University of Southern Queensland

NO WASTE pilot precinct and SIMPLE Hub – Centre for Future Materials Summer Research Program 2023-2024

2023-2024

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University of Southern Queensland

Contents

About the Centre for Future Materials

The Centre for Future Materials (CFM) was established in 2016 and has positioned itself as a leader in collaboration with local, national, and international SME's and large companies.

CFM's unique strength is in industrial engagement and development, to develop personnel, IP, new products, and open new sectors through collaborative research programmes which utilises industry funding leveraged against state and national funding mechanisms in order to de-risk the cost of research and deliver maximum impact for industry, the funding body, and the University of Southern Queensland.

CFM is working closely with industry and other research institutions to develop cutting edge technologies, through fundamental research and industry application in the area of advanced composites and concrete, and to provide solution-support to the community.

About the NO WASTE Pilot Precinct

The New Options for Waste And Saving The Environment (NO WASTE) pilot precinct focuses on design and development of new material circular economies to fit operating environments from regional to metropolitan scales. NO WASTE pilot precinct will develop new knowledge and skills and enterprise opportunities from more than 2 million tonnes of plastic waste, glass, and textile fibres, which are currently not recycled due to undefined or unprofitable pathways. NO WASTE is in partnership with industry, community, vocation and school education and supported by the Australian Government Department of Education via a Strategic University Reform Fund (SURF) grant and the summer research scholarships for this program are funded by this grant. The NO WASTE pilot precinct has many technical research programs focusing on circular economy modelling, 'waste' material characterisation, new process and product development. Spend the summer with the NO WASTE team and you may be able to continue your work into an Honours or Masters project later. To contact the leadership team of NO WASTE please email NOWASTE@usq.edu.au.

About the SIMPLE Hub

The Hub will implement a comprehensive research program targeted at the development of sustainable cross-sector industry 'ecosystems' that support development of new circular economies. The SIMPLE Hub will create a step-change by focusing on capacity building initiatives to enable industry and universities to co-design and develop new products and processes to support regional manufacturing priorities such as technical, environmental, economic, educational and cultural aspects of green energy, resource recovery and waste recycling/upcycling. The SIMPLE Hub will enable an innovative ecosystem, linking industry with regional universities to create more efficient, intelligent, responsive and agile industry sectors that are profitable, scalable and transferable nationally and globally. It will also create a workforce pipeline to support the sector, with a focus on training of industry-ready researchers who will be the innovators for regional manufacturing industries into the future, while attracting and retaining manufacturing opportunities and talent in regional areas.

About the NO WASTE and SIMPLE Summer research program

NO WASTE and SIMPLE summer research program eligibility

Requirements are minimum GPA of 5.5 and must have completed a minimum of 4 course units. Students can be recently finishing if that is the case (so current final year students). It would be advantageous for students to have an engineering, science or education background, but anyone competent in a lab and open to trying new work is welcome to apply. It will also be advantageous if candidates know how to use Excel for data analysis.

NO WASTE and SIMPLE summer research program scholarship value

The projects are offered with a stipend of $5000 for each successful applicant. The listed projects can be extended further into an Honours or Masters coursework research project, which can open the opportunity to transfer the gained knowledge and experience to future research activities including a research Masters or PhD project.

How to apply for the NO WASTE and SIMPLE Hub Scholarship projects

1. Students may choose up to 3 projects from the list of available projects.

2. Prior to submitting an application, students are required to make contact with the primary co-Director of the NO WASTE pilot precinct and SIMPLE Hub, Doctor Tristan Shelley by sending an email to NOWASTE@usq.edu.au with a subject line of *'NO WASTE Project [insert project number] enquiry'* or *'SIMPLE Project [insert project number] enquiry'* to obtain more information.

3. Students will submit their completed application form and send to NOWASTE@usq.edu.au along with supporting documents by the **29th of September 2023**. Students must use a subject line of *'NO WASTE Project [insert project number] application*' or *'SIMPLE Project [insert project number] application'*. Students are to submit only one application, but the application form allows more than one project to be identified as second and third options.

