Engineered Application Device For Graffiti Removal

Mechanical Engineering
University of Colorado Boulder

University of Colorado Boulder | Colorado Mesa University

Ethan Davis · Kassidi Day · David Hale · Dylan Hallett

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Background

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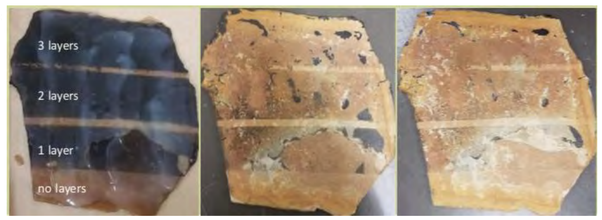
** 

Design Results

- ✓ Portability and weight meet requirements
- ✓ Storage tank holds & mixes 1.5 gal. of mixture
- ✓ Maintains desired temp ±5°C for 2 hours
- x Power required unconfirmed (see next steps)
- x Dispensing of mixture unverified (see next steps)

Next Steps

- Add trigger to applicator head that actuates CO_2
- Test system to ensure that applicator head ejects and evenly spreads mixture onto surface at 1.25 g/in^2
- Implement small battery-powered motor for mixing
- Test whole system

*Promposal on the Colorado National Monument
**Figure of test done by CMU Chemistry Team

Design

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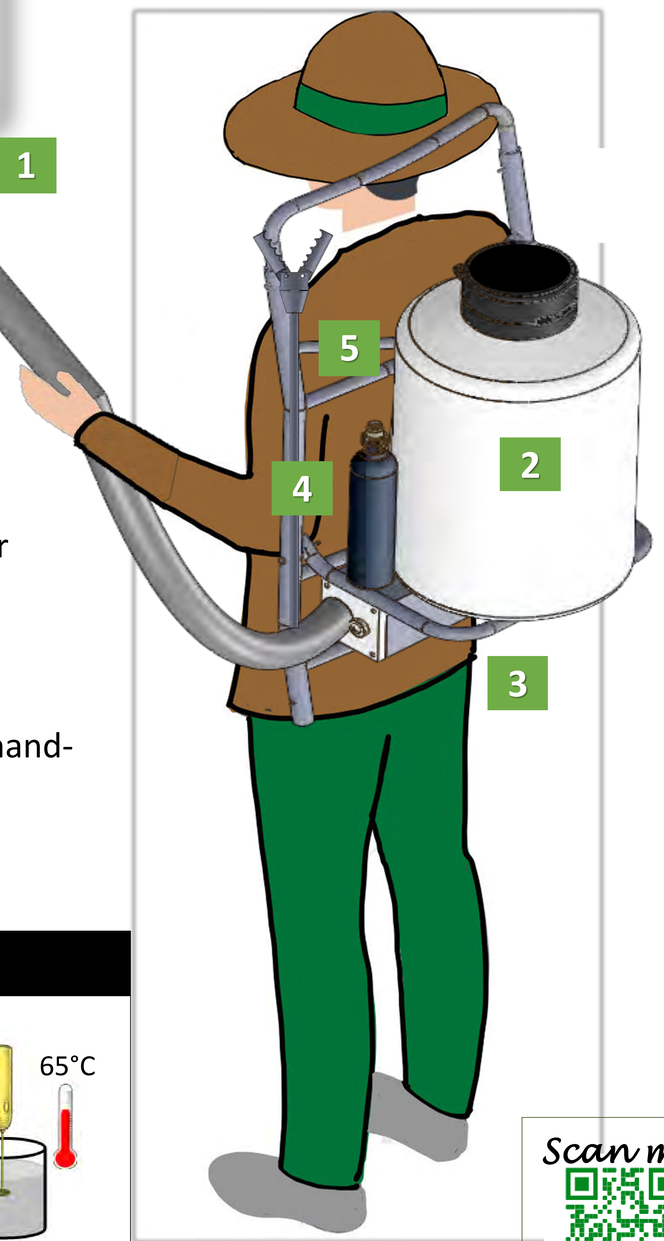


