PhD Position

Recyclable Composites for Wind Energy Applications: Influence of Aging on Functional Properties and Recyclability through a Multiscale Approach

Context

Wind energy deployment in Europe currently represents approximately 15–20 GW of newly installed capacity per year. This corresponds to a demand of roughly 200–300 kilotonnes of polymer-matrix composite materials, primarily used in the manufacturing of onshore and offshore wind turbine blades. This demand is expected to grow significantly, reaching around 400 kilotonnes by 2030 and up to 600 kilotonnes by 2040. Most polymer matrices used in these applications are thermosetting resins, which inherently limit recyclability and contribute to increasing volumes of plastic waste. To address this challenge, new material solutions are being explored, particularly vitrimer-based systems that offer promising recyclability. However, the long-term evolution of these materials under service conditions (fatigue, creep, rain erosion, and environmental exposure) remains insufficiently understood. A key scientific challenge is therefore to investigate how the physico-chemical structure evolves at the molecular scale during aging, and to establish robust structure-property relationships. This knowledge is essential for developing durable and recyclable composite systems that meet the stringent requirements of wind energy applications.

Research Project

This PhD position will start on October 1st 2026 and is funded by a doctoral grant from Claude Bernard Lyon 1 University and will be carried out at the Polymer Materials Engineering Laboratory (IMP), in collaboration with the Aerospace Structures and Materials group at Delft University of Technology (TU Delft, Netherlands). The supervision team includes Agustín Rios de Anda, Romain Tavernier (IMP), and Julie Teuwen (TU Delft). The candidate will work on the development and characterization of bio-based polyurethane coatings designed to protect composite structures, as well as on the multiscale analysis of a composite core made of a vitrimer matrix reinforced with natural fibers. The main objectives of the PhD are to:

- Develop polyurethane formulations with processing capabilities and durability comparable to current industrial standards
- Investigate the evolution of physico-chemical and thermomechanical properties of vitrimer-based composites under various aging conditions (thermal, UV, oxidative, mechanical, and hygrometric)
- Apply advanced characterization techniques, including modulated DSC, DMA, mechanical testing, and especially low-field solid-state NMR
- Establish structure–property relationships to describe the evolution of functional performance so as to propose relevant recycling strategies based on material degradation and property evolution

Profile

Applicants should hold an Engineering or a Master's degree in Polymer Science (or a closely related field), with a strong background in polymer chemistry and/or physico-chemistry, materials formulation, mechanics and/or rheology. Experience with characterization techniques for polymers and composites will be highly appreciated. Applicants should be bilingual in English.

Application

Candidates should submit the following documents: Curriculum Vitae and Cover letter in English, TOEIC results, and at least one letter of recommendation. Applications should be sent to: agustin.rios-de-anda@univ-lyon1.fr