

## PROBLEM STATEMENT 1<sup>st</sup> Phase DEPARTMENT OF CHEMICAL ENGINEERING

#### Industrial

### Design a system for real-time monitoring and control of chemical processes to optimize production of plug flow reactor .

#### Introduction:

The following system design outlines a comprehensive solution for real-time monitoring and control of chemical processes, specifically focusing on optimizing the production of a plug flow reactor. The system aims to enhance process efficiency, reduce costs, improve scalability, and mitigate current issues associated with plug flow reactor operations.

#### Components and Architecture:

A. Sensors and Data Collection
B. Central Control System
C. Control Strategies *Cost Economics:*

Perform a comprehensive cost-benefit analysis of implementing the real-time monitoring and control system:

Cost Savings Product Quality Safety Enhancement *Previous work :* By adjusting factors like temperature and pressure

#### Current Issue:

Identify and address a common issue associated with plug flow reactor operations:

#### **Residence Time Distribution (RTD) Variability:**

Implement advanced control strategies to minimize RTD variability and achieve more uniform reaction outcomes.

#### Conclusion:

The proposed real-time monitoring and control system for plug flow reactor operations offers a comprehensive solution to optimize production, reduce costs, improve scalability, and address current operational challenges. By leveraging cutting-edge sensor technology and advanced control algorithms, the system has the potential to significantly enhance process efficiency and product quality while contributing to long-term economic sustainability.

**Reduction of the emissions of volatile organic compounds (VOCs) in industrial processes.**  Reducing the emissions of volatile organic compounds (VOCs) in industrial processes is a critical environmental and health challenge. VOCs are organic chemicals that easily evaporate into the air and can have harmful effects on air quality, human health, and the environment. Addressing VOC emissions involves a combination of regulatory measures, technological advancements, and cost considerations.

**Previous Work:** Emission Controls Process Optimization

#### Cost Economics:

The cost of implementing VOC emission reduction measures can vary widely depending on factors such as the type of industry, the scale of operations, the regulatory environment, and the specific technology used.

#### New Advancements:

Recent advancements in reducing VOC emissions focus on both technology and process improvements:

Advanced Emission Control Technologies Membrane Separation Bioremediation and Biofiltration Green Solvent Development

## Reducing carbon Emissions in Cement Production: DevelopingSustainable Practices and Technologies to Minimize the EnvironmentalImpact of Fossil Fuel Combustion and Limestone Heating Processes

#### About Cement Production and Carbon Emissions:

Cement production involves the transformation of raw materials, primarily limestone, into clinker through high-temperature processes. This process releases significant amounts of carbon dioxide (CO2) due to the combustion of fossil fuels for energy and the chemical reaction that occurs during limestone heating.

**Previous Work and Efforts:** 

Energy Efficiency Upgrades Alternative Raw Materials and Blended Cements Carbon Capture and Utilization (CCU) Research into Low-Carbon Clinker Alternatives

#### Cost Economics:

Implementing emission reduction measures in cement production often involves initial costs but can lead to long-term benefits:

Capital Investments Operational Savings Regulatory Compliance Market Opportunities

#### New Advancements and Innovations:

Recent advancements in reducing carbon emissions in cement production include:

Carbon Capture and Storage (CCS) Carbon Utilization Electrification Digitalization and AI

The ongoing challenge is to strike a balance between the environmental benefits and the economic viability of these advancements. The cement industry's journey toward carbon emission reduction requires a combination of innovation, policy support, and stakeholder engagement to drive meaningful change.

#### Environmental

#### The Synthesis of Biodegradable Detergents with High Performance: Developing an Efficient and Scalable Manufacturing Process to Meet Consumer Demand and Regulatory Requirements.

Developing a process for the synthesis of biodegradable detergents with high performance involves selecting environmentally friendly raw materials and optimizing the reaction conditions with parameters Emulsification or Micellization, pH Adjustment & Toxicity and Biodegradability.

#### Previous Work:

**1.**The production of biodegradable detergent from Azadirachta Indica (neem) seed oil was studied in this work.

2. Biodegradable synthesis detergents from low temperature lignite tar

#### Cost Economics:

The synthesis of biodegradable detergents presents both challenges and opportunities in terms of cost economics. It's important for manufacturers to strike a balance between the initial higher costs of biodegradable detergents and the potential long-term benefits, such as reduced environmental impact and increased consumer demand for eco-friendly products.

*New Advancements:* Enzyme Engineering Nanotechnology Smart Formulations

Current Issues:

Regulatory Compliance Performance Expectations Raw Material Sourcing Public Awareness and Education

#### <u>Utilizing Agricultural By-Products in Biodegradable Plastics Production:</u> <u>Developing an Efficient and Sustainable Process to Optimize Resource</u> <u>Utilization and Reduce Environmental Impact</u>

Developing a process for utilizing agricultural by-products in biodegradable plastics production involves By product selection, Pre Treatment, Chemical Treatment, Mixing, Plastic Processing, scalability & Environmental Assessment.

#### Previous Work:

#### **1.** Preparation of cellulose acetate from flax fibre and cotton linters

#### 2. Introduction to polylactic acid.

#### Cost Economics:

The use of agricultural by-products in biodegradable plastics production can offer cost advantages compared to traditional fossil-fuel-based plastics. However, there are challenges in terms of processing and refining these by-products into usable plastic precursors, which may require specialized equipment and additional processing steps.

