

The University of Queensland - IIT Delhi Academy of Research Joint PhD Project

PROJECT TITLE	UNLOCKING THE POTENTIAL OF LIGNOCELLULOSE PLANT WASTE FOR VALUE ADDED POLYMER INDUSTRIES, THROUGH AN INTEGRATED BIOREFINERY APPROACH
PROJECT CODE	UQIDAR 00160
PROJECT DESCRIPTION	<p>Rigid polyurethane foam (RPUF) is an efficient insulation and structural material for global energy-saving in space conditioning applications, appliances, and automotive sectors. Due to an increasing demand for infrastructure development and energy-saving materials aligning with population growth, the global RPUF market is estimated to increase up to AUD \$36 billion by 2025, with dominant utilisation in Asia Pacific region. The current production of high-performance RPUF utilises large amounts of petroleum derived aromatic polyols and isocyanates. The use of biomass-derived materials will offer a sustainable solution to expand the application potential and environmental sustainability of RPUF. However, it is currently limited by both i) the inferior long-term performance of the RPUF under service life environments, and ii) the multi-step chemical-intensive biorefinery approaches to make reactive precursors. To address the first issue, UQ team is investigating the use of a bioderived nanomaterial nanocellulose and a biorefinery by-product lignin for modifying the RPUF microstructure and improving the compressive mechanical strength and long-term insulation properties. To make a step change in the utilisation of lignocellulosic biomass in polyurethane foam industry, the challenges associated with lignin and multi-step chemical-intensive biorefinery still need to be addressed. This project in collaboration with IIT-Delhi aims to derive the highly reactive lignin based precursors through an integrated biorefinery approach and investigate them for RPUF manufacturing. This will result in a fresh understanding of lignin extraction from nonwood agricultural crop wastes in India and a greener high-throughput processing strategy for lignin utilisation in to polyurethane foams. It is also planned to develop flame retardant coating materials for RPUF by doping lignin dispersions with graphene, layered double hydroxide and clay nanoparticles. Specific outcomes include new insights into lignin utilisation and methods for producing the sustainable insulation materials. This will benefit polyurethane and the future green building-construction industries.</p>
PROJECT OUTCOMES	<p>This project aims to develop high performance foam materials, coatings using sustainable biobased precursors for building insulation and construction applications. The focus would be on following two areas; 1. Lignin, Nanolignin, Nanocellulose incorporated polyurethane foams for insulation applications 2. Lignin/inorganic nanoparticles dispersions for flame retardant and protective coatings</p>
ADVISORY TEAM	<p>Dr Pratheep Kumar Annamalai https://researchers.uq.edu.au/researcher/2859 p.annamalai@uq.edu.au Australian Institute for Bioengineering and Nanotechnology (AIBN) The University of Queensland</p> <p>Professor K.K Pant http://web.iitd.ac.in/~kkpant/index.html kkpant@chemical.iitd.ac.in Department of Chemical Engineering Indian Institute of Technology Delhi</p>

<p>TYPE OF STUDENT</p>	<p>Applications are open to i/a students who meet eligibility criteria. note: i-students must have own scholarship to apply (CSIR, UCG-NET, etc)</p>
<p>DISCIPLINE BACKGROUND OF STUDENT</p>	<p>Ideally, this project requires students with a background in chemical engineering, chemistry, materials science/engineering, polymer science/engineering.</p>
<p>IDEAL CANDIDATE</p>	<p>Essential capabilities:</p> <ul style="list-style-type: none"> • M.Sc, Chemistry, Polymer Science, Materials Science, BTech and MTech Degree, in Materials Engineering, Polymer Technology, Chemical Engineering, Nanomaterials Engineering, Composites Essential scores • Masters Degree: Minimum 6.5 on 10 point scale or BE/B.Tech: Minimum 8.0 on 10 point scale a- students: Master's degree or post graduate degree, in similar disciplines with minimum 5.65 on 7 point scale. <p>Desirable capabilities:</p> <ul style="list-style-type: none"> • First Class in all previous degrees (CGPA of 6.75 or 60% marks) <p>Expected qualifications (Courses, degrees, etc.):</p> <ul style="list-style-type: none"> • Major Research Project in Biorefinery (wood, non-wood or waste), Biopolymer, Composites or related topics at UG or PG level
<p>APPLICATION PROCESS</p>	<p>Apply online by the due date: https://www.uqidar.org/students/how-to-apply/</p>