



PhD in INGEGNERIA DEI MATERIALI / MATERIALS ENGINEERING - 40th cycle

**THEMATIC Research Field: BASALT FIBRE AND VITRIMER MATRIX COMPOSITES FOR
WIND INDUSTRY CIRCULARITY**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

**Motivation and objectives of the research
in this field**

The proposed research is embedded in the EU funded Eolian project “Bio-based, repairable and recyclable vitrimer composites and advanced sensors for highly reliable and sustainable wind blades” (Grant agreement 101147532 - <https://doi.org/10.3030/101147532>). Vitrimer matrix composites have the potential to deliver more readily repairable and recyclable wind blades. Moreover, the use of basalt instead of glass in the reinforcement phase, would allow to extend the useful life of the structure. Overall, the proposed material solution would be a better fit to the EU Waste Framework Directive than traditional fiberglass. The goal of the present activity is to assess the suitability of vitrimer resin-based basalt fibre composite throughout the useful life of a wind blade focusing on: the applicability of existing wind blade manufacturing techniques; the assessment of mechanical performance and environmental resistance; the development of sustainable repairing and recycling process. Particular attention will be dedicated to the development and prototyping of a mechanical recycling process that would not require phase separation. The work conducted during this research will heavily contribute to the final goal of the Eolian project: i.e. the realisation of a real-size demonstrator.

**Methods and techniques that will be
developed and used to carry out the
research**

The PhD candidate will develop the thesis in an experimental laboratory, applying knowledge and techniques for composite material characterisation



	<p>techniques for composite material characterisation research, with a specific focus on life-cycled evaluation and end-of-life management. The following steps are envisaged:</p> <p>1) A full characterisation campaign will be conducted on:</p> <ol style="list-style-type: none"> Constituents, e.g. thermo-rheological characterisation of the vitrimer matrix and single basalt fibre properties. Constituents' interaction, e.g. fibre-matrix adhesion. Bulk composite materials mechanical properties. <p>2) Moreover, some aspects of the material will be investigated after simulated lifecycle aging conditions.</p> <p>3) Design and development of a suitable mechanical recycling process for manufacturing and of life waste, and its application to the aged material.</p>
Educational objectives	<p>The PhD candidate will learn methodologies and techniques for:</p> <ol style="list-style-type: none"> Multiscale composite materials characterisation, both mechanical and thermo-rheological; Composite behaviour analysis; Materials' environmental aging investigation; Design and development and prototyping of production processes.
Job opportunities	<p>The candidate will acquire the skills to find positions as:</p> <ul style="list-style-type: none"> • R&D specialist of material development and manufacturing processes for the overall composite industry, and wind sector; • R&D specialist of recycling processes for the overall composite industry; • Researcher in public and private research centres, such as academic postdoctoral researcher or research engineer;
Composition of the research group	<p>1 Full Professors 3 Associated Professors 3 Assistant Professors 7 PhD Students</p>
Name of the research directors	Prof. Marco Luigi Longana

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Web-pages of the research group: <https://www.cmic.polimi.it/en/ricerca/elenco-gruppi-di-ricerca/polyenglab/>

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Confidentiality: since this is a thematic scholarship, the management of Confidential Information, Results and their publication is subordinate to the restrictions agreed upon with the funding company. Upon acceptance of the scholarship, the beneficiary may have to sign a specific commitment.

Educational activities (funding for participation in courses, summer schools, workshops and conferences) - financial aid per PhD student per year:

1st year: around 1.900 euros per student

2nd year: around 1.900 euros per student

3rd year: around 1.900 euros per student

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student: There are various forms of financial of for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities within the limits allowed by the regulation.