1 Detachable Applicator Head

- Dispenses and spreads mixture at 1.25 g/in^2

2 Starch Mixture / Storage Tank

- Holds 1.5 gal. of starch mixture at ~65°C for two hours

3 Pumping Mechanism

- Dispenses mixture using CO_2 and a manual pneumatic cylinder
- Compressed gas power used to pump mixture

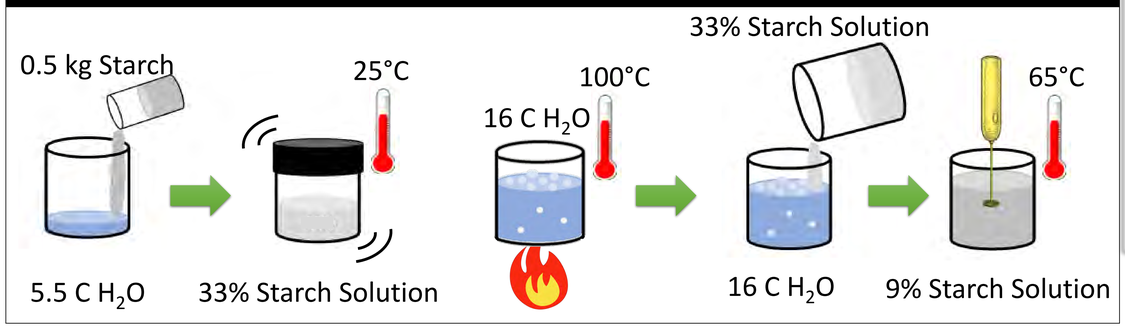
4 Mixing Mechanism

- Mixes starch mixture at graffiti site
- Power required for mixing by battery smaller than common hand-drill battery

5 Frame Pack

- Portable for off-grid use with system weight less than 50 lb

Starch Mixture – Shock Method



Scan me
For team video

Sponsor: Christopher Penick | Acknowledgments: Dr. Andrew Wolff, CMU Chemistry Team, Lockheed Martin, President Tim Foster, Dr. Scott Kessler, Unconventional Energy Foundation

