Development of green composites with flax fibers and study of their fracture behavior.

Ανάπτυξη πράσινων σύνθετων υλικών με ίνες λιναριού και μελέτη της θραυστομηχανικής τους συμπεριφοράς.

Laboratory of applied mechanics and vibrations

KANELLOPOULOS IOANNIS
A.M.: 1054469

Supervisor Professor
KOSTOPOULOS VASILEIOS

Supervisor Researchers
KOSTAGIANNAKOPOULOU CHRISTINA, PEGKOS DIMITRIOS

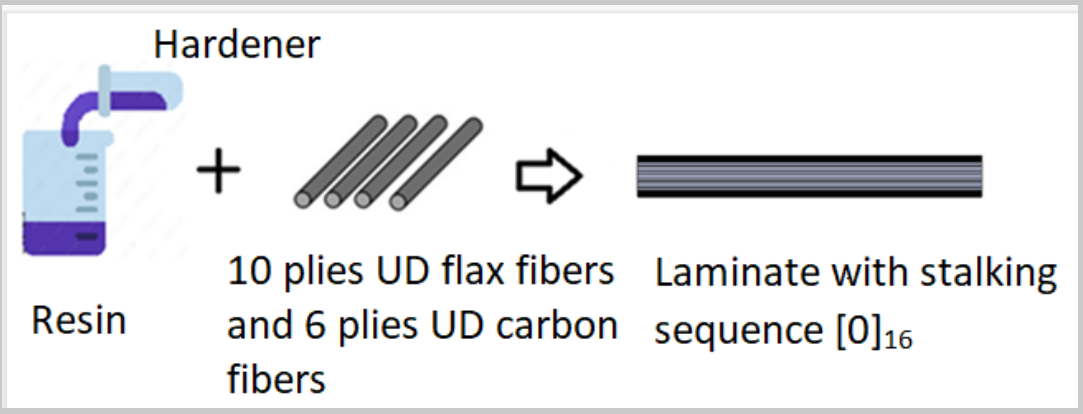
AIM OF THE THESIS

- The aim of the current thesis is the study of the fracture behaviour of composites reinforced with UD flax fibers. Specifically, it was investigated, if a biobased epoxy (contains a content from renewable resources) deteriorates the fracture behavior in comparison to a conventional epoxy. The biobased epoxy, which was used is the GreenPoxy 56 (Sicomin) and the corresponding conventional epoxy was the L epoxy (Faserverbundwerkstoffe). Moreover, it was investigated if the thermal treatment of flax fibers at 220°C in an inert atmosphere can ameliorate the properties of the composites (for this purpose ILSS experiments were carried out)

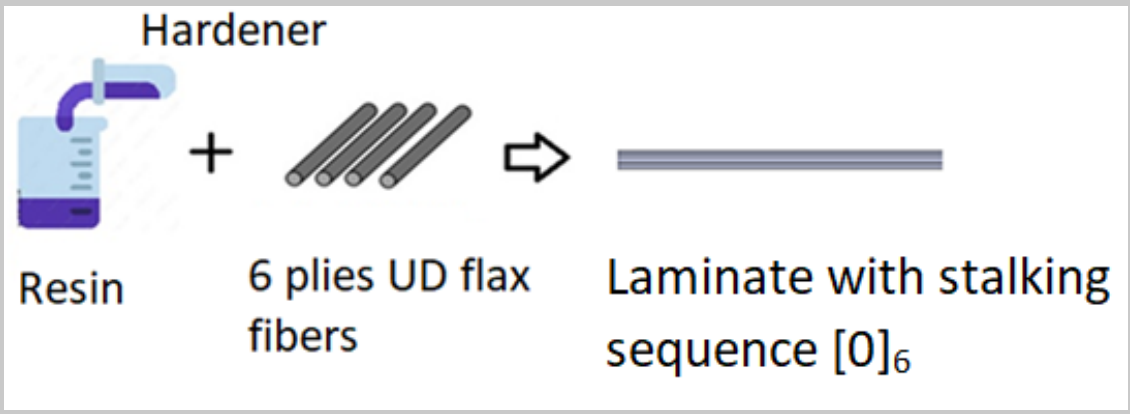
- In order to determine the interlaminar fracture toughness of the composites, laminates were created with a combination of the manufacturing processes of hand lay-up and autoclave. Also, laminates for the determination of interlaminar shear strength values were created with the manufacturing method of vacuum infusion.