4. All applicants will be notified of the outcome of their application by **6th October 2023** and are expected to commence on the **30th of October 2023**. Students must conclude their summer project by the **26th of January 2024**. Please inform us if you're already subscribed to the trimester calendar so that we can adjust dates accordingly if possible.

5. A note that many of these projects can be continued beyond the summer program into coursework thesis projects for both Masters and Honours programs.

NO WASTE pilot precinct summer projects on offer 2023-2024

NO WASTE Project 1: Characterisation of mixed plastic materials and new product design

Dr Matt Flynn | Dr Tristan Shelley | A/Prof Polly Burey | Dr Zahra Gharineiat
Institute of Advanced Engineering and Space Sciences/Centre for Future Materials/School of Agriculture and Environmental Science/School of Surveying and Built Environment

Project Description

In 2019-2020 Australia generated 2.5MT of waste plastic, of which only 15% was recovered. On the 1st of July 2021, the ban on export of mixed used unprocessed plastics came into legislation in Australia, and on the 1st of July 2022, a ban on the export of single source, used, unprocessed plastics came into effect. These are currently problematic materials with emerging use pathways however not all of the options are financially viable. Waste plastics comprises one of the landfill waste materials that are a major concern for many countries including Australia. Developing strategies for value-adding plastic waste are therefore vital to enable recycling processes which can handle the increasing volumes of plastic waste.

This study aims to characterise the composition of mixed plastic streams from regional recovery facilities and larger scale materials recovery facilities and investigate ways in which these materials can be combined into new products with minimal stream separation. The project will have a processing focus and will involve chemical transformation of plastics, heat processing of plastic mixtures and laboratory analyses of mixed plastic products including mechanical analyses, chemical analyses, structural analyses, scoping of potential use applications and comparative evaluation of mixed plastic samples against other competitor products. There is also room for creativity in product design! The results of this project are anticipated to provide useful information that is required to determine the most suitable uses of mixed waste plastic composites in the development of novel and sustainable materials for a range of applications.

Project Location

The successful candidate will be required to work at the Toowoomba campus for the duration of the project with opportunities to work with other students, researchers and industrial partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Be trained in the use of advanced research facilities at Toowoomba campus
- Understanding of the test procedures in characterizing plastic-paper composites
- Safe use of processing equipment
- Experimental design and testing
- Data collection and data analysis
- Understanding importance of waste recovery and value add.
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

This project will lead to a better understanding of the characteristics of plastic/paper-based composite materials produced from ‘waste’ and will generate useful information to determine the most suitable uses and value-add for this waste material. Data from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

NO WASTE Project 2: New product pathways for plastic-coated paper waste to prevent landfill

A/Prof Andreas Helwig | Dr Matt Flynn | Dr Jessica Feldman | A/Prof Polly Burey
Institute of Advanced Engineering and Space Sciences/Centre for Future Materials/School of Agriculture and Environmental Science/School of Engineering

Project Description

Plastic-coated paper-based products such as waxed cardboard and disposable cups pose a significant problem after their use in applications where a barrier to moisture is required, such as cold chain storage of food. If left in typical recycled paper and cardboard collections, they have the potential to contaminate pure paper and cardboard recycling streams. Variability in the coating composition also poses a hurdle to re-use in other applications. Therefore, new strategies of value-adding these composite materials are vital for their increased utilisation.
This study aims to characterise a range of coated paper-based products from QLD materials recovery facilities and develop end use applications for these current waste materials into new value-added products with minimal stream separation. The project will have an analytical and processing focus and will involve sample preparation through breakdown/milling of plastic-coated products, and laboratory analyses of the coatings including thermogravimetric analysis (TGA), Fourier Transform Infrared analysis (FTIR) and Differential Scanning Calorimetry (DSC). The milled products will also be used in pressing or extrusion processes to create new product prototypes for applications in construction, or other industries. The results of this project are anticipated to provide useful information that is required to determine the most suitable uses of plastic-paper composites in the development of novel and sustainable materials for a range of applications. Preliminary results from this research area have shown that disposable paper cups can be used to produce a material which is comparable to MDF, and this research can also be expanded upon as part of the project.