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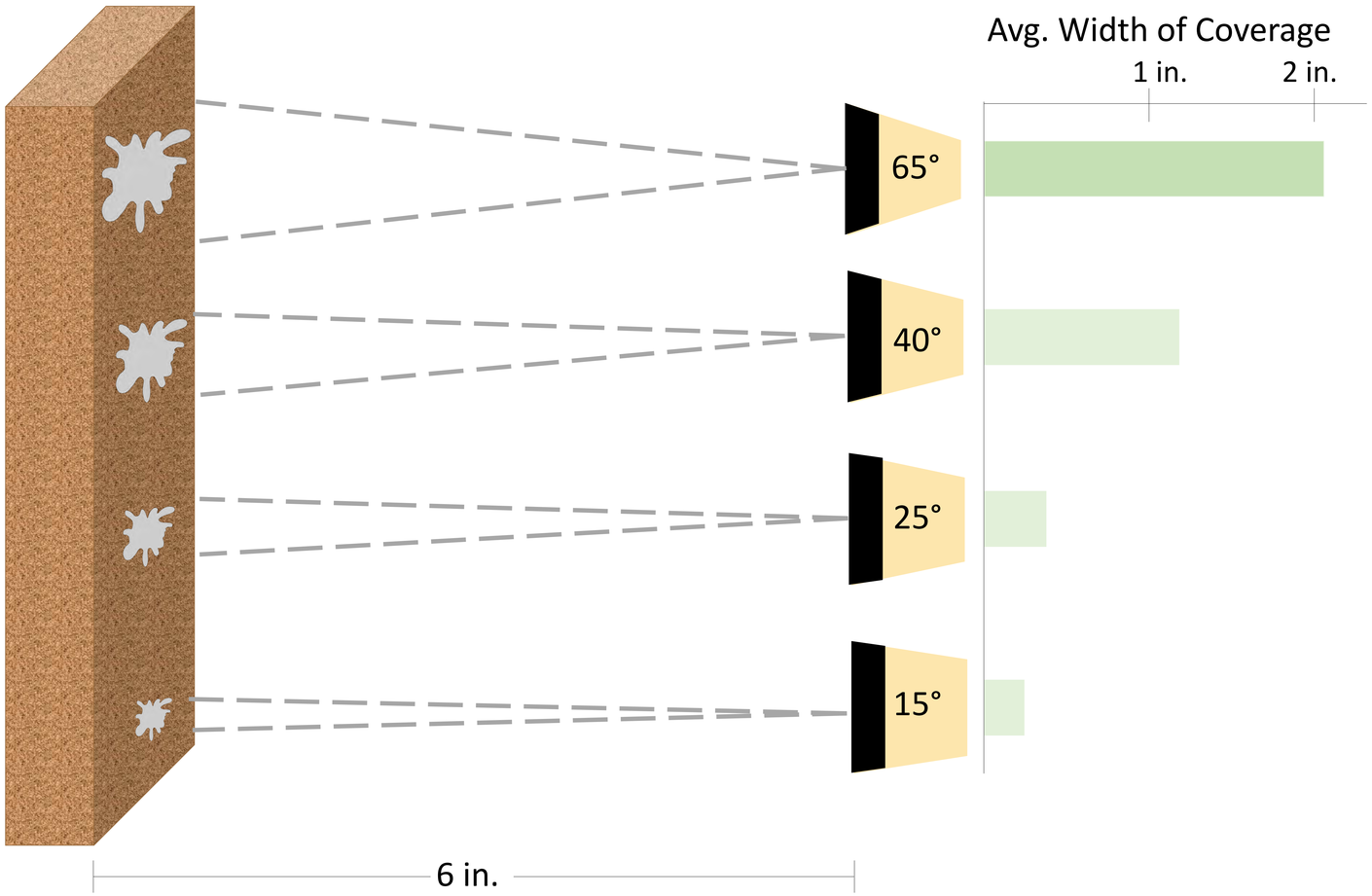
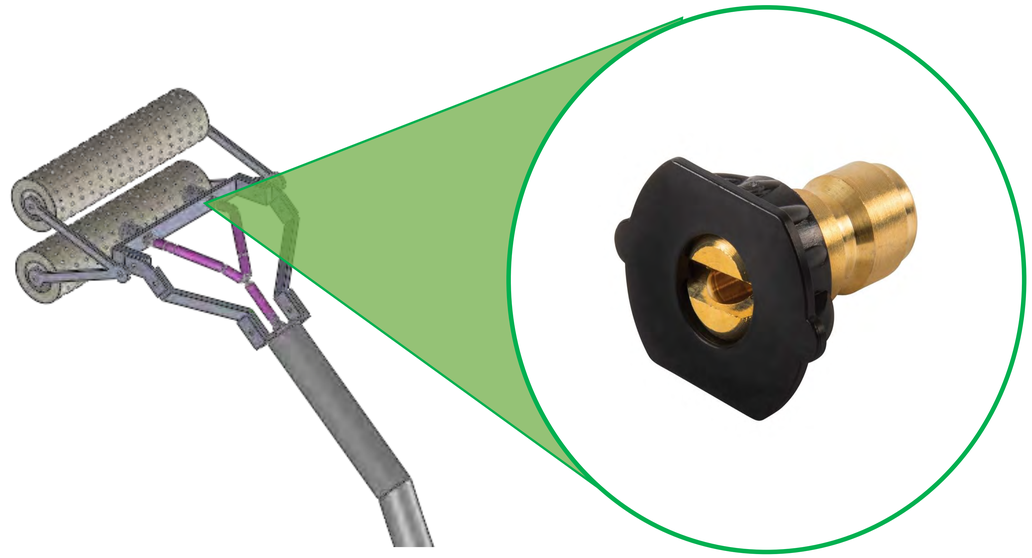
1 Detachable Applicator Head





