Engineered Application Device For Graffiti Removal
University of Colorado Boulder | Colorado Mesa University
Ethan Davis • Kassidi Day • David Hale • Dylan Hallett

Background

Design

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 CO₂
• Test system to ensure that applicator head ejects and evenly spreads mixture onto surface at 1.25 g/in²
• Implement small battery-powered motor for mixing
• Test whole system

1 Detachable Applicator Head
• Dispenses and spreads mixture at 1.25 g/in²

2 Starch Mixture / Storage Tank
• Holds 1.5 gal. of starch mixture at ~65°C for two hours

3 Pumping Mechanism
• Dispenses mixture using CO₂ 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

0.5 kg Starch
25°C
100°C
5.5 C H₂O
33% Starch Solution

16 C H₂O
33% Starch Solution

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For team video

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

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

Avg. Width of Coverage

- 1 in.
- 2 in.

- 65°
- 40°
- 25°
- 15°

6 in.

× 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/in²
2 Starch Mixture / Storage Tank

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
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

35 psi
30 psi
25 psi
20 psi
15 psi

X Dispensing of mixture unverified

Next Steps
- Implement trigger to actuate CO₂
- Test whole system
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4 Mixing Mechanism

![Diagram of mixing mechanism]

- **9 min.** mixing time
- **1 min.** mixing time

Visual Consistency of Shampoo

- **✓** Mixes 1.5 gallons of starch mixture
- **✗** Power required unconfirmed

**Next Steps**
- Implement small battery-powered motor to agitate swing mixer
The base of the frame pack was adjusted to reduce the moment felt by the user.

Portability and weight meet requirements

\[ W_{\text{system}} = 43.6 \, \text{lb} \]
Budget & Next Steps

Budget:

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<tr>
<th>Component Category</th>
<th>Cost</th>
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<tr>
<td>Applicator Head</td>
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<tr>
<td>Starch Mixture/Storage Tank</td>
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<tr>
<td>Pumping Mechanism</td>
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<td>Mixing Mechanism</td>
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<td>Frame Pack</td>
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<td><strong>Total</strong></td>
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<tr>
<td>Unused from Unconventional Energy Fund</td>
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</tbody>
</table>

Next Steps:

- Add trigger to applicator head that actuates CO₂.
- Test system to ensure that applicator head ejects and evenly spreads mixture onto surface at 1.25 g/in².
- Implement small battery-powered motor for mixing.
- Manufacture necessary components.
- Test whole system.

Timeline:

- **Phase 1**: Research & Design
- **Phase 2**: Preliminary Design
- **Phase 3**: Final Design & Manufacture
- **Phase 4**: Testing & Evaluation