Project Location

The successful candidate will be required to work at the Toowoomba campus for the duration of the project with opportunities to work with other students, researchers and industrial partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Be trained in the use of advanced research facilities at Toowoomba campus
- Understanding of the test procedures in characterizing plastic-coated paper materials
- Safe use of processing equipment
- Experimental design and testing
- Data collection and data analysis
- Understanding importance of waste recovery and value add.
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

This project will lead to a better understanding of the characteristics off plastic-paper composite materials produced from ‘waste’ and will generate useful information to determine the most suitable uses and value-add for this waste material. Data from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

NO WASTE Project 3: Physical and mechanical properties of concrete mix containing hybrid waste plastics and glass aggregates

Prof Allan Manalo | Dr Wahid Ferdous | Dr Matt Flynn | A/Prof Polly Burey
Institute of Advanced Engineering and Space Sciences/Centre for Future Materials/School of Engineering/School of Agriculture and Environmental Science

Project Description

Waste glass comprises one of the largest volumes of landfill waste materials that are becoming a major concern for many countries including Australia. While crushed waste glass is currently being used as fillers in concrete and road construction, only 20% of these wastes are recycled globally. The massive volume of remaining unused wastes goes to landfill creating environmental problems. Recent developments have combined waste plastics and waste glass sands to produce hybrid aggregates for sustainable concrete production. However, understanding on the behaviour and properties of concrete mix utilizing these hybrid waste aggregates is lacking. This study aims to test and characterise the physical and mechanical properties of concrete mix with different dosages of hybrid waste aggregates and comparatively evaluate them against concrete with natural aggregates. To achieve these aims, the flowability and workability of fresh concrete and the mechanical properties of hardened concrete under compression, splitting tensile and flexure will be evaluated. The results of this project are anticipated to provide useful information that is required to determine the optimal amount of hybrid waste aggregates that will produce a concrete mix with acceptable physical and mechanical properties for building and construction.

Project Location

The successful candidate will be required to work at the Toowoomba campus for the duration of the project with opportunities to work with other students, researchers and industrial partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Be trained in the use of advanced research facilities at Toowoomba campus
- Understanding in developing mix design for concrete with hybrid aggregates
- Familiarizing the test procedures in characterizing different grades of crushed waste glass, natural sand and aggregates
- Safe use of processing equipment
- Experimental design and testing
- Data collection and data analysis
- Understanding importance of waste recovery and value add.
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

This project will lead to a better understanding of concrete mix with hybrid waste aggregates and will generate useful information to determine the most suitable uses and value-add for waste plastics and glass. Data from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

NO WASTE Project 4: Crushing waste glass to reduce the alkali-silica reaction and improve concrete performance

Dr Jessica Feldman | Dr Hannah Seligmann | A/Prof Andreas Helwig | Prof Allan Manalo
Institute of Advanced Engineering and Space Sciences/Centre for Future Materials/School of Engineering

Project Description

Whilst recycling of glass back into glass products such as beverage bottles is a well-known pathway, this is not always an option due to the challenges of contamination, glass colour sorting requirements and competition with the low cost of glass imports. Due to this, the glass recycling rate in Australia was only 46% in 2017-18.
The replacement of natural aggregate with recycled crushed glass has been shown to produce acceptable mechanical properties, and standards have recently been developed in Australia for use in non-structural concrete. However, the inclusion of recycled crushed glass as aggregates in concrete has also been observed to increase alkali silicate reaction subsequently decreasing the long-term strength and performance of the concrete. The purpose of this project is to investigate an improved glass crushing process that can produce smaller particle size glass aggregate and therefore avoid alkali-silica reaction.
This project will be used as input into techno-economic and life cycle analysis to determine whether this is a viable, long-term pathway for waste glass. This will take into consideration that there are potentially higher-value applications, grading and processing requirements (e.g. washing to remove contaminants), and variable recycled crushed glass supply across Australia.

