Summary Deliverable 3.2

Report on material properties in cryogenic conditions

This deliverable reports the material properties of fibre-reinforced thermoplastic composites and metal hybrids produced by the laser-assisted Automated Tape Laying (ATL) process. Basic linear elastic tensile material properties in the temperature range for an automotive application (hydrogen pressure vessel) range from the usage temperature at cryogenic conditions up to 65 °C. The materials investigated are carbon fibre-reinforced thermoplastic materials such as PE, PP, PC, PET, PA6, PA12, and UHMWPE. The bending test results demonstrate an increase of 0° flexural strengths among all tested materials at a temperature decrease. The 90° strengths and moduli follow the same trend, with the PA6 as an exception. A reduction of the strength was observed from -77 °C to -196 °C. The 0 °C bending moduli are highest at room temperature.

Decreasing the temperature reveals no changes in the moduli or a slight decrease (e.g., PP, PC). Quenching tests between the temperature ranges of liquid nitrogen and 70 °C revealed no debonding between the PA6, PA12, and PC matrices to the aluminum, whereas detachments of PET and PP were observed.