TEAM 079

Energy and Nutrient Recovery from Sewage Sludge

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Problem Statement

Energy and Nutrient Recovery System in Sewage Sludge aims to minimize sludge volume, permit the production of renewable energy through anaerobic digestion, and recover nutrients to form Class A fertilizers, thereby providing an environmentally friendly and economically sustainable wastewater treatment solution for the Kingdom of Saudi Arabia.

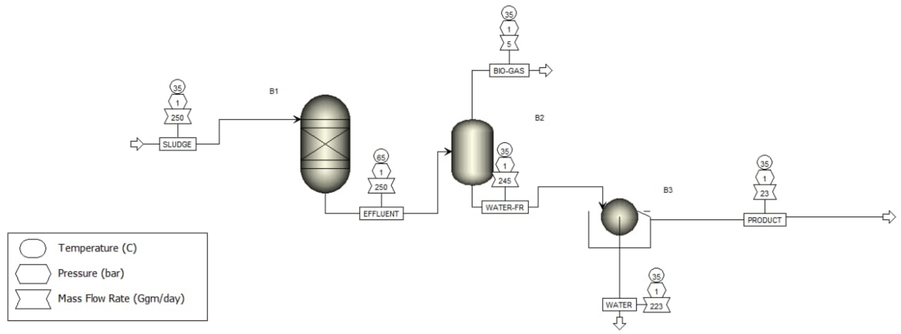
Objective

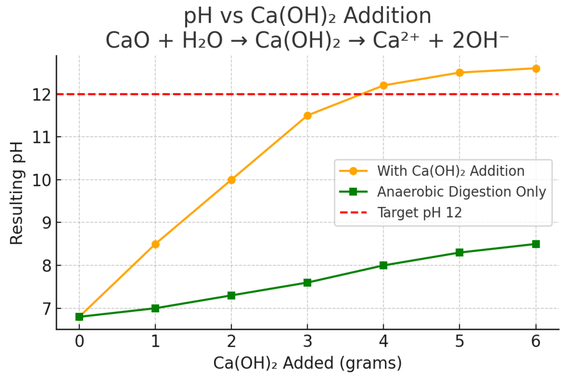
The intention of this project is to develop a less dependent system that reduces sludge volumes, produces energy through digestion, and extracts nutrients to produce class A fertilizer.

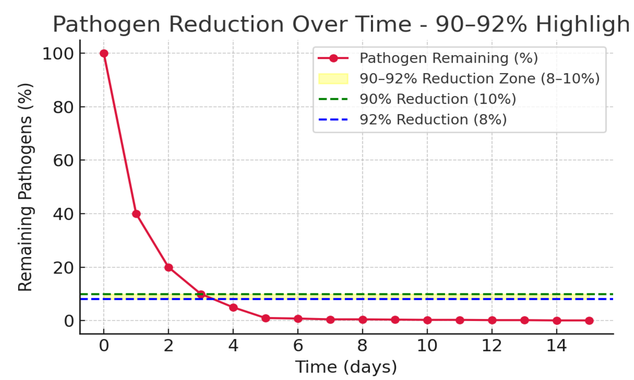
Specifications

- PH Range Between: 12-12.8
- Biogas Production: At least 200 mL per 100 g of sludge.
- Fertilizer Nutrient Composition: N: 4%, P: 3%, K: 2%.
- Pathogen Removal Efficiency: Greater than 90% in treated sludge.
- Energy Production: The system should generate more than 1 kWh per 100 g of sludge.
- Prototype Capacity: Should handle sludge volumes between 250–500 g per day.
- Energy Self-Sufficiency: Biogas should supply more than 30% of the system's energy needs.
- Fertilizer Production Rate: 75g per day with NPK quality.

Conclusions







Constraints

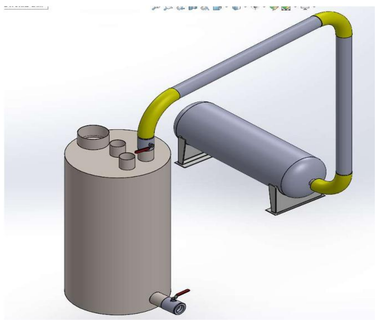
Time for sewage treatment: 15-25 days

System Operating Temperature: 35-65°C

The system reduces sludge volume ≥ 30%

Land Area for Plant: ≤ 2000 m²

Final Design



Conclusions

This project designed and tested a sewage sludge treatment prototype targeting Class A fertilizer production. While full functionality was not achieved, the system's theoretical performance combining lime stabilization and thermophilic digestion was verified through simulations and analysis. Key insights into mechanical and chemical challenges were gained, providing a solid foundation for future improvements toward sustainable fertilizer solutions aligned with Saudi Vision 2030