Project Location

The successful candidate will be required to work at the Toowoomba campus, with some occasional travel to the Springfield campus for the duration of the project with opportunities to work with other students, researchers and industrial partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Be trained in the use of advanced research facilities at Springfield and Toowoomba campus
- Understanding of the test procedures in characterizing glass, crushed glass and concrete materials
- Safe use of processing equipment
- Experimental design and testing
- Data collection and data analysis
- Understanding importance of waste recovery and value add.
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

The results of this project are anticipated to provide useful information that is required to determine the most suitable uses of waste glass in the development of novel and sustainable construction materials. Data from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

NO WASTE Project 5: New materials from agrifood waste

A/Prof John Dearnaley | Dr Jessica Feldman | Dr Matt Flynn | A/Prof Polly Burey |
Institute of Advanced Engineering and Space Sciences/Centre for Future Materials/School of Agriculture and Environmental Science

Project Description

Food excess and byproducts throughout food supply chains comprise a significant amount of useful material worldwide, but it is not currently utilised enough or appropriately. This project aims to create new materials with tailored mechanical properties for a range of applications that may range from medical to civil infrastructure utilising biomass which is high in cellulose and chemical compounds of value including flavonoids and polyphenols.

This project will involve selecting a food by-product from a range on offer (rice husk, orange peel, coffee grounds etc) and treating it either mechanically, thermally biologically or chemically to control the physical properties of the resulting product. This may include the use of fungi, heat pressing equipment, reagents derived from food or other approaches.

Project Location

The successful candidate will be required to work at the Toowoomba campus, with some occasional travel to the Springfield campus for the duration of the project with opportunities to work with other students, researchers and industrial partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Be trained in the use of advanced research facilities at Toowoomba and Springfield campus
- Understanding of the test procedures in characterizing novel materials derived from agrifood waste
- Safe use of processing equipment
- Experimental design and testing
- Data collection and data analysis
- Understanding importance of waste recovery and value add.
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

This project will lead to a better understanding of the characteristics of materials produced from agrifood biomass currently considered ‘waste’ and will generate useful information to determine the most suitable uses and value-add for this waste material. Data from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

SIMPLE Hub summer projects on offer 2023-2024

SIMPLE Project 1: Using CAD/CAM and 3D printing to recapitulate the bone microenvironment

Alissa Reinke | Dr Louisa Windus | Prof Eliza Whiteside | Dr Jessica Feldman
Centre for Health Research/School of Health and Medical Sciences
Toowoomba Hospital, Darling Downs Health
Centre for Future Materials/School of Agriculture and Environmental Science

Project Description

Prostate cancer is the most diagnosed cancer in males and while early stages are treatable, metastatic prostate cancer, particularly to the bone, has a poor prognosis. A major reason for the lack of effective drugs to treat advanced prostate cancer is due to difficulties in developing appropriate models that replicate the metastatic bone niche. This project will investigate the development of a bioink to be used in a 3D printer which will replicate the compressive strength and porosity of bone at different densities. Current literature will be used alongside CAD/CAM software to produce the 3D scaffolds. The scaffolds will then be used in downstream experiments to create a bioscaffold, to identify interactions between metastatic cancer cells and the native environment. Scaffold material will be sourced from recycled materials such as eggshell waste and chitosan from fungi.

Project Location

The successful candidate will be required to work at the Toowoomba campus, with some occasional travel to the Springfield campus for the duration of the project with opportunities to work with other students, researchers and Toowoomba Hospital partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Be trained in the use of advanced research facilities at Toowoomba campus
- Understanding of use of recycled materials and associated national and state government legislation impacts on local council compliance strategy and action plans
- Development of CAD/CAM and 3D printing skills
- Safe use of equipment
- Experimental design and testing
- Data collection and data analysis
- Understanding the importance of waste recovery and value add and social credentials in circular economy development.
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

This project will potentially lead to improved outcomes for patients undergoing scaphoid repair, as well as reduced operating time for the orthopaedic surgeons. Data from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

