Final Year Project Showcase Batch 2021
Year 2024

	Department: Polymer & Petrochemical Engineering Programme: Polymer & Petrochemical Engineering
1	**Project Title** Effect of Reinforcement of Modified Nano Crystalline Cellulose (NCC) in Nitrile Butadiene Rubber (NBR)
2	**Project Idea** Traditional fillers like carbon black and silica are commonly used in Nitrile Butadiene Rubber (NBR) to enhance the mechanical and thermal properties. Theses fillers have significant drawbacks including high density, non-biodegradability and environmental concern. The use of nonrenewable resources also contributes to the carbon footprint of NBR products.
3	**Process** The process involve the modification of NCC by ionic liquid through surface treatment. The ionic liquid interacts with the NCC surface, improving its dispersion within the NBR matrix by enhancing compatibility and reducing aggregation. The process involves 1. Surface Modification of NCC: Enhance Nano Cellulose through surface modification. 2. NBR-mNCC Nano-composites Preparation: Mix NBR with rubber additives and a reducing agent; incorporate modified Nano Cellulose into rubber sheets. 3. Testing and Characterization: Conduct SEM, FTIR, and mechanical tests for comprehensive analysis.
4	**Outcome** **1.** Improve Mechanical Properties **2.** Thermal Stability **3.** Potential for Bio-based and Sustainable Composites **4.** Improve oil and solvent resistance.
5	**Evidence (Theoretical Basis)** This study focuses on developing nitrile butadiene rubber (NBR) nano-composites reinforced with modified nano-crystalline cellulose (m-NCC), using an ionic liquid to improve compatibility. Unlike previous approaches that involved extracting cellulose from micro-to-nano scale, this work utilizes commercially available NCC directly. To enhance the dispersion and interaction of NCC within the NBR matrix, the ionic liquid 1-allyl-3-methylimidazolium bis(trifluoromethylsufonyl)imide was employed during the modification process. The modified NCC, in varying amounts (e.g. 3 and 5 phr), was uniformly incorporated into the NBR matrix using the two-roll mill technique. This ensured even distribution and effective interaction of m-NCC throughout the composite. Mechanical testing of the final nano-composites revealed that the reinforcement provided by m-NCC significantly enhanced the performance of NBR. The findings highlight the potential of m-NCC as a sustainable and efficient filler for improving the properties of NBR in advanced applications
6	**Impact on Sustainability of Urban Regions or SDG-11 "Sustainable Cities and Communities"** Project aligns with key United Nations Sustainable Development Goals (SDGs) to address global challenges. SDG 9 - Industry, Innovation, and Infrastructure find relevance in the innovative approach employed, introducing modified Nano Crystal Cellulose (NCC) for enhanced gas kit sealing within the Nitrile Butadiene Rubber (NBR) composites. Moreover, it also contributes to SDG 11 - Sustainable Cities and Communities by preparing materials

	that go beyond conventional sealing solutions. The goal of developed NBR composites is to ensure enhanced sealing	
7	**Competitive Advantage or Unique Selling Proposition** (Cost Reduction, Process improvement, Attainment of any SDG (Sustainable Development Goal), increase of market share or capturing new market or having superior performance over a competitor. In summary, any striking aspect of the project that compels the industry to invest in FYP or purchase it. Some detailed description is required in terms of how, why when what. You can select one or more from the following dropdown and delete the rest of them). Please keep relevant options, delete the rest of them, and correct the sequence	
a	**Attainment of any SDG** (e.g. How it is achieved and why it is necessary for the region) SDG-9	
b	**Environmental Aspect** (e.g. carbon reduction, energy-efficient, etc.) Reduction of Carbon foot print.	
8	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service Aerospace Industries.	
9	**Team Members** (Names along with email address	1. Khadija Javed (PP-21004) khadijajaved222@gmail.com 2. Kiran Allah Rakha (PP-21006) kiranallahrakha30@gmail.com 3. Muhammad Bilal Wahid(PP-21040) bilalkhatree@gmail.com 4. Asad Malik(PP-21043) asadmalick68@gmail.com
10	**Supervisor Name** (along with email address)	1. Engr Asra Nafees (Supervisor) asranafees@gmail.com