Synthesis of an HPMC-g-PEA Hydrogel for Chronic Wound and Burn Care Applications

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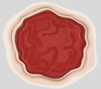
CHRONIC WOUNDS & BURNS

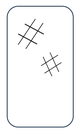
- Treatment is challenging due to[1]:
  - Increased risk of infection
  - Patient discomfort
  - Slow healing rates
- Large cost burden on the Canadian healthcare system.

Chronic Wounds
$3.9 B/year [2]



Burns
$177 M/year [3]

- Some wound dressing options include:



Gauze[1]
- Adheres to the wound, causing pain and damage upon removal

Hydrocolloids[4]
- Expensive
- Slow healing due to low oxygen exchange

THE GLIXO SOLUTION

- A hydrogel wound dressing that provides[5]:
  - Natural cooling sensation
  - Oxygen exchange for faster healing
  - Moisture at the wound site
  - Simple removal by rinsing with water, for ease of use at home and in clinical settings

PLANT SPECIFICATIONS

Annual Operating Hours	2400
10	Years of Plant Operation
Minimum Plant Square Footage	455

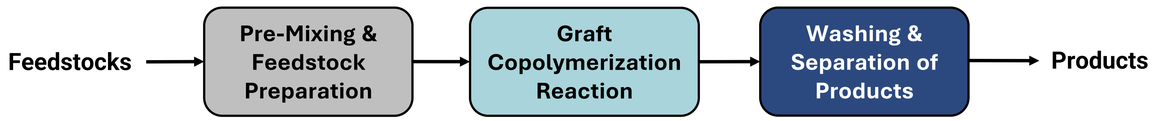
Location[6]: Calgary AB

Hydrogel		PEA
26,667	Product Output (kg/year)	2051
$250	Sale Price (CAD/kg)	$3000

ACKNOWLEDGEMENTS

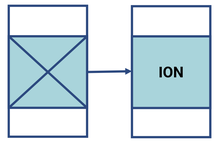
Thank you to Dr. Gemma (Qingye) Lu and Amber Chen for supporting and supervising this project.

PROCESS OVERVIEW



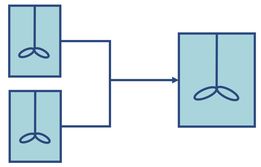
1 Water Filtration

- De-ionized (DI) water is used throughout the process
- Produced by filtering municipal water
- Stored for later use

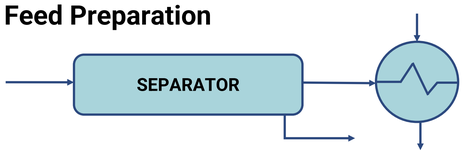


2 Primary Feed Preparation

- Dissolution and mixing of:
  - Polymer backbone, hydroxypropyl methylcellulose (HPMC)
  - Reaction initiator, potassium persulfate (KPS)



3 EA Feed Preparation



- Ethyl acrylate (EA) is washed with 5% NaOH to:
  - Remove impurities
  - Remove MeHQ, an inhibitor that prevents EA polymerization during storage.
- EA is heated before the reactor with a hot water loop

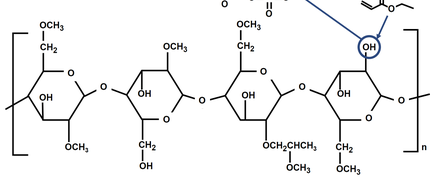
4 Graft Copolymerization Reaction

- EA is grafted onto HPMC using KPS as an initiator[7,8,9]
- Continuously-stirred tank reactor
- Highly exothermic (-484 kJ per kg hydrogel)
- Reaction conditions; T=60°C, P=115 kPa

Reaction 1: 688 HPMC + 6068 EA → **1 HPMC-g-PEA** (product)
Reaction 2: 4535 EA → **1 PEA** (byproduct)

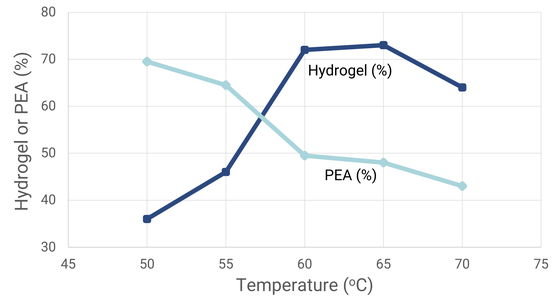
Initiator – KPS[11]

Monomer – EA[12]



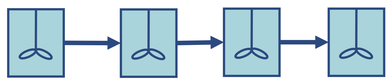
Base polymer – HPMC[10]

Grafting Percentages[7]



5 Washing and Separation

- 4-step process to remove contaminants
- Hydrogel is vacuum dried and UV sterilized
- Packaged in 100g tubes



6 PEA Recovery

- Recovered from ethanol washing streams
- Water is added to precipitate PEA from the solution
- Sold to qualified suppliers to be purified and used in various biomedical applications[13,14]

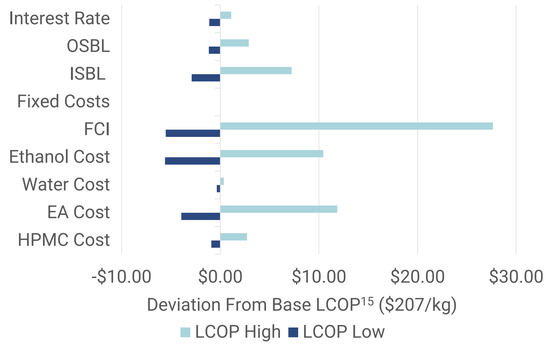
Artificial Corneas

Cell Culture

ECONOMIC EVALUATION

Parameters[15]	Results
Total Capital Investment	$9 010 000
Net Present Value	$16 572 000
Discounted Rate of Return	60%
Simple Payback Period	0.6 years
Annual Operating Costs	$5 439 000/year
Annual Revenue	$12 684 000/year
Average Annual Net Profit	$6 013 000/year
Project is Low Risk & Feasible!	

Sensitivity Analysis



PROJECT IMPACTS

Safety

- Compliance with **medical product quality** regulations
- Proper storage and heating of EA monomer[16]
- **Prevention of thermal runaway**
- Inherently safer design
  - Limiting use of hazardous substances
  - Low temperatures and pressures throughout
- **Process and safety control systems** identified through hazard and operability (HAZOP) study

Environmental

- Reduction of waste through **PEA byproduct recovery**
- **Hydrogel biodegradability** prevents environmental accumulation
- Minimal plant footprint

Social

- Creating jobs in Alberta within the biomedical field
- Improving **accessibility and affordability** for Canadian consumers

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