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Background

- Pearl millet is a major crop in India, particularly for the lower classes¹
- Pearl millet flour has a shelf life of about 8-10 days²
- Rancidity is caused by lipase turning the lipids into free fatty acids (FFAs)
- Heat is one way deactivate enzymes

Problem Statement

- Determine a cost-effective method to heat treat pearl millet in order to deactivate lipase to extend shelf life

Objectives

- Deactivate lipase in pearl millet
- Maintain a constant moisture content
- Maintain pasting properties
- Keep cost under \$20,000

Global and Societal Impacts

- Effective deactivation of lipase will extend the shelf-life of pearl millet flour
- With a longer shelf-life, less pearl millet will go to waste

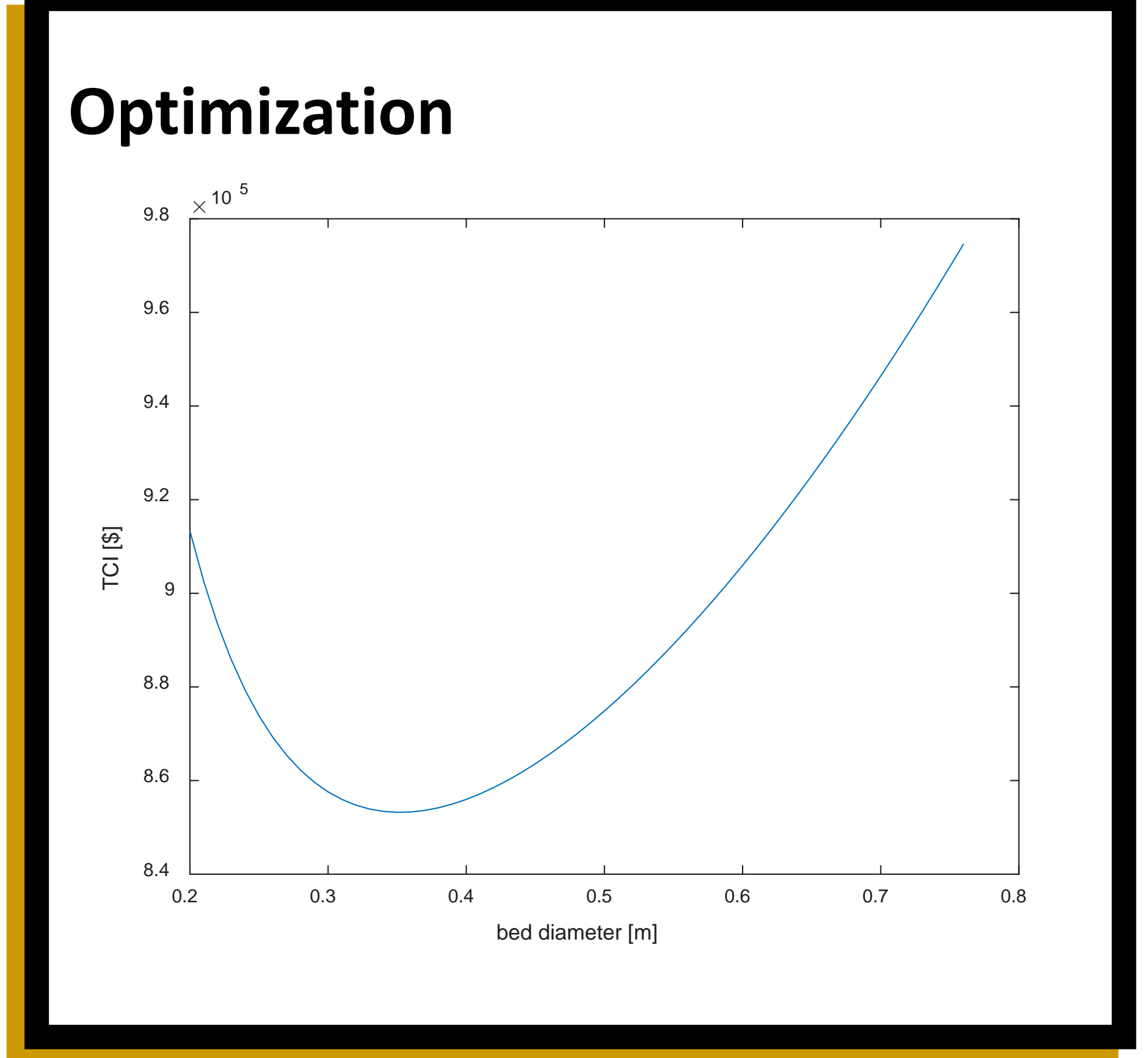
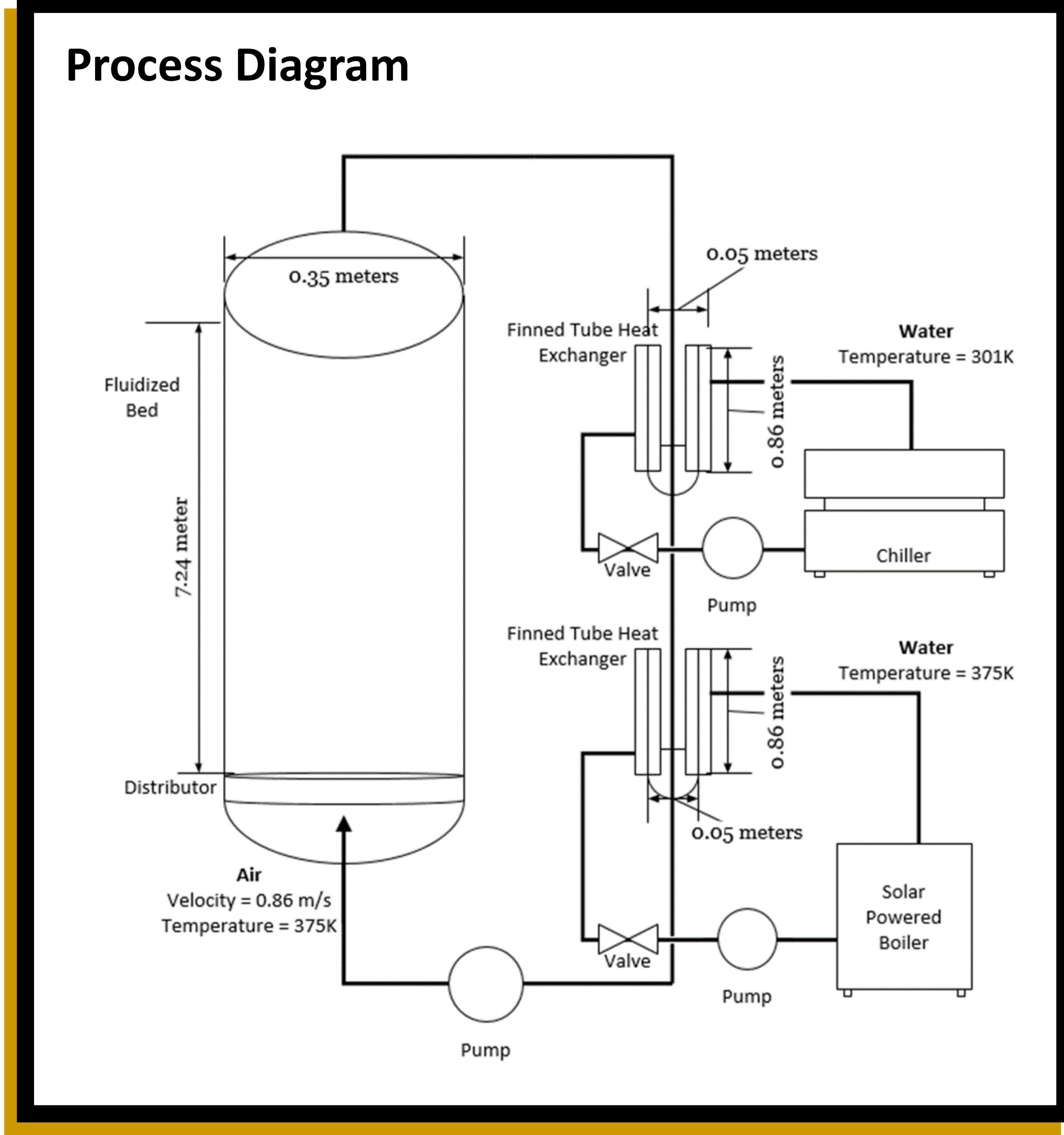
