

Fabrication and mechanical characterization of carbon-carbon composites with human-hair derived carbon as filler material

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Carbon-carbon composite comes under the category of high performance materials with high specific mechanical properties and thermal stability. These thermostructural composites are able to efficiently retain their properties even at very high temperatures up to 3000 °C [1]. Due to this advantage carbon-carbon composite are used in various high temperature structures like rocket nozzles, turbine components, diesel engine components etc. [2]. Carbon-carbon composite is fabricated by using phenolic resin as matrix material, bi-directional woven carbon fabric as reinforcement material and human hair derived carbon as filler material. Carbonization of human hair is done in an inert environment of nitrogen gas with the temperature going up to 500 °C and a heating rate of 5 °C/min in a horizontal tube furnace to derive porous carbon, which is used as a filler material. The temperature profile followed during the carbonization of human hair is shown in Figure 1.

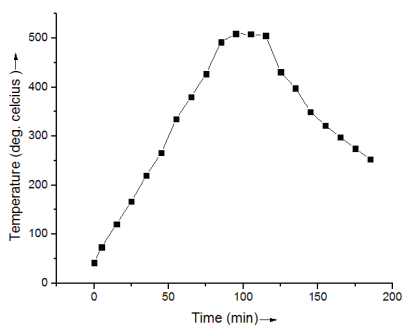


Figure 1: Temperature profile during carbonization of human hair

Hand lay-up technique is used to prepare composite preforms which is followed by curing at a temperature up to 190 °C with a particular curing profile as shown in Figure 2 and a pressure of 3.8 MPa is applied in a conventional hot press.

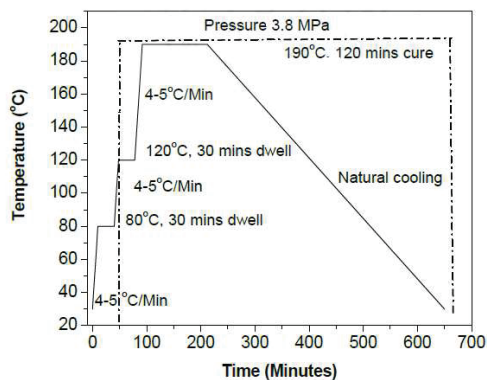


Figure 2: Curing profile of phenolic-carbon fabric composite

Finally the carbon fibre reinforced phenolic resin composite are carbonized in a horizontal tube furnace at a heating rate of 1 °C/min in a nitrogen atmosphere at different temperatures ranging from 600-1200 °C with an increment of 300 °C in temperature to prepare different samples carbon-carbon composite. Also, different samples of carbon-carbon composites with different content of human hair derived carbon as filler material are prepared. Effects of carbonization temperature and filler loading on mechanical properties of carbon-carbon composites are investigated by tensile test, flexural test.

References

1. Savage G. Carbon-Carbon composites. Chapman and Hall, New York, 1993.
2. Schmidt DL, Davidson KE, and Theibert LS. Unique Application of Carbon-Carbon composites., SAMPE J., 35 (1999) 27-39.