X Dispensing of mixture unverified

Next Steps

- Add trigger mechanism to applicator handle
- Test system to ensure that applicator head ejects and evenly spreads mixture onto surface at 1.25 g/in^2

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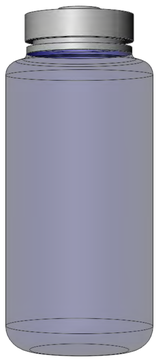
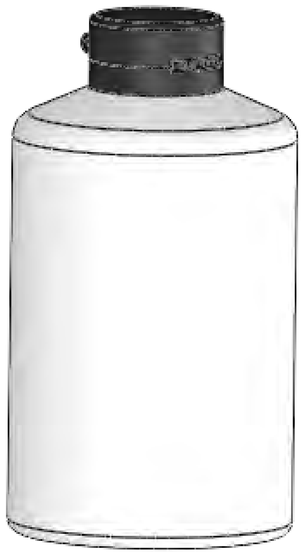
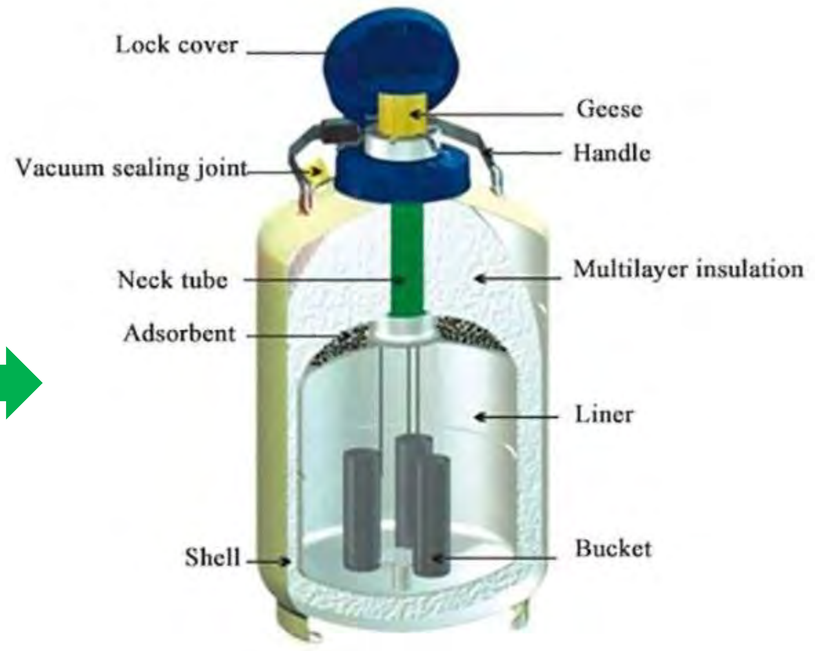
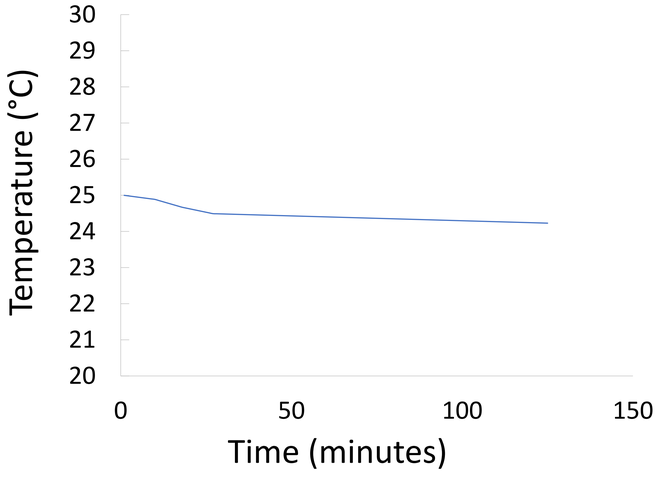
2 Starch Mixture / Storage Tank



