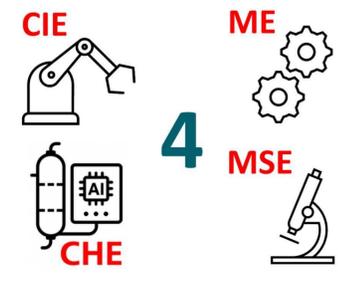




Industrial Oily Wastewater Treatment by Coagulation and Membrane

TEAM: 89

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Introduction/Background

Problem Statement:
 Transforming Industrial Oily Wastewater is designed to develop a sustainable solution for removing hydrocarbons and grease from industrial wastewater using nano-composite membrane technology, ensuring environmental compliance and efficiency.

- Project Goal:**
1. Reduced Environmental Impacts (Waste Emissions)
 2. Recovery of Valuable Resource (Water)
 3. Enhanced Process Efficiency (85-99% Filtration)

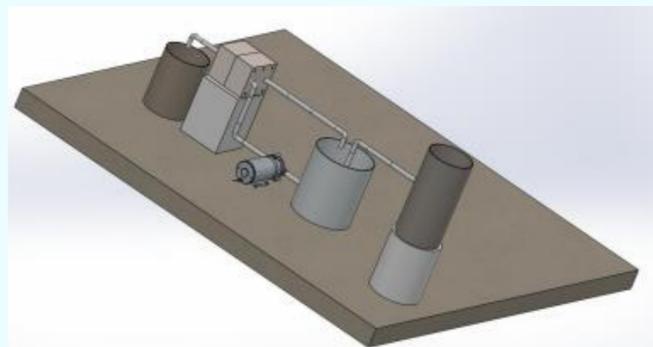
- Constraints:**
- Durability (2-5 years)
 - Drinkable water (oil contaminant < 3 mg/L)
 - Stability
 - Energy consumption (around 160 W)

- Target Specifications:**
- Pressure: 2-7 bar
 - Water purity (removal > 85%)
 - Water Flux (100 L/m²h)
 - Acidity (around 7)
 - Oily wastewater synthesis (10mg/L, 200-400mL emulsifier)
 - Power supply (36V)
 - Leckege (0 droplets)

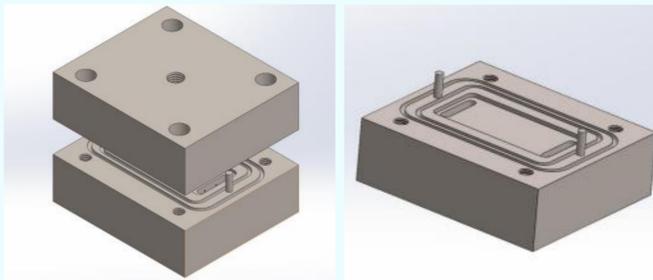
Project Impact

- **Energy Efficiency:** The system is designed to minimize energy consumption by optimizing coagulation and membrane filtration processes.
- **Eco-Friendly Solutions:** Environmentally friendly approaches are integrated into the system.
- **Ease of Operation:** The system is user-friendly and adaptable.
- **Low Maintenance:** Long-term durability is prioritized to reduce operational costs.
- **Long-Term Materials:** Corrosion-resistant and high-durability materials, such as a membrane, extend the system's lifespan and reduce replacement costs.

3D Design



Final Assembly:



Membrane unit:

Testing/Validation

- Using TOC test analysis, we measure oil content of samples:

