An Impacted Tolerant Fabric Composite

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Abstract

- In this study, four different types of composites were successfully prepared for mechanical properties test. The four types were Glass fiber, Carbon fiber, Kevlar thread, and Shape Memory Polymer (SMP) fiber. Constructing composites that featured different fabrics inside them would grant each composite with different properties such as modulus, toughness, and strength. This experiment purpose is to prepare the four composites to determine which composites have the optimal mechanical properties.

- Keywords: Polymer, Fiber, Kevlar, Composite, Epoxy resin

Materials

- **Glass fibers are formed when thin strands of silica-based or other formulation glass are extruded into many fibers with small diameters suitable for textile processing.**
- **Carbon fibers are very stiff, high in tensile strength, low weight, high in chemical resistance, high temperature tolerance and have low thermal expansion**.
- **Shape Memory Polymer (SMP) fibers are smart materials that posses the ability to return to their original shape from their deformed shaped when an external trigger, such as UV exposure, triggers the polymer.**
- **Kevlar is a key material that is used in protective gear such as combat helmet and bulletproof vest by the United States armed forces.**
- **Epoxy resin also known as polyepoxide are polymeric or semi-polymeric materials. Since they rarely exist as pure substances, since variable chain length results from the polymerisation reaction used to produce them. Epoxy resins feature many purposes such as coating metals and fiber-reinforced plastic composites.**

Background

Glass fibers, Carbon fiber, Kevlar thread and SMP fibers are not very strong materials. The purpose of this experiment is to determine which of these composites is the strongest one. Also, to establish what can be added to each of these fabrics to improve their overall strength.

Methods

Glass and Carbon Fibers:

- In order to create these two molds the fibers needed to be cut into equal lengths so the mold would be consistent. The length of the strands was not important as long as each composite was composed of 5% fibers. Each of these molds had 8 layers; in each layer there were 13 fiber strands that were spaced 0.5 cm away from each other. Once the molds were completed they needed to be filled with Epoxy resin (93%) and hardener (7%). Then required about 2-3 days to dry completely depending on the size of the mold.

SMP Fibers and Kevlar Thread:

- These molds were created a tad bit differently; since these two materials were much thinner in comparison to the glass and carbon fibers used they needed to be wrapped around nails. Each mold consisted of 8 pairs of nails, each nail was spaced 0.5 cm apart and the paired nails were 20 cm apart. Each fabric was wrapped around the paired nails 20 times. The SMP elastic was stretched to 2 times its original length. Kevlar is not a stretchy material so it was not stretched around the nails. Once the wrapping of the fibers was completed the perimeter of the nails had to be sealed so the composites could be filled with Epoxy resin (93%) and hardener (7%). Then required about 2-3 days to dry completely depending on the size of the mold.

Results

This is an on-going research experiment so the results have not been concluded yet. My portion of this project was specifically to create the different composites and ensure that they have been successfully and accurately created.

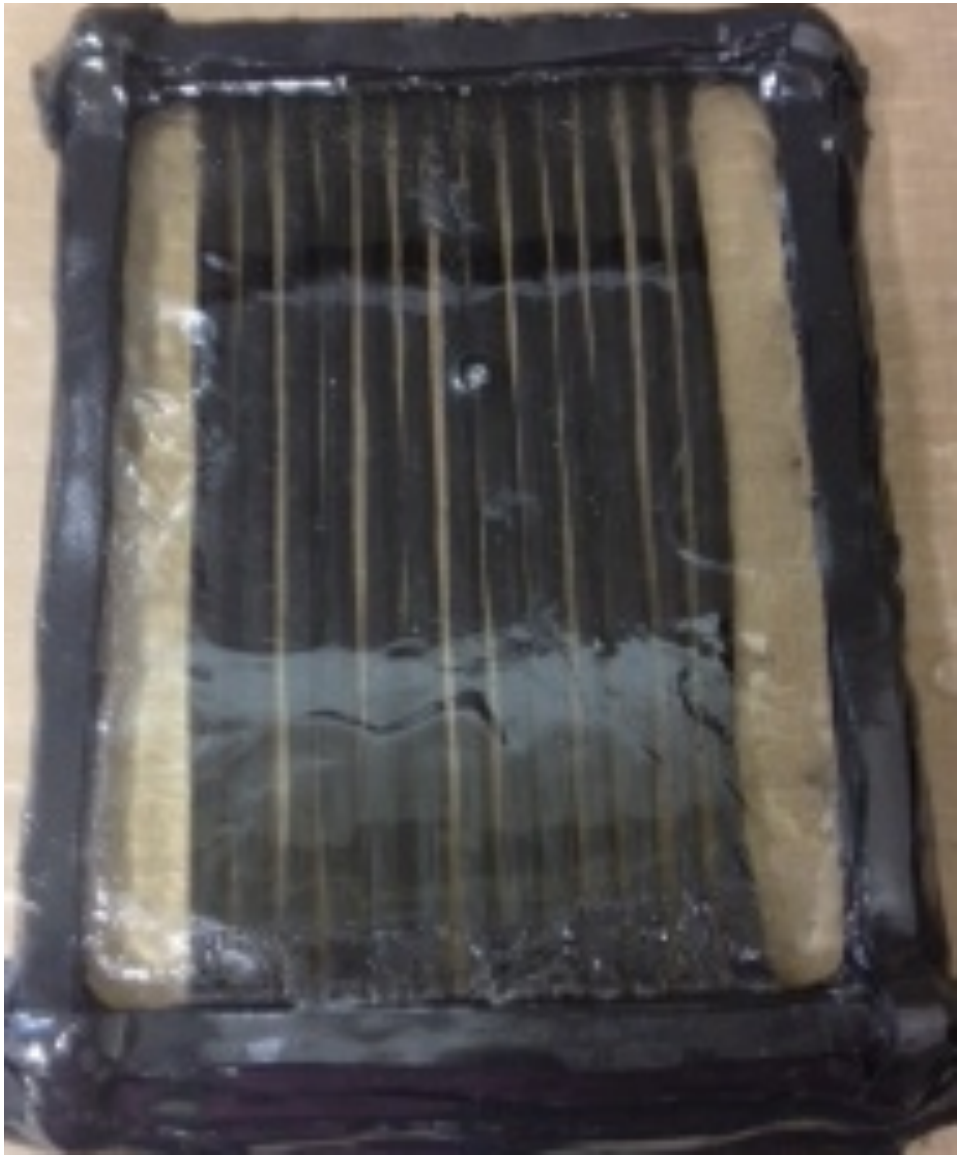
Conclusion

Four types composites were successfully prepared with Glass fiber, Carbon fiber, Kevlar thread, and Shape Memory Polymer (SMP) fiber as the reinforcement fibers. Epoxy was used as the resin. The hardener content of the epoxy matrix was 7%.

Future Work

The next step in this project is to cut each of the completed composites into smaller specimen. After the specimens are cut they will be placed into an impact machine to measure the amount of pressure that each specimen can withstand before shattering or cracking.

Visuals



Acknowledgments

This material is based upon work supported by the National Science Foundation under the NSF EPSCoR Cooperative Agreement #EPS-1003897 with the additional support from the Louisiana Board of Regents.