ABSTRACT

The composite materials currently used by all the leading industries like automobile, aircraft, home appliances, and space. It can reduce the weight of the automobile parts so that it can save a considerable amount of fuels and at meanwhile it prompts the more strength and stiffness. The reason behind the selection of the composite material is to enhance the better mechanical properties, corrosion resistance, good appearance, easy to manufacture and longer life. The composite materials are divided into three categories such as Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs).

The natural fibers are extraordinarily extended substances created by nature and creatures make them into fibers, string or ropes. The frame textures created like woven, sewed, tangled or reinforced are fundamental to the society. Today, most common fibers are used to make apparel and compartments, and to insulate material, mollify and design our living spaces. Progressively, conventional materials are utilized for mechanical purposes and also used in segments of composite materials, in therapeutic inserts, and geo-and agro-materials.

The major intention of this research is to familiarize the new natural fiber as to reinforce in the polymer matrix composite and to produce the lightweight products. Agave Angustifolia Marginata (AAM) is one of the species that is lingo-cellulosic, and the materials may be extracted merely with less power consumption. The AAM plant can found throughout the earth, especially in India. In this research work, the AAM fibers were extracted by using the mechanical decortication process and they were subjected to alkali treatment (NaOH) to remove the surface impurities of the
raw fiber. During the alkali treatment of the fiber, the varying concentrations of the NaOH prepared and used with different immersion time. The different properties like physicochemical, mechanical, moisture absorption of untreated (raw) and varying concentration of alkali treated AAM fiber determined experimentally. Based on the result, the sufficient NaOH concentrations identified. The difference in weight measured before the start of the alkali treatment process and after the completion of NaOH treatment. The morphological (SEM) and FTIR-Spectroscopy conducted for the both raw, and alkali treated AAM fibers. The outcome demonstrated that the 5 wt. % with one hour immersion time of alkali treatment evacuated the surface impurities of the fiber efficiently when compared with another weight percentage of the alkali treatment.

The AAM fibers separated into varying lengths such as 10, 30, 50, 70 and 90 mm correspondingly. The matrix prepared by using a different combination of randomly oriented AAM fiber and epoxy resin like 60:40, 65:35, 70:30 and 75:25. The AAM fibers are weighted and placed on the lower mold randomly. The above mixture of composite plate with a dimension of 300×300×3mm manufactured by using the Compression Molding Machine (CMM). The testing specimens were made as per the ASTM standards from the fabricated AAM fiber polymer composites plate. Then, the specimen endured to the different test such as tensile, flexural, impact and compression. Also, the short randomly oriented AAM fiber (50mm) reinforced composites fabricated by using compression molding machine and the specimen divided as per ASTM requirement. Then, the prepared samples are subjected to fatigue and wear test. Finally, 50 mm alkali treated fiber and 65:35 matrix shown the strong interfacial adhesion between the fiber and epoxy resin when compared with others. The above result concluded that 65:35 polymer matrix composites attained the better
mechanical behavior and water absorption properties. The short randomly oriented AAM fiber reinforced composite with a matrix ratio of 65:35 decreased the wear rate and improved the fatigue behavior.

The morphological investigation of tensile, flexural and impact made by using scanning electron microscopy. The SEM study explored that the bonding and interfacial strength has improved in the matrix because of the alkali treatment of the AAM fiber. The outcome examined that the chance of applying AAM fiber-epoxy composites in slight load structural uses.

Thermogravimetric Analysis (TGA) made for the different combination of randomly oriented AAM fiber reinforced composites such as 60:40, 65:35, 70:30 and 75:25. The thermal stability has increased in the 65:35 ratio combination of the composite specimen when compared with the raw and another weight percentage of AAM fiber reinforced composite specimens. Due to the effective alkali treatment, the lignin content reduced in the AAM fiber, and degradation point begins at a higher temperature. The results exposed that the possibility of using AAM leaf fiber-epoxy composites was in minimum temperature for thermal applications.

The moisture absorption test conducted for the raw and varying alkali treatment of the AAM fiber concerning with different immersion timing. The water consumption test revealed that the 5 wt. % NaOH treated fiber with one-hour soaking duration absorbed the less amount of the moisture content as compared with the raw and other weight percentages of alkali treated AAM fiber. Similarly, the different weight percentage (60:40, 65:35, 70:30 and 75:25) of the alkali treated AAM fiber reinforced composite dispensed through for the water absorption test, and after that, it is subjected to a various mechanical test in wet condition. The water absorption decreased in the 65:35 ratio composite because of sufficient bonding strength and less void. Also, the
mechanical properties reduced in the wet specimen as compared with the dry specimen. The 65:35 ratio of composite increased the mechanical behavior in wet condition as compared to all other ratio of composites.

The wear test accompanied for the short randomly oriented AAM fiber reinforced epoxy composites with a different combination of composites such as 60:40, 65:35, 70:30 and 75:25. For all the combinations of AAM fiber composites, the wear behavior studied at various speed and load condition with the constant sliding distance condition. The wear test samples were prepared as per the ASTM method, and each sample applied against the disc of wear test machine with the various speed and load conditions. The outcome proved that the 65:35 short alkali treated AAM fiber (50mm length) reinforced composites resist the wear rate than the other weight percentages of composites. The specific wear rate, the coefficient of friction and wear loss in grams calculated for all the samples and the results discussed. The micro-hardness test directed to the above-said combination of composites and the results determined. The result confirmed that the addition of 35 wt. % fiber content in the composite has improved the hardness properties due to the excellent interfacial bonding and lowered voids in the composite. The wear mechanisms and bonding strength found by using scanning electron microscopy. The outcome shows that the development of this composite is for making tribological applications and products like gears.

The fatigue properties determined in the short alkali treated fiber AAM composites. The stress value and number of cycles to failure increased in the 65:35 mixture ratio of composites than the other weight percentage of the composites. Due to the excellent fiber-matrix adhesion and exact proportion of the fiber-matrix, the life cycles and number of cycles to failure also improved in the fatigue test.
The experimental study of AAM fiber and composite exposed that the 5 wt. % with one hour soaking period of alkali process drastically changed the physicomechanical, chemical and moisture absorption characteristics of the AAM fiber. Thermal degradation starting point attained at a high temperature in alkali treated fiber. By using 5 wt. % of alkali treated fiber in the reinforcement with a proportion of 65:35 AAM fiber composites improved the mechanical properties, thermal stability and decreased the water consumption. The short AAM fiber and mixture ratio of the composite influenced the wear and fatigue properties. The AAM fiber composite components manufactured with less weight, cost-effective and pictorial in appearance. Moreover, the demonstration of these products flushes the way for the substitute of synthetic fibers by AAM leaf fibers for making commercially esteemed products.