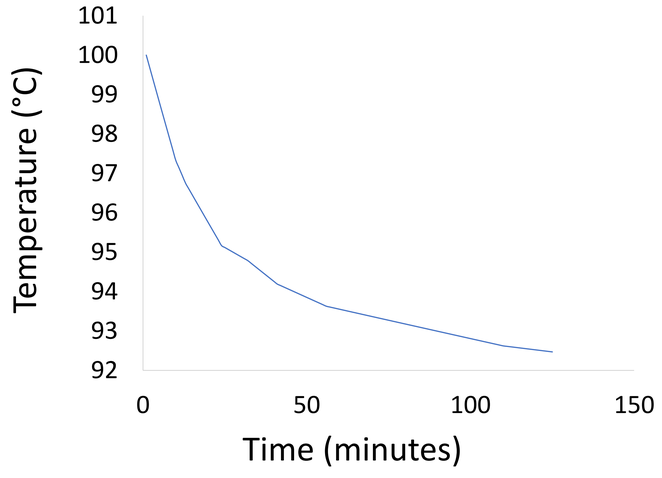




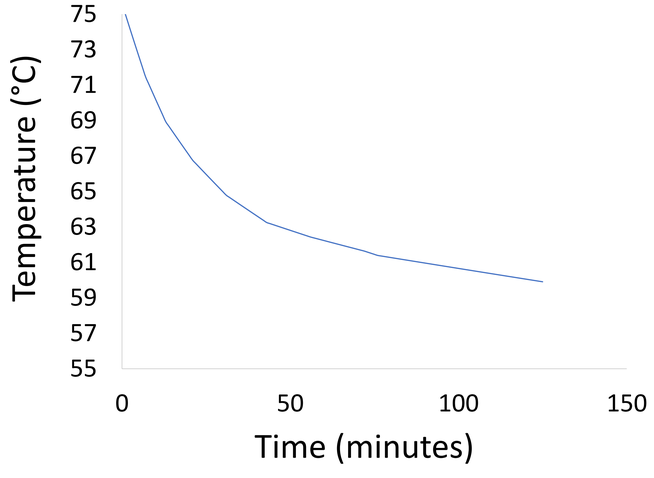
Slurry- Time vs Temperature



Water- Time vs Temperature



Mixture- Time vs Temperature



✓ Maintains slurry at 25 ± 5°C for 2 hours

✓ Maintains water at 95 ± 5°C for 2 hours

✓ Maintains mixture at 65 ± 5°C for 2 hours