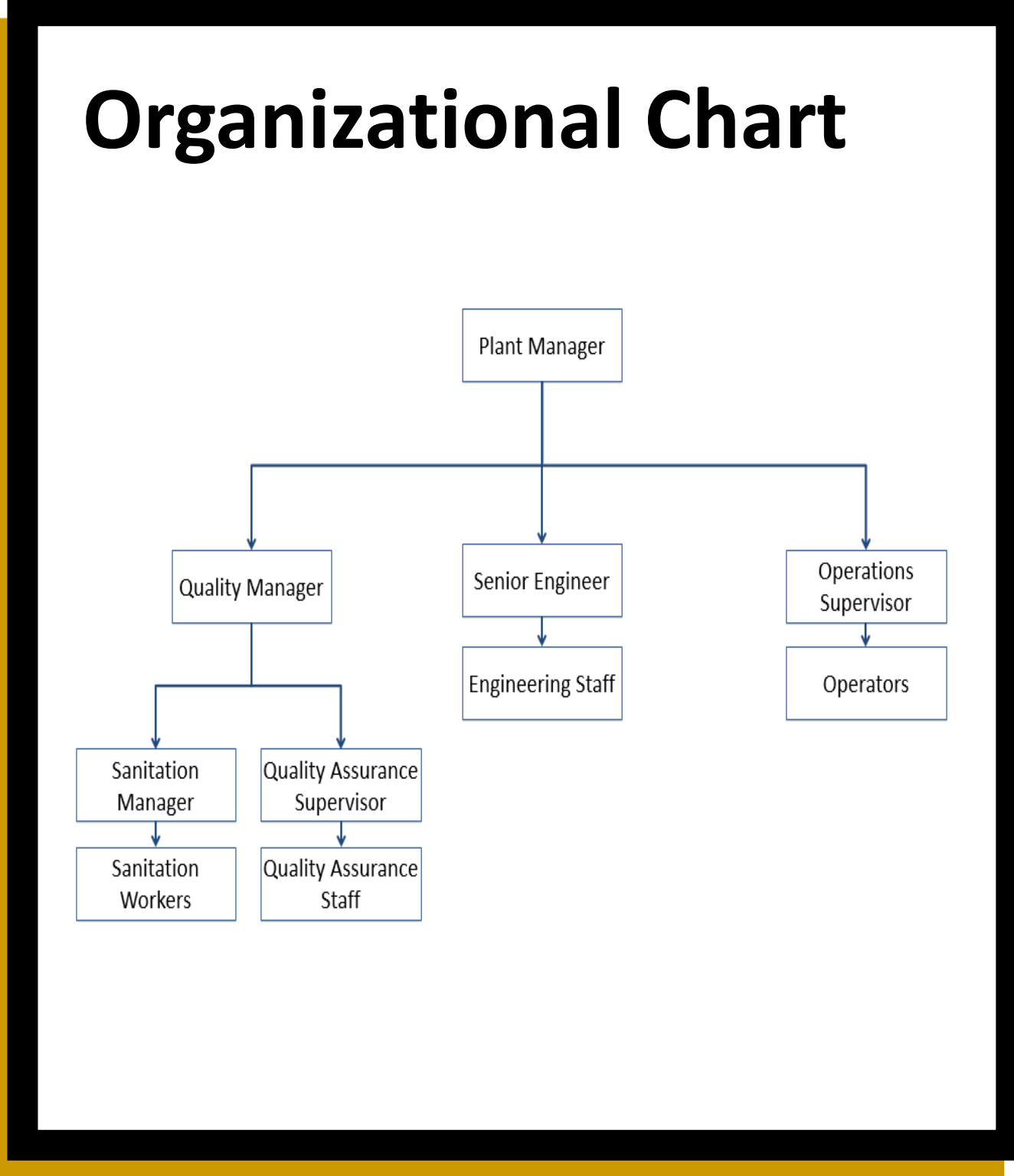
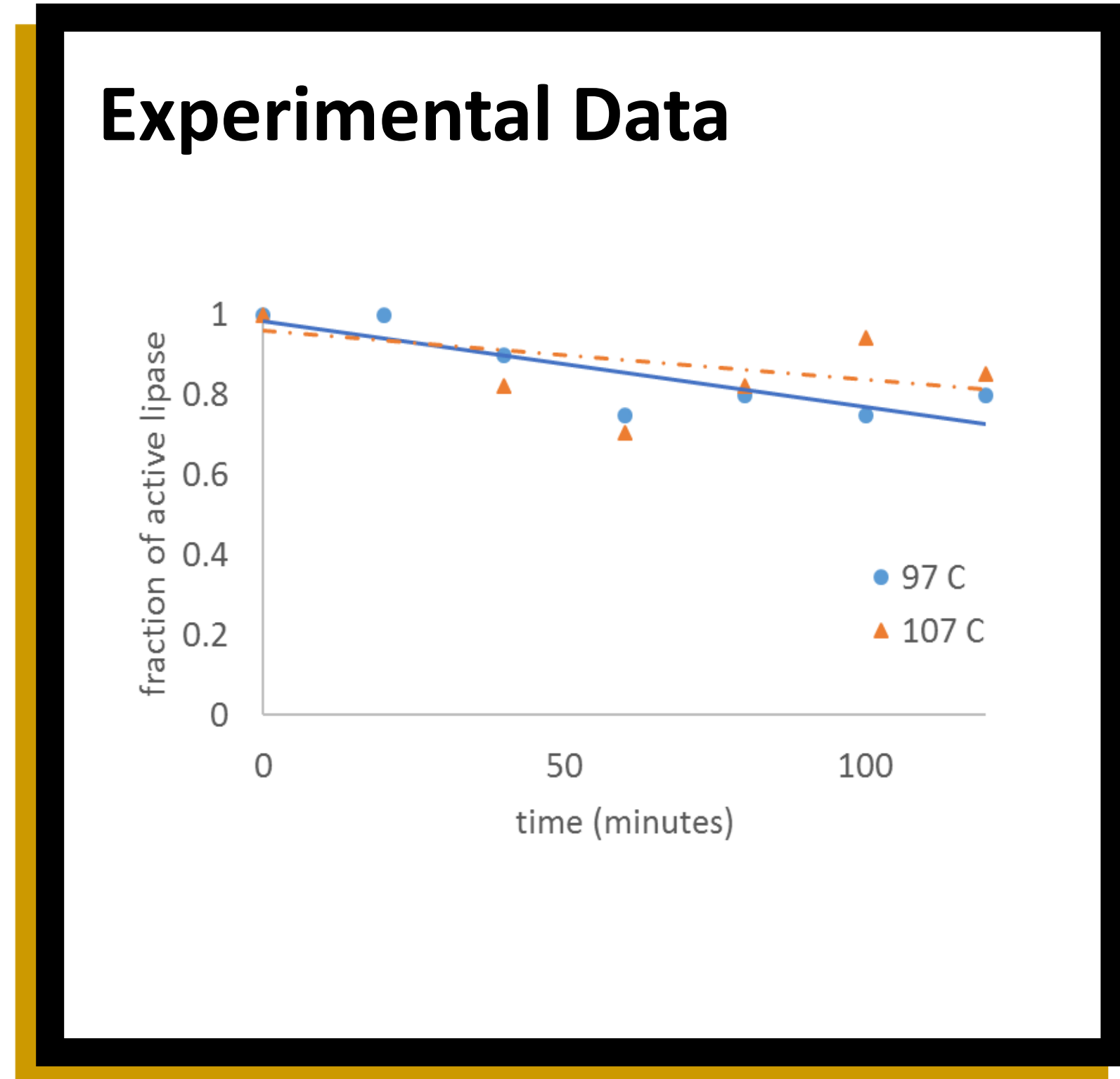
Sustainability

- India's sunny climate allows for solar power to be used
- Water is continuously recycled through the heat exchangers

Morphological Analysis

The Problem—Reaction Kinetics

Experiments²



Processing Requirements and Economics^{3,4}

Requirement	Load	Equipment	Size/Capacity	Cost (USD)
Batch size	253 kg pearl millet	Fluidized bed	0.70 m ³	133,940
Cycle time	7 hours	Piping	14.5 m	8,490
Throughput	1.64 bushels/hour	Heat exchanger (2)	0.40 m ²	27,191
Power required per batch	7.65 kW	Pumps (2)	0.86 m/s	200
Total Equipment Cost				169,821

Break-Even Chart

Future Work

- Correlate percent deactivation with how many days the shelf-life is extended
- Measure pasting properties after deactivation
- Test process in a fluidized bed

References
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