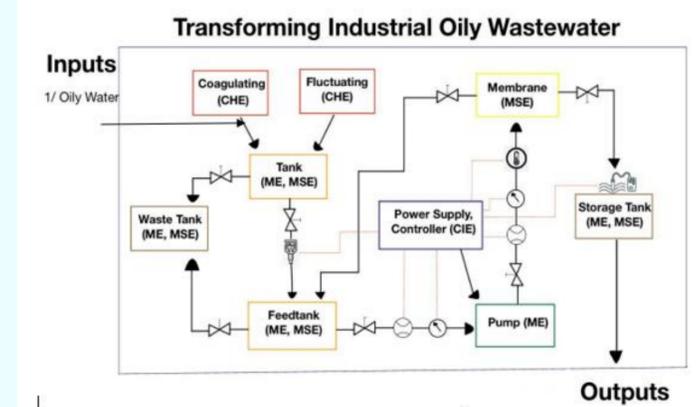
Oil content feed = 1500mg/L

Oil content after the process = 100.8mg/L

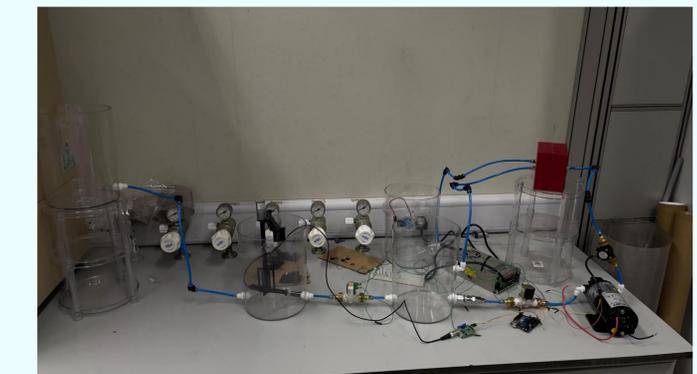
$$\% \text{Oil removal} = \frac{(1500 - 100.8)}{1500} \times 100 = 93.3 \%$$

- Acidity is around 7 based on pH sensor
- Pressure is specified by the pump used (6.22 bar)
- The durability of membrane material is 2-5 years based on literature
- Leakage was prevented by seals

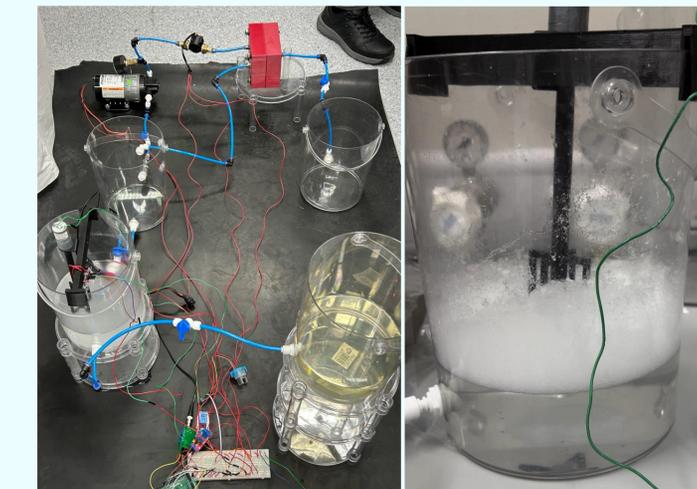
Block Flow Diagram



Prototype



The complete chassis of the device



Novelty and Creativity

- **Novelty (MSE):** Composite Membrane (GO/ZIF-67)
 High purity against oily water
 Long lifespan
- **Creativity (ME):** 3D Printed Crossflow Membrane Unit
 Low prototype cost
 Easy build
- **Creativity (All):** Coagulation/Flocculation + Membrane
 Efficient treatment
 Extending membrane life

Conclusions

Throughout this project, our multidisciplinary team collaborated to develop a sustainable, efficient, cost-effective solution for treating oily wastewater from petrochemical industries. By integrating coagulation and advanced membrane filtration utilizing innovative materials such as GO/ZIF-67 membranes within a 3D-printed filtration cell, we successfully engineered a prototype that prioritizes durability, environmental responsibility, and operational efficiency. The system demonstrated exceptional performance, achieving over 88% contaminant removal. Furthermore, accurate material selection, energy optimization, and system layout contributed to an energy-efficient process without compromising treatment quality. Beyond its technical success, this solution addresses critical environmental and societal challenges, particularly in water-scarce regions such as Saudi Arabia.

Future Recommendation

To further advance this system, we recommend optimizing the GO/ZIF-67 membrane formulation and scaling its fabrication process through collaborative efforts with research institutions or industry partners. This will enhance its commercial viability while maintaining high flux and durability. Additionally, future testing should transition from synthetic wastewater to real refinery effluent to validate system performance under variable and more complex industrial conditions. Such evaluations will ensure robustness and adaptability in practical applications.