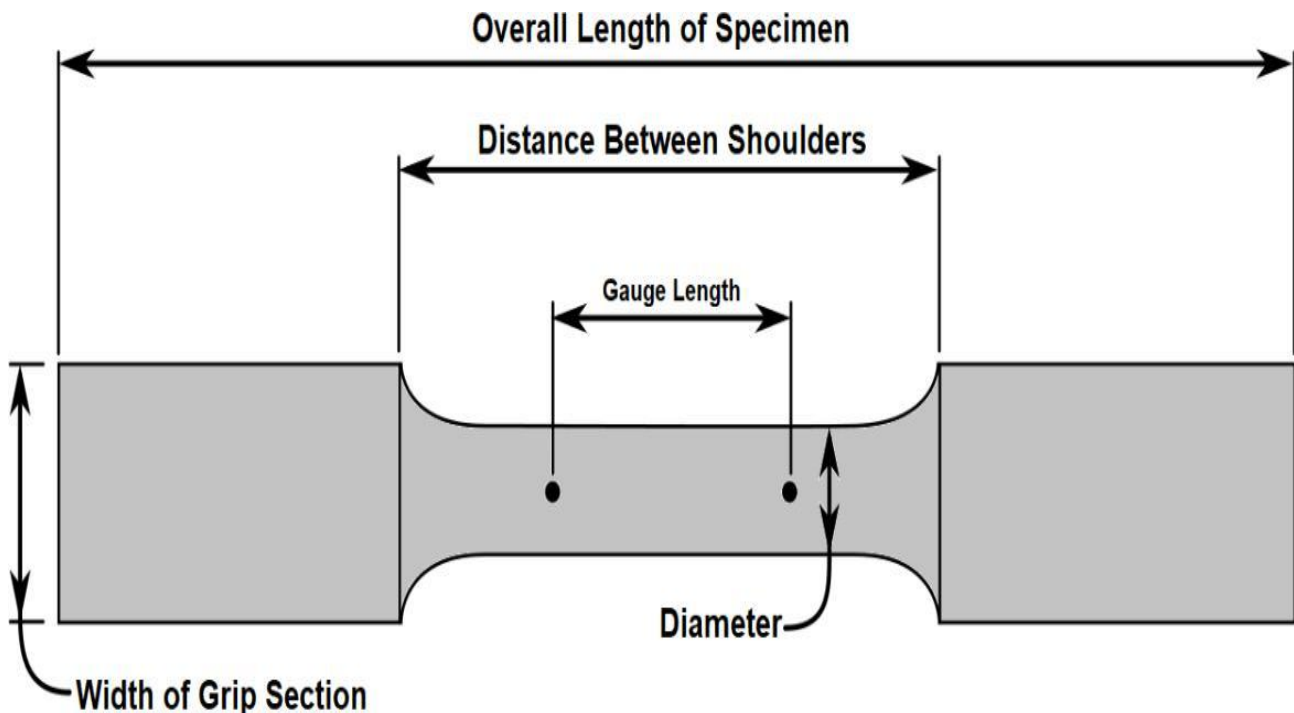
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liquid melt by stirrer. Stirring of the mixture is carried out at different holding time (10, 20, and 30 minutes) to achieve homogeneity of particulates. The stainless steel stirrer blade was coated with zirconia to avoid the reaction between stainless steel and al alloys at higher temperatures. The argon gas was supplied into the near the crucible during the stirring to avoid the formation of oxide layer on the surface of matrix melt. The stirring speed 450 rpm was maintained throughout work. The mixture is allowed to solidify in the preheated (300°C) steel die.

V. EXPERIMENTAL ANALYSIS

1. Tensile test
2. Compression test
3. Impact test
4. Flexural test

1. TENSILE TEST



Tensile testing also known as tension testing is a fundamental materials science and engineering test in which is subjected to a controller tension until failure. It's a destructive test process that provides information about the tensile strength yield strength and ductility of the metallic material.

The basic idea of the tensile test is to place a sample of material between two fixtures called "grips" which clamp the material. The material has known dimensions like length and cross-sectional area. We then begin to apply weight to the material gripped at one end while the other end is fixed. We keep increasing the weight while at the same time measuring the change in length of sample.

