Traumatic Brain Injury Reducing Army Combat Helmet

Team 6
Week 3
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Work Completed:

This week revolved around the setup and application of the method for cutting the Kevlar into an adequate shape in order to begin molding the outer shell. The method used in the original Advanced Combat Helmet is similar to that of a star, where edges are cut off in order to drape the Kevlar over the contours of the helmet and have no overlapping. Overlapping must be avoided at all costs because it will cause air bubbles in the final product, which leads to weakening in that target area as well as other imperfections. Figure 1 is an example of this type of technique.

Figure 1: “Star” Kevlar Layering Technique
This method proved difficult to shape correctly for our purposes for two reasons. The primary reason is that the measurements are different for this prototype helmet because it is slightly longer on the sides and in the back. In addition, we do not have any accurate mechanical process to cut the Kevlar, so this method is difficult to cut by hand. The first alternative design process thought up is based on the idea of both a Soccer ball and a "Bucky Ball", a Carbon-60 molecule. These designs have five hexagons each connected to the face of a pentagon. Figure 2 is an example of this design.

![Figure 2: Example of “Bucky Ball” Design](image)

The reasoning behind this choice of model is that on a molecular level it allows aromatic molecules to be able to be shaped into a ball. If a piece of Kevlar were to represent an aromatic molecule, then it would allow a model that gives minimal curvature to the Kevlar pieces and thus less air bubbles during the hardening process.
This idea may be viable for one of the helmets being built and tested. However, it was ultimately not chosen as the method that will be used for the first prototype helmet shell.

Instead of pentagons and hexagons, the first shell prototype will use simple triangles due to their each of both creation and handling. This allows the process to speed up. For example, as of today the first few Kevlar layers have been already hardened onto the mold and the next few layers will be added in a day or so. The other two models are logistically more difficult to perform out amongst everyone.

In addition to work on the shell layering model I also spent some time at the library researching other possible methods pertaining to Kevlar. Unfortunately, it seems that most of the books on the subject are very general and many are just chapters in books pertaining to larger subjects such as Ceramics in the TS technology section. Only one book was about Kevlar in its entirety. Perhaps if this helmet project becomes an annual one this section of the library could expand based on some recommendations our group may have by the end of the project.

**Future Work:**

The first prototype outer shell should be completed within the next few days. Since much of the design part of this process has been completed, most of the time spent will be working. This will include measuring and cutting out several hundred triangles and also applying them onto the helmet and allowing the Epoxy to harden.

**Hours Worked:**

Four hours were spent on Friday mainly researching the three methods of Kevlar layering described in the Works Completed section. About 90 minutes were spent researching the TS technology section on the campus library. In addition, about 2 hours were spent in the 313D laboratory measuring and cutting out approximately 120 Kevlar triangles for layering.