The Future of Composites

In our daily lives we use composites made with fiberglass for many applications, including car dashboards and sports equipment. However, the fibers are not biodegradable and have health risks[1]. This project's goal was to engineer and evaluate the performance of composite materials made with natural fibers (hemp, wood, hybrid mixtures of them) compared to fiberglass composites. This project is important as presently we are searching for green solutions to replace materials that can have negative health and environmental impacts.

To achieve my goal, (1) I made composites with natural fiber sheets, including 100% BC softwood cellulose (100W), 100% hemp (100H), 25% hemp 75% cotton (25H), 25% flax 75% cotton (25F), and compared these to chopped strand fiberglass (Fg). All the composites used a polyester resin and catalyst. (2) I evaluated the properties of the composites according to density, displacement (mm), Young's Modulus (MPa) and tensile strength at breaking load (N). Using a roller to help bond the fibers, ten samples were made for each type of fiber and also of pure resin (a baseline).

The results showed that among the natural fiber composites, the hybrid 25% flax-75% cotton had the highest tensile strength at the breaking load (639N) and the highest Young's Modulus (1043 MPa), significant difference showed by a T-test ($p<0.05$). The 100% hemp had the lowest tensile strength at breaking load (338N) and Young's Modulus (772MPa). This likely indicates that **hybridization of natural fibers creates a stronger composite,** likely due to a better bond between the fiber and resin and a decrease of voids between the fibers[3,4]. Fiberglass composites still surpass natural fiber composites in terms of Tensile strength (6875N), and Young's Modulus (1814Pa). However, the **natural fiber composites proved to be less dense than the fiberglass composite**. This is because natural fibers are more porous than fiberglass and so soak up more resin[2]. The resin therefore accounts for much of the total mass and has a strong control over density.

In conclusion, although the bio composites are not as strong as fiberglass composites, they can still sustain the required mechanical load for many applications. Their lower density is an advantage to fabricate lighter structures. This could be implemented in the industry where weight is more important than strength. For example, the bio composite could be used to fabricate water bottles, packaging, car dashboards, boat cabinets, and others. In the search to create environmentally friendly and sustainable materials with less health risks, bio composites can play an important role. The bio fibers made with flax, hemp, cotton, and wood are all completely biodegradable and non-toxic to humans.

Acknowledgements: Thank you to Bast Fiber Tech and Catalyst Pulp Mills for providing the pulp and fiber sheets used in this experiment, and to Bastein Lanusse from the Faculty of Engineering at UVic for his help with the Tensile Strength Machine.