SIMPLE Project 2: Exploring educational perspectives of sustainability - educating for a sustainable future

Prof Petrea Redmond | A/Prof Andreas Helwig | Dr Zahra Gharineiat | Dr Carole Haeusler | Dr Karen Spence | A/Prof Polly Burey
Institute of Advanced Engineering and Space Sciences/Centre for Future Materials/School of Education/School of Engineering/School of Surveying and Built Environment/School of Agriculture and Environmental Science

Project Description

In 2019-2020 Australia generated 2.5MT of waste plastic, of which only 15% was recovered. On the 1st of July 2021, the ban on export of mixed used unprocessed plastics came into legislation in Australia, and on the 1st of July 2022, a ban on the export of single source, used, unprocessed plastics came into effect. These are currently problematic materials with emerging use pathways however not all of the options are financially viable. Waste plastics comprises one of the landfill waste materials that are a major concern for many countries including Australia. Developing strategies for value-adding plastic waste are therefore vital to enable recycling processes which can handle the increasing volumes of plastic waste.

This project aims to explore educational opportunities to present Science and humanities and social science concepts related to waste recycling and Sustainability associated with teaching years 4 - 10 in the formal Australian Curriculum. The results of this project are anticipated to provide useful research-informed unit and lesson plans for primary and secondary teachers and pre-service teachers.

Project Location

The successful candidate will be required to work at the Toowoomba campus, with or Springfield campus for the duration of the project with opportunities to work with other students, researchers and industrial partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Data collection and data analysis
- Understanding importance of waste recovery and value add and social credentials in circular economy development.
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

This project will lead to a better understanding of waste recycling and sustainability for the candidate, pre-service teachers, project teachers and their students. The intended project outcomes are a series of unit plans related to the Science Australian Curriculum and the Sustainability Cross curriculum priority. Information from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

SIMPLE Project 3: Utilization of Glass Waste in Environmentally Friendly Grout Mixtures

Dr Ali Mirzaghorbanali | A/Prof Andreas Helwig | Mr Hadi Nourizadeh
Institute of Advanced Engineering and Space Sciences/Centre for Future Materials/School of Engineering/School of Agriculture and Environmental Science

Project Description

This project is intended to investigate mechanical properties of amended grout products mixed with waste materials using compression testing machines. Initially, amended grout samples are cast by replacing cement for various percentages of waste to cement ratios ranging from 1 to 5%. Samples then are cured for different curing time intervals (1, 7, 14, 21 and 28 days), and tested for determination of Uniaxial Compressive Strength, Elastic Modulus in Compression and Shear strength. Following objectives will be followed:
1. A Literature review on mechanical properties of amended grout products,
2. Involved in experimental study on mechanical properties of amended grout for various curing time intervals,
3. Preparing test report
4. Presentation of project outcomes to the School, Centre and/or industry.
All the testing equipment and materials are currently available at the School of Engineering or can be purchased using the allocated research fund. The findings will be potentially be presented to the wider community at the Resource Operators' Conference.

Project Location

The successful candidate will be required to work at the Toowoomba campus, with some occasional travel to the Springfield campus for the duration of the project with opportunities to work with other students, researchers and industrial partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Be trained in the use of advanced research facilities at Toowoomba campus
- Understanding of use of recycled materials in novel grout materials for resource sector infrastructure
- Safe use of equipment
- Experimental design and testing
- Data collection and data analysis
- Understanding importance of waste recovery and value add and social credentials in circular economy development.
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

This project will lead to a better understanding of amended green grout applications in various conditions. An experimental equation will be developed based on the collected experimental data to model strength of amended grout in relation to various engineering parameters. Data from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

SIMPLE Project 4: Production of metal composite beads with optimal heat transfer and energy storage characteristics for solar thermal applications

A/Prof Andreas Helwig | Dr Mark Lynch | Dr Tristan Shelley
Institute of Advanced Engineering and Space Sciences/Centre for Future Materials/School of Engineering/School of Agriculture and Environmental Science