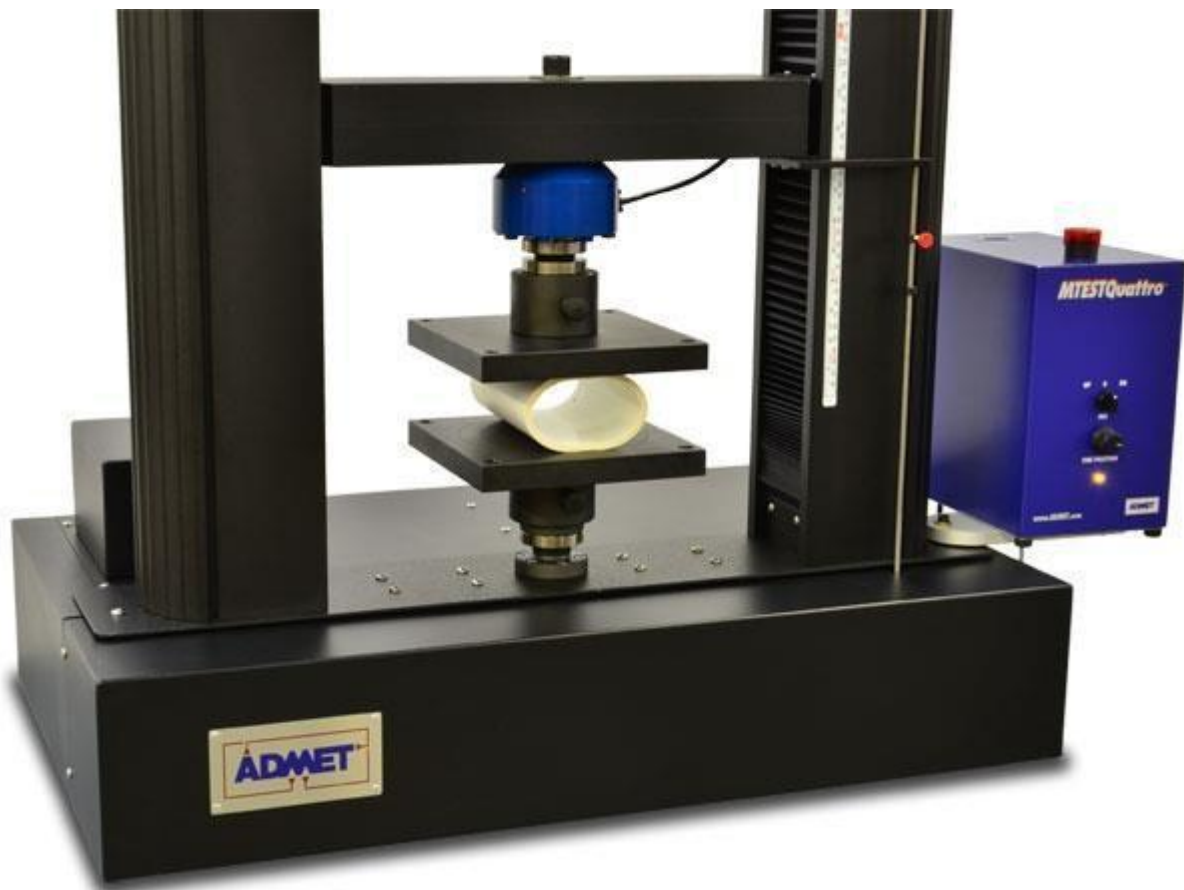
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2. COMPRESSION TEST



The one of the testing method which is used to establish the behavior of metallic materials that are subjected to a uniaxial compression stress distributed uniformly over the cross section is called as compression test. The goal of a compression test is to determine the behavior or response of material while it experience a compression load by measuring fundamental variable such as strain, stress and deformation.

By testing a material in compression the compressive strength, Yield strength, Ultimate strength, elastic limit and the elastic module among other parameter may all be determined with the understanding of these different parameters and values associated with a specific material it may be determined whether or not the material is suited for special applications or if it will fail the specified stresses.

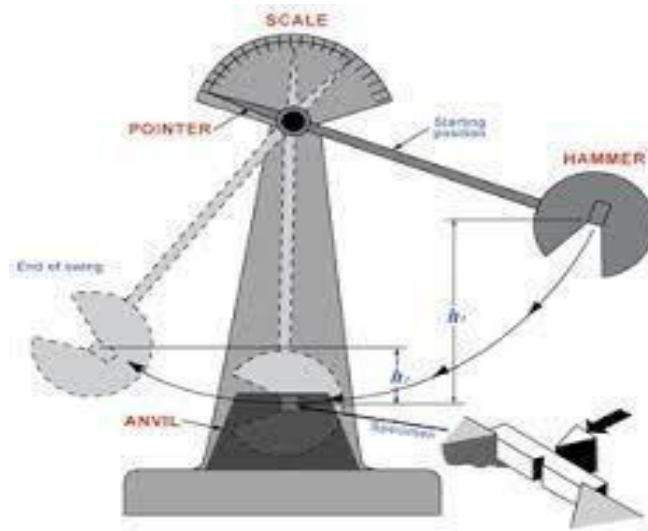
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3. IMPACT TEST



The process of evaluating the toughness, impact strength and notch sensitivity of engineering materials .This type of test is considered to be called as impact test.

Impact tests are used in studying the toughness of material. A material's toughness is a factor of its ability to absorb energy during plastic deformation. Brittle materials have low toughness as a result of the small amount of plastic deformation that they can endure. The impact value of a material can also change with temperature. Generally, at lower temperatures, the impact energy of the material is decreased. The size of the specimen may also affect the value of the Izard impact test because it may allow a different number of imperfections in the material, which can act as stress riser's ad lower the impact energy.

4. FLEXURAL TEST



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The maximum stress at the outcome fiber on either the compression or tensile side of the specimen. This corresponding stress and slope of the stress calculation is to be called flexural stress.

It measures the force required to bend a beam of plastic material and determines the resistance to flexing or stiffness of a material. Flex modulus is indicative of how much the material can flex before permanent deformation. In case of a plastic lock arm or snap fit assemblies, the arm needs to flex to allow the proper seating of the connection in place. If the locking mechanism is made of brittle material, then the mechanism would have higher tendency to break when flexed. In an example of support beams the flex testing indicates how much load the beams can bear before flexing and thus rigid or stiffer material is more adequate for each application. Alternately, a diving board is required to show higher flexing to support the driver's jump.

VI. CONCLUSION

In this study the aim of the present investigation is to develop the enhancement of mechanical properties of aluminium diamond composite by using stir casting process to achieve the goal of the composite of aluminium and diamond testing was made at Francis Xavier engineering college at Tirunelveli the experiment was carried out in diamond aluminium composite in the period of March 2020.

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