Department	School of Engineering and the Built Environment
Supervisors	Dr Reza Salehiyan
Project Title	Development of recyclable bio-based materials with potential in packaging

PROJECT DESCRIPTION

Plastic waste is a significant issue in Scotland, as it is in many other parts of the world. According to data from Zero Waste Scotland, around 500,000 tonnes of plastic waste is generated in Scotland each year, with packaging and single-use items such as food containers, cups, and straws representing a significant proportion of this waste stream. There is a growing awareness of the need to reduce plastic waste and transition to more sustainable alternatives such as bio-plastics. The Scottish Government has set ambitious targets to reduce plastic waste, including a ban on single-use plastics by 2030. As part of this effort, there are initiatives to encourage the use of bio-plastics and increase the recycling of bio-plastic waste. One of the most popular bio-based and biodegradable polymers is polylactic acid (PLA). PLA and its blends with other biodegradable plastics such as poly (butylene-adipate-co-terephthalate) (PBAT), Polybutylene succinate (PBS) and Polycaprolactone (PCL) have been extensively studied for their potential in sustainable packaging applications. However, currently, the use of bio-plastics is still relatively limited compared to traditional plastics, due to challenges associated with the collection, composting and recycling of bio-plastic waste. Therefore, the development of new technologies and the increasing demand for sustainable alternatives to traditional plastics are expected to drive the growth of the bio-plastic industry in Scotland and beyond.

The main goal of this project is to address the challenges in mechanical recycling of such bio-based compounds and develop formulations with prolonged recyclability. During mechanical recycling in a simulated environment such as extrusion, materials go through extensive shear and thermal history, losing their physical properties, hence, their end-of-life is shortened. In this project we aim to optimize the formulations of bio-based blends and their associated processing conditions to allow multiple times recyclability to the final product with thermal and mechanical properties retained.

Prospective applicants are encouraged to contact the Supervisor before submitting their applications. Applications should make it clear the project you are applying for and the name of the supervisors.

Academic qualifications

A first degree (at least a 2.1) ideally in Material Science/Engineering, Chemical Engineering, or related disciplines with a good fundamental knowledge of polymers, polymer blends, and their processing.

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

Essential attributes:

- Experience of fundamental polymer processing e.g., extrusion, injection moulding, 3D printing etc.
- Competent in polymers, including but not limited to bio-derived and biodegradable polymers
- Knowledge of material characterisations, e.g., rheology, mechanical and thermal analyses
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

Team player, eager to learn new technologies and flexible Knowledge of extrusion Knowledge of compatibilization in polymer blends	
Indicative Bibliography	Dedieu I, Peyron S, Gontard N, Aouf C. The thermo-mechanical recyclability potential of biodegradable biopolyesters: Perspectives and limits for food packaging application. Polymer Testing. 2022;111:107620 Musioł M, Sikorska W, Janeczek H, Wałach W, Hercog A, Johnston B, et al. (Bio)degradable polymeric materials for a sustainable future – part 1. Organic recycling of PLA/PBAT blends in the form of prototype packages with long shelf-life. Waste Management. 2018;77:447-54. Nofar M, Salehiyan R, Ciftci U, Jalali A, Durmuş A. Ductility improvements of PLA-based binary and ternary blends with controlled morphology using PBAT, PBSA, and nanoclay. Composites Part B: Engineering. 2020;182:107661. Arruda LC, Magaton M, Bretas RES, Ueki MM. Influence of chain extender on mechanical, thermal and morphological properties of blown films of PLA/PBAT blends. Polymer Testing. 2015;43:27-37.nalyses
Enquiries	For informal enquiries about this PhD project, please contact Dr Reza Salehiyan R.salehiyan@napier.ac.uk
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process