## CONCLUSION AND SCOPE FOR FUTURE WORK

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7. CONCLUSION AND SCOPE FOR FUTURE WORK

7.0 INTRODUCTION

In the present investigation, sisal, jute, and glass fiber reinforced hybrid composites are prepared with three different fiber weights and two different fiber orientations. Mechanical properties such as tensile, flexural and impact properties are evaluated as per the ASTM standards. Apart from the mechanical properties, drilling studies are carried out to analyze the thrust force, torque and delamination by using the solid carbide brad and spur drills. Based on the experimental results and analysis, the following conclusions are drawn:

7.1 CONCLUSION

From the analytical and experimental investigation on sisal, jute and glass fibers reinforced polymer composites the following conclusions have been arrived at:

- A multilayered hybrid composite has been fabricated successfully by reinforcing two low cost, light weight, eco-friendly natural fibers (sisal and jute) with glass fiber, using a polyester resin matrix.
- According to the directional orientation, 0° orientation composite samples perform better than the 45° fiber orientation composite samples and as per the fiber volume, SJGFRP samples yield better results than the single natural fiber of either only sisal or jute reinforced composite samples.
The maximum tensile load has been absorbed by the 0° fiber orientation composite sample S₂, with the maximum tensile strength of 229.54MPa, followed by the composite sample S₃, with the value of 200MPa.

The maximum flexural load of 300MPa was absorbed by the hybrid composite sample S₃ followed by sample S₁ and it has been able to withstand the flexural load of 230MPa.

The maximum impact strength of 18.67Joules is observed for sample S₅ followed by sample S₁, with an energy of 18Joules.

The tensile and flexural strengths of the 0° fiber orientation composite samples are almost 3 times greater than those of 45° fiber orientation composite samples.

The maximum stress absorbed by the material during tensile loading is around 240N/mm², and during flexural loading it is around 13N/mm².

From the experiment it has been observed that, the incorporation of sisal and jute fibers with glass fiber modifies the tensile, flexural and impact strengths of the composites; however, their strength properties are not found to be as good as those of the glass fiber reinforced composites. This suggests that sisal and jute fiber have the potential to replace the glass fiber, and these fiber reinforced hybrid composites are favorable for medium load applications.

The maximum thrust force absorbed by the hybrid composite
samples is 340.34N, and the maximum torque is 1.892Nm.

➢ The thrust force and torque increases with an increase in the feed rate, for all cutting combinations.

➢ The thrust force is highly influenced by the feed rate followed by the spindle speed. The drill diameter has the least influence on the thrust force.

➢ The torque also is highly influenced by the feed rate, followed by the spindle speed and drill diameter.

➢ The most influential input parameters of delamination are in the order of spindle speed, feed rate and drill diameter.

➢ The thrust force and torque increase when the feed rate and drill diameter increase, and they decrease when the spindle speed increases.

➢ Surface response methodology is used to model the output responses in terms of the independently controllable variables.

➢ The significant machining parameters influencing the output responses in the drilling of hybrid composites are identified through the successful implementation of ANOVA.

➢ The coefficient of correlation for all the models is nearly equal to 1, and hence, these models can have very good prediction potentials.

➢ From the morphology analysis, the interfacial relationship between the fiber and the matrix, fiber dispersion into the matrix, fiber pullout, fiber debonding and the internal cracks of the drilled
surfaces are clearly observed.

- The results indicate that a high cutting speed, low feed rate and low drill diameter are preferred for the machining of glass and natural fiber reinforced hybrid composites.

- It is suggested that these hybrid composites can be used as an alternative material for synthetic fiber reinforced polymer composites, especially for medium load structural applications, as they significantly reduce the problems related to environmental concerns.

7.2 RECOMMENDATIONS FOR POTENTIAL APPLICATIONS

Sisal, jute and glass-fiber reinforced hybrid composites were fabricated and evaluated for their mechanical and machining characteristics. From the analysis of this investigation, it has been found that adequate potential applications are found in the following fields: in erosive environments, manufacturing of light weight sports goods such as, tennis rackets, balls, bicycle frames, snowboards etc. The present study has established that these hybrid composites are used when cost reduction is the prime consideration, and can effectively replace the conventional and relatively expensive materials. Their use may be suggested in house hold applications like the manufacturing of tables, chairs, door panels, interior paneling, door-frame profiles, food trays, partitions, bath units, lampshades, suitcases, helmets, etc. The use of these composites, in general, may also be recommended for
applications in the field of the transportation industry including manufacturing of seat backs, headliners, dash boards, car doors, pallets, trunk liners, decking, parcel shelves, spare tyre covers, spare-wheel pan, automobiles and railway coach interiors, boats, and interior paneling.

7.3 SCOPE FOR FUTURE WORK

The present research work leaves a wide scope for future investigators to explore many other aspects of such hybrid composites. Some recommendations for future research include:

1. The other properties of composites such as moisture absorption, fatigue and tribological behaviour may be determined using extensive experimentation.

2. The experiments can be extended by adding other potential natural fibers, by changing the fiber orientation and fiber content and their mechanical and machining characteristics may be analysed.

3. The experiments can be extended by increasing the number of machining parameters, such as tool geometry, tool materials, etc.

4. The experiments can be repeated by using different tool inserts with wider geometries.

5. The experiments can be extended to other machining processes, such as milling, reaming etc.

6. The experimental data can be modelled and analyzed using other modelling techniques, such as fuzzy logic, ANFIS etc.