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Analysis of a Dense Triaxial Weave Carbon Fiber Composite under Compressive Stress

Abstract

The compression resistance of dense triaxial weave carbon fiber composites was studied in order to determine whether this weave is a viable addition to the weaves currently on the market. The triaxial weave was hand woven at angles of 0 and plus or minus 60 degrees. To determine the properties of the weave, a deflection test and compression test were performed on the composite samples. The deflection and compression tests were performed using a closed drill chuck as a plug to initiate a failure mode in the composite. It was found that the dense triaxial weave composites did not deflect as much as the biaxial weave composites before structural integrity was compromised. However, it was also found that the dense triaxial weave composites withstood on average over 50 percent more pressure before failing. This is most likely due to the presence of the third layer of carbon fiber at any point in the weave. From the data, it can be concluded that the dense triaxial weave is a viable addition to those weaves currently on the market, and that further testing of the weave is warranted.

Layman's Explanation

I studied the resistance to compression of a triaxial weave carbon fiber composite. The weave, known as a dense triaxial weave (three axes at 0 degrees and 60 degrees to either side; this creates what looks like a six-pointed star) was hypothesized to be more resistant to compression than a standard biaxial weave (which looks like a checkerboard) because there are three layers of carbon at any point in the weave rather than two. To determine how much compression a composite formed from this weave could withstand, I placed hand-woven samples on top of a hollow cylinder and used a drill press to push a closed drill chuck downwards into the sample. In two different tests, I determined how far the sample could bend before becoming structurally unsound and how much pressure could be placed on the sample before breaking. I found that although the triaxial weave composites did not bend as much before becoming structurally unsound, they withstood much higher pressures before breaking. From these results, I have concluded that the weave may be a viable addition to the weaves currently available on the market. Therefore, further testing is warranted to determine the other properties of the weave, as well as the properties of samples that are produced with the help of machines.