

Sustainable Ethanol Production from Agricultural Waste

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ENGINEERING & SCIENCE
STUDENT DESIGN SHOWCASE

FLORIDA TECH

Abstract

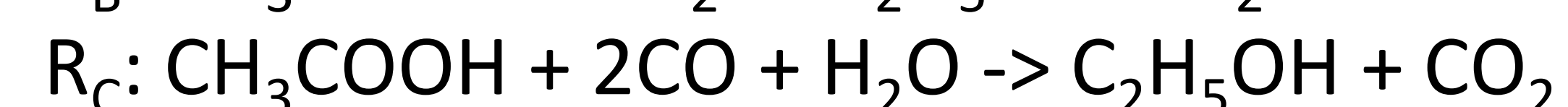
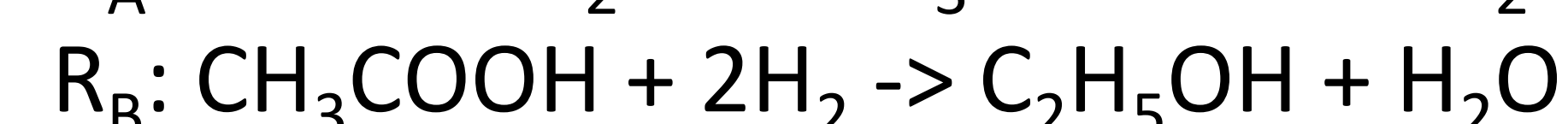
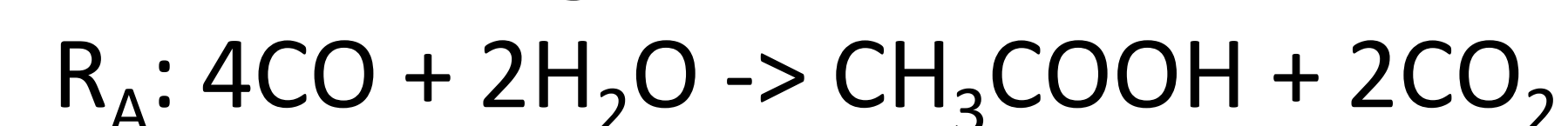
This project details the design of a commercial-scale facility in De Soto, Kansas, intended to convert corn stover into 300,000 MT/yr of high-purity ethanol. Utilizing a hybrid thermochemical-biochemical pathway, the process bypasses the need for expensive enzymes required in traditional cellulosic hydrolysis. The final product achieves a 99.5% purity level, optimized for industrial applications.

Novelty

- **Feedstock Valorization:** Converts 250 million tons of underutilized agricultural waste into high-value chemicals
- **Non-Food Competition:** Unlike starch-based ethanol, this process does not threaten the global food supply
- **Self-Sustaining Integration:** The plant generates its own syngas on-site, removing dependency on external industrial off-gases
- **Advanced Kinetic Modeling:** The simulation integrates modified Monod kinetics with bubble column mass transfer coefficients for realistic industrial scaling
- **Byproduct Utilization:** Process byproducts are valorized for greater profitability and sustainability

Reactions

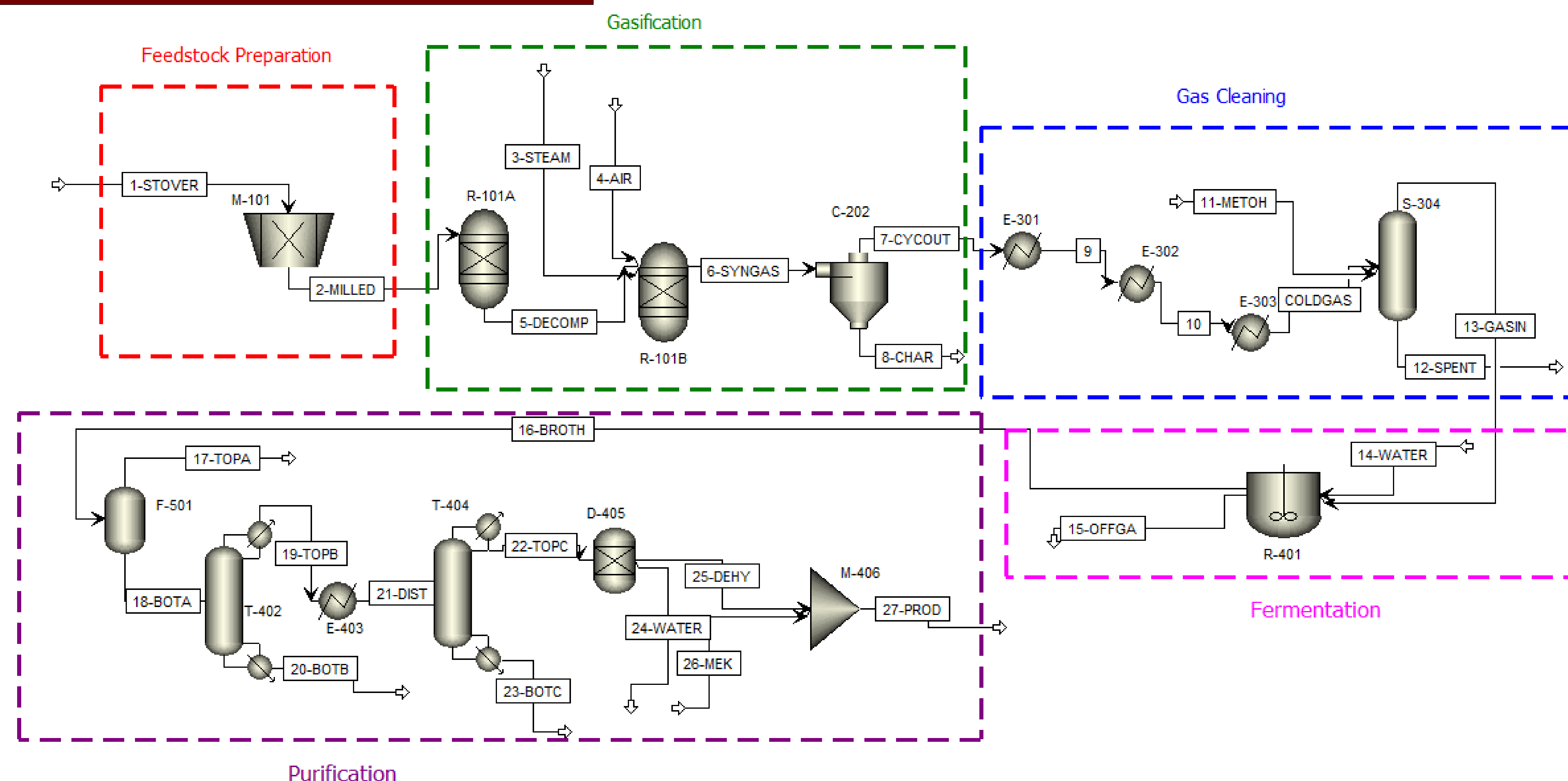
Wood-Ljungdahl Pathway via Clostridium autoethanogenum