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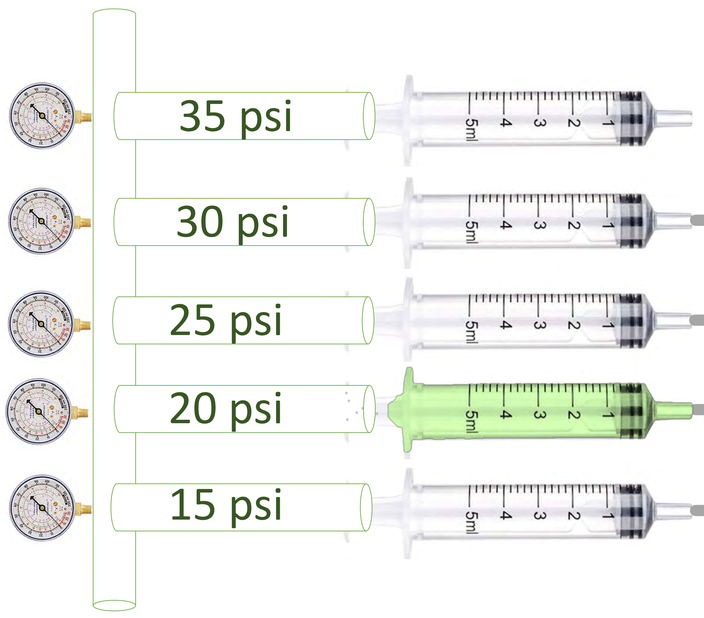
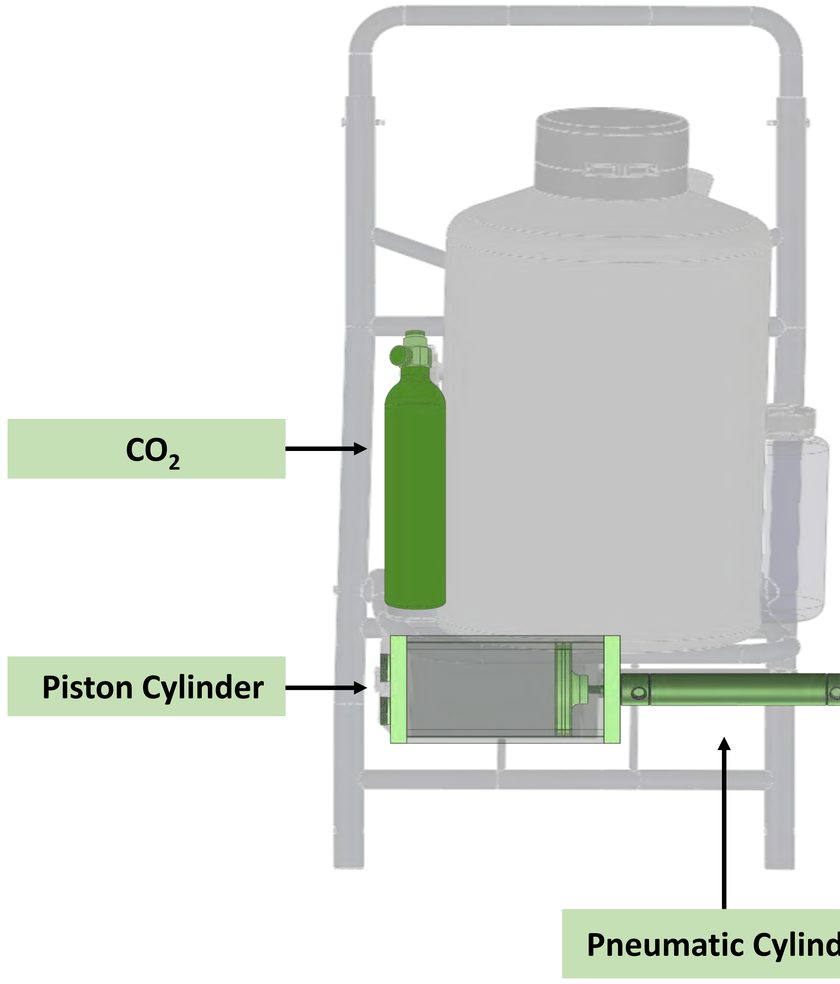
3 Pumping Mechanism

Due to the properties of a dilatant fluid, high pressures caused air to blow straight through the fluid creating a "hole".