Manufacturing of laminates

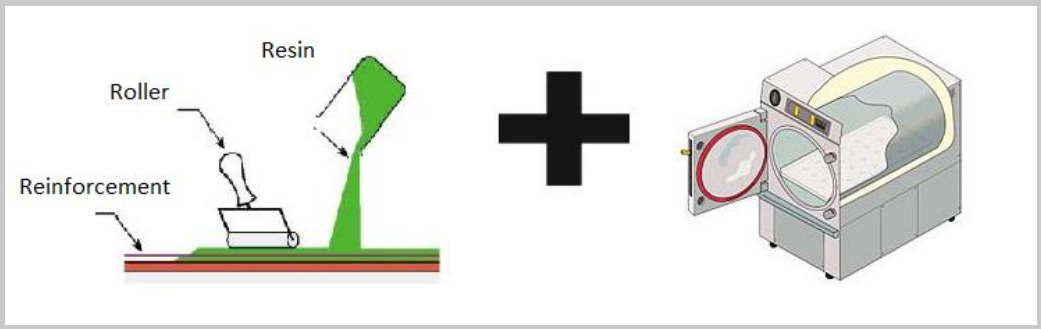
Laminate for fracture experiments



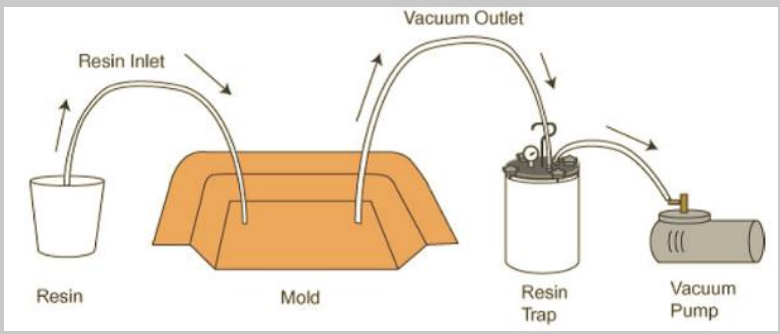
Laminate for ILSS experiments



Manufacturing processes used: Hand lay-up and Autoclave

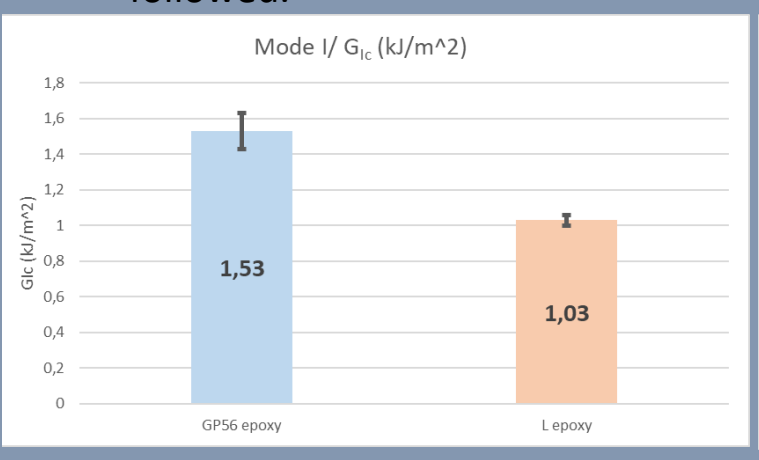


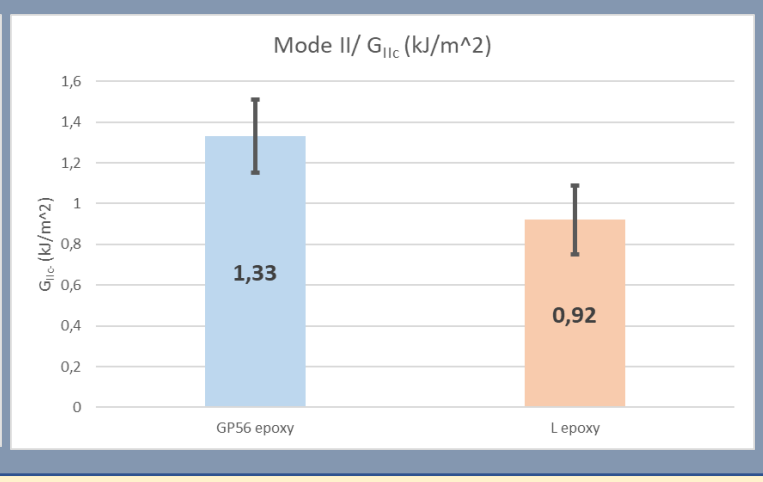
Manufacturing process used: Vacuum Infusion

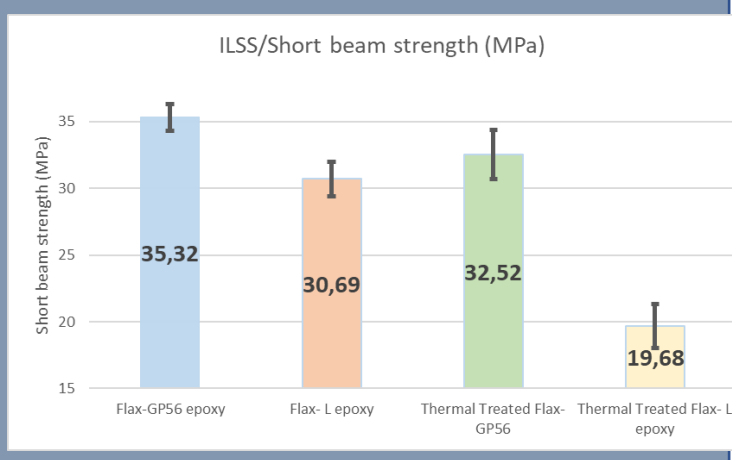


Experiments and Results

In order to determine the interlaminar fracture toughness of the different composites, experiments for Mode I and Mode II were carried out. The standards which were followed for the corresponding modes, were the *ASTM 5528* and *AITM 1.0006.* Also, for the determination of the interlaminar shear strength, the standard *ASTM 2344* was followed.







- For Mode I and II experiments, the material with the biobased epoxy showed an overall better performance compared to the respective with the conventional epoxy (greater Gaverage for Mode I by 47% and greater Giic by 44%).
- For the ILSS experiments, again the materials with the biobased epoxy showed better ILSS values compared to the respective with the conventional epoxy resin (greater by 15% for the composites reinforced with untreated flax fibers and 65% for the composites with the thermal treated flax fibers). Also, the composites reinforced with thermal treated flax fibers, showed reduced ILSS values compared to the composites reinforced with untreated flax fibers (fall of 8% for the category of the bioepoxy resin and 55% for the category of conventional epoxy). This fact is attributed possibly to the degradation of the fiber-matrix interface with the apply of the thermal treatment to the fibers