Project Description

One of the continuing barriers for hydro-thermal waste treatment is the cost of thermal energy to drive this process. For hydro-thermal pyrolysis (nominally at 300°C) to treat organic waste streams, a thermal storage is required to extend the working hours other than daylight hours available. Our industry partner, Impacts, is working closely with this research project to develop hydro-thermal energy storage to accomplish this. The project is to design an array of hexagonal cross section stackable heat beads assembled on an array standard copper or stainless steel 6.35mm seamless tubing to allow heat to be absorbed and melt a low temperature metal in the copper/graphitic carbon char heat bead to store heat; and then release the heat back into the tubing. Heat beads containing different combinations of metal powders (e.g. tin, zinc, aluminium) will be produced and then tested for their thermal heat transfer and heat energy storage characteristics incrementally up to 650°C.

Project Location

The successful candidate will be required to work at the Toowoomba campus, with some occasional travel to the Springfield campus for the duration of the project with opportunities to work with other students, researchers and industrial partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Be trained in the use of advanced research facilities at Toowoomba campus
- Energy systems and energy flow/efficiency analysis skills
- Development of 3D design and construction skills
- Safe use of equipment
- Experimental design and testing
- Data collection and data analysis
- Understanding of the importance of solar thermal storage contribution towards the development of various hydro-thermal chemical waste treatments
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

This project is the next R&D step for the SIMPLE Hub project in collaboration with Impacts Renewable Energies to explore hydro-thermal pyrolysis development. This provides the groundwork for interested municipal councils and to contribute towards improving the economic viability of hydro-thermal organic waste treatment. Data from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

SIMPLE Project 5: Upgrading recycled plastics to fire-retardant materials for electronic vehicles applications

Prof Pingan Song | Dr Venkata Chevali | Dr Matt Flynn | A/Prof Polly Burey
Institute of Advanced Engineering and Space Sciences/Centre for Future Materials/School of Agriculture and Environmental Science

Project Description

The project focuses on developing a promising strategy to reuse recycled plastics and aims to explore conversion of recycled polyethylene (PE) to fire retardant PE materials with preserved physical properties by adding bio-based fire retardants and using reactive processing. The resultant fire-retardant PE materials are anticipated to find potential applications in electric vehicles, such as in battery packaging and interior decoration materials. To this end, this project will be accomplished by:

1. Doing a comprehensive literature review on biobased fire retardants, and fire retardancy of polyolefins, particularly PE;
2. Screening and formulating new biobased fire-retardant systems,
3. Examining their impacts on the processing, fire retardancy and mechanical properties of PE; and
4. Optimising the reactive processing protocols to achieve balanced fire retardancy and mechanical properties.

Project Location

The successful candidate will be required to work at the Springfield campus, with some occasional travel to the Toowoomba campus for the duration of the project with opportunities to work with other students, researchers and industrial partners. Some aspects of the project including literature review and data analysis may be able to be completed off campus. This would need to be negotiated with the supervisory team.

Time Commitment

Please note, this project is being funded from a research grant the time commitment is different to Faculty funded scholarships. This project involves a time commitment to a 38-hour/5 day week, 10-12 week intensive R&D project. This can assist students to meet work placement requirements.

Benefits for Successful Candidates

The successful candidate will gain experience working in a collaborative research environment and with researchers from different disciplinary backgrounds. Skills development may include:

- Be trained in the use of advanced research facilities at Toowoomba campus
- Understanding of use of recycled materials in novel advanced technical applications
- Safe use of equipment
- Experimental design and testing
- Data collection and data analysis
- Understanding importance of waste recovery and value add and social credentials in circular economy development.
- Opportunity to meet and engage with industry partners, government and interested stakeholders

Project Outcomes

This project will lead to a better understanding of the design of biobased fire retardants, and the physical properties and melt processing of recycled PE. Another outcome would be how to optimise formations to achieve a balanced overall property for the final materials for their practical applications. Data from the project may be also used in publishing high quality journal articles. The successful candidate will be a co-author on these outputs.

University of Southern Queensland

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