School of Computing, Engineering, and the Built Environment
Edinburgh Napier University

PHD STUDENT PROJECT

Funding and application details

Funding status: Self-funded students only

Application instructions:
Detailed instructions are available at https://www.napier.ac.uk/research-and-innovation/research-degrees/how-to-apply

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:
- DIRECTOR OF STUDY: Reza Salehiyan (Email: R.Salehiyan@napier.ac.uk)
- 2ND SUPERVISOR: Dongyang Sun

Subject Group: Engineering & mathematics

Research Areas: Polymers, Textiles, Chemical Engineering

Project Title: Development of Biodegradable Fiber-Based Bags for Sustainable Plant Nurture

Project description:

The need for environmentally friendly and sustainable solutions to combat plastic pollution has never been more critical. Plastics, particularly single-use plastic bags, have had a detrimental impact on our ecosystems and contribute to environmental degradation. In response to this challenge, this Ph.D. project aims to develop biodegradable fibrous bags designed for nurturing plants, thus contributing to a more sustainable and greener future.

The project will primarily focus on the utilization of Polyhydroxybutyrate (PHB) and related biodegradable polymers to create fiber-based materials. PHB is a

biodegradable thermoplastic polymer produced by various microorganisms and offers excellent biodegradability properties. By exploring PHB blends and composites, we aim to enhance the mechanical and degradation properties of the materials.

We will conduct comprehensive studies to evaluate the biodegradability of these fiber-based materials under various environmental conditions, such as soil, water, and compost. Understanding the degradation kinetics and environmental factors influencing biodegradation is crucial in ensuring the eco-friendliness of these bags. The project will include the design, production, and optimization of fiber-based bags suitable for nurturing plants. These bags will be engineered to provide essential support for plant growth, including moisture retention, breathability, and structural integrity.

By focusing on the development of biodegradable fiber-based bags, this project aligns with the broader sustainability goals of reducing plastic waste and promoting circular economies. These bags will offer a sustainable alternative to traditional plastic planters and nursery pots, addressing the issue of plastic pollution and providing a solution that benefits both the environment and agriculture.

The research methodology will involve a combination of material science, polymer blending, biodegradation testing, and plant growth studies. Various techniques such as fiber spinning, melt extrusion, compounding, and biodegradability assessment under controlled conditions will be utilized to achieve the project goals. The optimisation of blending conditions, ratios and processing conditions and the rheological-fibre spinnability will be taken into account.

This Ph.D. project is a proactive step toward addressing the environmental challenges posed by single-use plastics. It offers a sustainable solution for nurturing plants and aligns with the global push for eco-friendly alternatives. By developing biodegradable fiber-based bags, this research aims to contribute to a greener and more sustainable future while promoting circular economy principles in the agriculture and horticulture sectors.

References:

[1] Guerrini, Sara, Giorgio Borreani, and Henk Voojis. "Biodegradable materials in agriculture: case histories and perspectives." Soil degradable bioplastics for a sustainable modern agriculture (2017): 35-65.

[2] Rives-Castillo, Selene CH, et al. "The Effect of Netting Bags on the Postharvest Quality, Bioactive and Nutritional Compounds, and the Spoilage Microorganisms Content of Bell Peppers." Foods 12.10 (2023): 2071.

[3] Amelia, Tan Suet May, et al. "Applications of PHA in agriculture." Biotechnological applications of polyhydroxyalkanoates (2019): 347-361.

Candidate characteristics

Education:

A second class honour degree or equivalent qualification in Material Engineering, Polymer Science, Mechanical Engineering, or Chemical Engineering

Subject knowledge:

- Materials,
- Polymers,
- Biodegradable Polymers

Essential attributes:

- The candidate should have a solid academic foundation with a bachelor's and preferably a master's degree in a related field, such as materials science, polymer chemistry, environmental science, or a closely related discipline. Understanding of polymer processing techniques such as electrospinning, melt extrusion, and rheology of the polymers is a plus.
- Strong analytical and problem-solving skills are crucial for conducting research, optimizing materials, and addressing biodegradation challenges.

Desirable attributes:

- A basic understanding of biodegradable polymers and related materials science concepts can be advantageous. Experience in biodegradation analysis of the polymer is desirable.