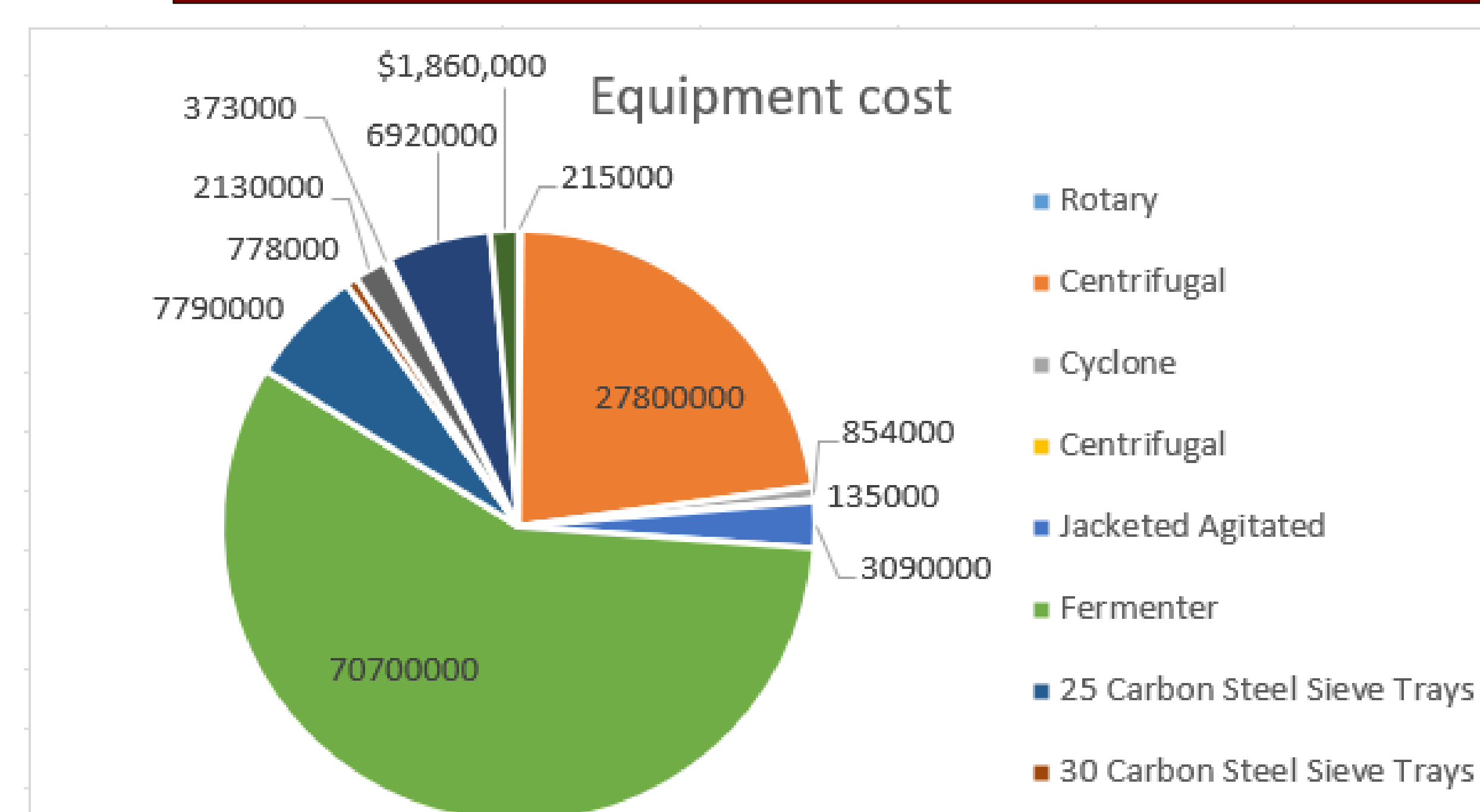
Process Specifications

- **Location:** DeSoto, Kansas
- **Feedstock:** 187,667 kg/hr of corn stover with < 20% moisture.
- **Gasification:** Fluidized bed at 850 °C and 1 bar using an olivine catalytic bed.
- **Fermentation:** Anaerobic bubble column at 37 °C, 5 bar, and pH 5.
- **Dehydration:** 20-unit 3A molecular sieve system
- **Denaturant:** Methyl Ethyl Ketone (MEK) added at 1% to 2% by volume.

Process Flow Diagram



Economics and Profitability



Cash Flow Diagram