Hole?
Yes
Yes
Yes
No
No



X Dispensing of mixture unverified

Next Steps

- Implement trigger to actuate CO_2
- Test whole system

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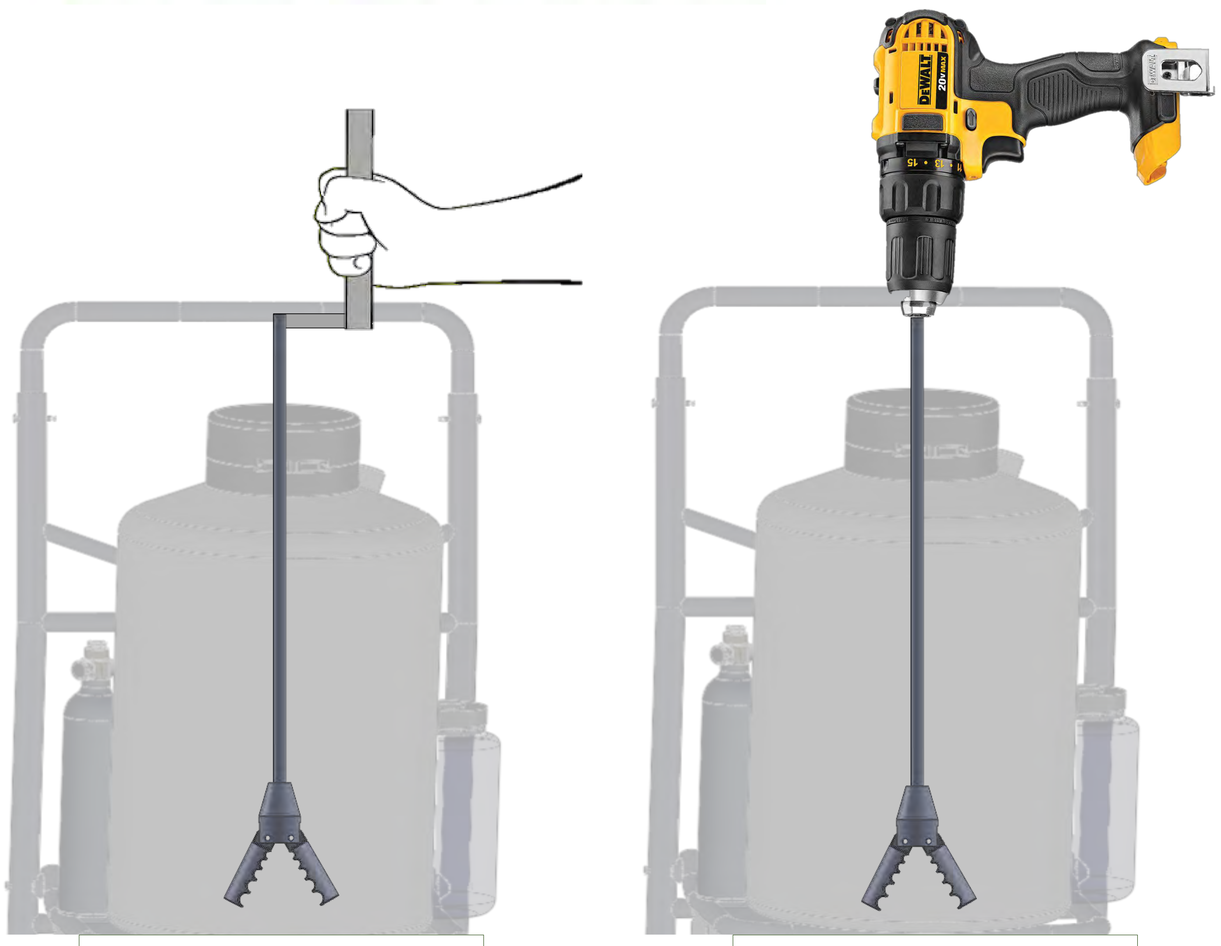
4 Mixing Mechanism