New Advancements:

Advanced Conversion Technologies Biotechnological Approaches Supply Chain Integration

#### Current Issues:

Raw Material Variability Processing Challenges Competition for Resources Regulatory Considerations

In conclusion, utilizing agricultural by-products in biodegradable plastics production offers the potential to create more sustainable and environmentally friendly plastic alternatives.

#### The Degradation of Plastic Materials in Marine Environments: Assessing Microplastics, Degradation Factors, and Implementing Source Reduction and Biodegradable Alternatives to Mitigate Environmental Impact

The degradation of plastic materials in marine environments is essential to understanding the environmental impact of plastic pollution through Microplastics, Degradation Factor, Environmental Impact Assessment by Source Reduction & Biodegradable Alternatives.

#### **Previous Work:**

#### **Degradation of PW**

#### Cost Economics:

The cost economics of addressing the degradation of plastic materials in marine environments involve both short-term and long-term considerations.

Upfront Costs Long-term Savings

#### New Advancements:

Recent advancements in addressing plastic degradation in marine environments include:

Biodegradable Polymers Microplastic Cleanup Technologies Advanced Recycling Technologies Blockchain and Tracking Systems

#### Current Issues:

Some of the current issues related to addressing plastic degradation in marine environments include:

Lack of Regulation Global Cooperation Technological Barriers Waste Management Infrastructure

#### Mixed

#### Minimizing Environmental Impact and Improving Recycling Practices in the Paper Industry: Developing Efficient Recycling Technologies and Collaborating with Stakeholders to Enhance Sustainability and Quality of Recycled Products

The paper industry faces environmental challenges like deforestation and pollution. To minimize pollution, they reuse solid waste, but recycling contaminated paper is difficult and reduces recycled product quality. Solutions include adopting sustainable practices, investing in better recycling technologies, and collaborating with stakeholders to enhance recycling rates and reduce contamination .

#### Cost Economics:

Efforts to minimize environmental impact and improve recycling practices in the paper industry involve both costs and potential economic benefits.

Initial Investment Long-term Savings Market Demand

New Advancements:

Advanced Sorting Technologies Chemical Recovery and Pulping Digital Watermarking

#### Current Issues:

Contamination Infrastructure and Collection Quality Consistency Market Demand and Price

#### Improving the Quality and Eco-Friendliness of Faux Leather: Developing Sustainable Alternatives to PVC Leather to Mitigate Environmental Harm and Enhance Animal Welfare

The faux leather industry faces environmental issues with PVC leather due to dioxin emissions and breathability concerns. To enhance their quality and eco-friendliness, the

industry aims to develop sustainable alternatives that are biodegradable and free from harmful emissions. This will reduce the environmental impact and improve animal welfare while providing a more environmentally friendly and breathable option for consumers.

#### Cost Economics:

Developing sustainable alternatives to PVC leather and improving the eco-friendliness of faux leather can involve both initial costs and potential long-term economic benefits.

**Research and Development** 

**Raw Material Costs** 

**Market Demand** 

New Advancements:

**Bio-Based Materials** 

**Recycled Materials** 

Water-Based Coatings

**3D** Printing

**Current Issues:** 

**Environmental Impact** 

**Quality and Aesthetics** 

**Durability and Longevity** 

**Animal Welfare** 

# Design and develop an AI-based system that can effectively assess the quality of various vegetables and predict their chemical content. The system should take input in the form of images of the vegetables and provide output indicating the quality rating and estimated chemical composition.

The AI model development process involves collecting a diverse dataset of vegetable images, quality assessments, and chemical content measurements. After preprocessing the data, relevant features are extracted for input. The model is trained using a CNN for image analysis and regression/classification models for chemical content prediction. The trained AI model is then integrated into a user-friendly interface for real-time assessment.

#### Cost Economics:

The cost economics of developing this AI-based system include:

**Data Collection and Preparation** 

**Development and Infrastructure** 

**Deployment and Maintenance** 

#### New Advancements:

Recent advancements in AI and related technologies that could enhance the project include:

**Transfer Learning** 

**Explainable AI** 

**Edge Computing** 

Current Issues:

Challenges and current issues in this project include:

#### **Data Quality and Quantity**

Robustness

**User Acceptance** 

#### **CRUCIAL GUIDELINES FOR PARTICIPANTS**

Ensure your Powerpoint presentation includes the following content in a structured sequence:

1.Commence with an introduction to the topic. Offer an initial overview of the subject matter.

**2.Elaborate** on prior work accomplished within the project. The prior efforts and accomplishments dedicated to the project before the current phase commenced.

**3.Highlight prevailing challenges encountered. Provide an overview of the current challenges and issues that the project is currently encountering.** 

**4.**Showcase recent advancements made in the project. Write about the recent groundbreaking developments that have taken place within the project.

5.Introduce your unique model. Provide an introductory overview of your model, detailing its key features, functions, and purposes.

6.Conclude your presentation with a comprehensive summary , summarizing the key findings, outcomes, and implications that have emerged from your research and efforts.