9 min.
mixing time

1 min.
mixing time

✓ Mixes 1.5 gallons of starch mixture

X Power required unconfirmed

Visual Consistency of Shampoo

Next Steps

- Implement small battery-powered motor to agitate swing mixer

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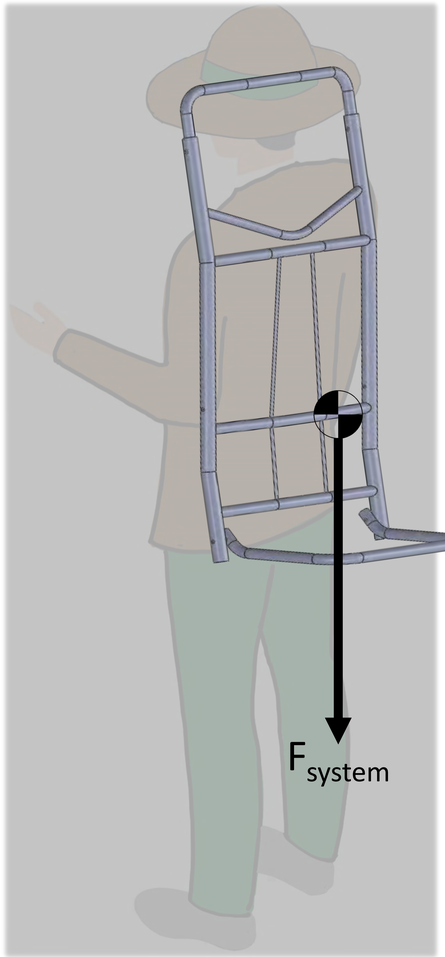
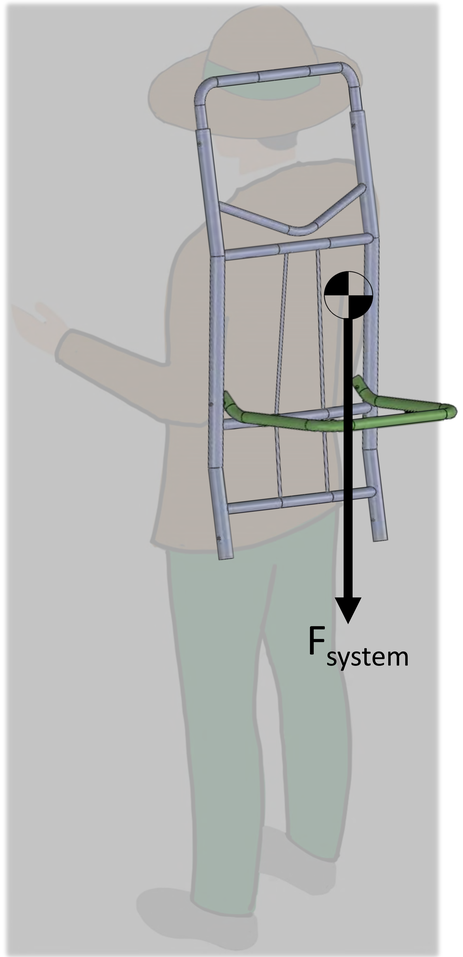
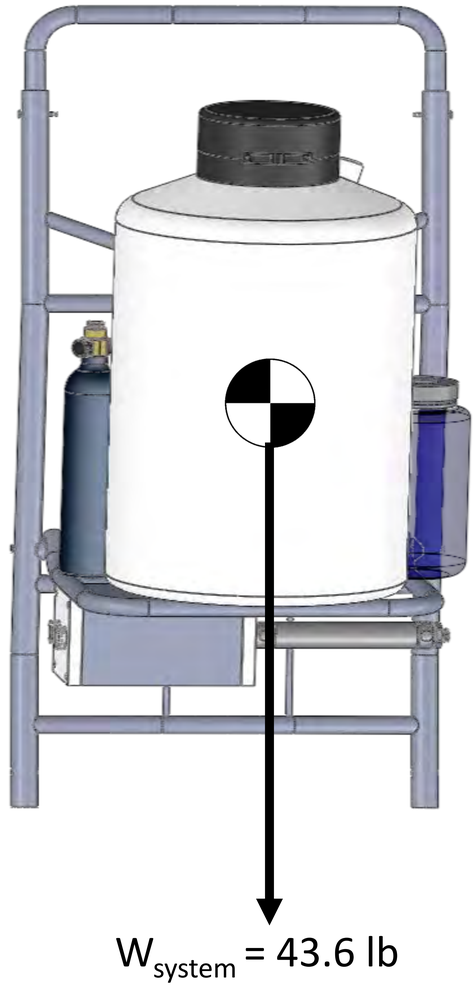
5 Frame Pack



The base of the frame pack was adjusted to reduce the moment felt by the user.





✓ Portability and weight meet requirements

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> Budget & Next Steps

Budget:

Component Category	Cost
Applicator Head	$ 292
Starch Mixture/Storage Tank	$ 504
Pumping Mechanism	$ 776
Mixing Mechanism	$ 40
Frame Pack	$ 65
Total	$1,677
Unused from Unconventional Energy Fund	$1,823

Next Steps

- Add trigger to applicator head that actuates CO_2.
- Test system to ensure that applicator head ejects and evenly spreads mixture onto surface at 1.25 g/in^2.
- Implement small battery-powered motor for mixing.
- Manufacture necessary components.
- Test whole system.

Timeline: