Development of Engineering Guidelines for Synthetic Fluid Dust Control Palliative Application
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Funding

Midwest Industrial Supply, Inc

Center for Environmental Sustainable Transportation in Cold Climates
1. Synthetic fluids have become an effective choice for dust management.

2. Synthetic fluids have become the choice product for dust management on Alaska’s rural runways and in some rural village roadways.

3. Synthetic fluids are broadly used around the world for dust management.

4. Experience of the manufacturers is currently the only engineering guidelines available.

5. UAF - AUTC has been conducting research on the use of synthetic fluids for dust management for the last eight years.
Results from Mobile Monitor

- Average PM10 Concentration (mg/m³)
- Fines Content (% Passing #200 Sieve)

Locations:
- Wales
- Buckland
- Kotzebue
- St Michael
- Kobuk
- White Mountain
- Summit

Since 1917
Influence of Bulk Density?
Synthetic Fluid Effectiveness Longevity
Project Objectives

1. Develop a correlation between the physical properties of aggregate and synthetic fluid dust control palliative performance.

2. Develop a correlation between a laboratory based palliative performance testing method (Dust Fall Test) and a field based palliative based testing method (UAF-DUSTM).

3. Use the results from objectives 1 and 2 to develop engineering guidelines for the application of synthetic fluid palliatives on gravel roads and runways.
Methodology

1. Understand how the fluid is existing in the pore space of the aggregate.

2. Test performance of different products (Midwest Industrial Supply, Inc. products) at different application rates on a mixed aggregate.

3. Change fines content and repeat test on only one product.

4. Compare results obtained from mobile monitor (UAF-DUSTM) to laboratory measurement (dust fall test) for multiple runways in Alaska.
UAF Dust Fall Test
Progress

1. Design and fabrication of test rack.
2. Development of aggregate mix.
3. Gaining a better understanding of how fluid exists in aggregate pore space through simple immiscible fluid tests.
4. Continued development of lab test (Dust Fall Test).
5. Completed 1st round of tests for a one month maturation period.
6. Preparing molds for 3 month maturation period.
7. Preparing molds to test aggregate obtained from runways where we have mobile monitor results (UAF-DUSTM).
Results - Test Rack
Results - Test Rack
Results - Test Aggregate
Alaska E1
Results - Synthetic Fluid Fundamentals

Development of a Total Fluid Capillary Force

Reducing Loss of Soil Water by Evaporation

Soil grain

Synthetic fluid

Soil gas

Soil water

Thin layer of synthetic fluid

Soil grain
Results - Synthetic Fluid Fundamentals: Implications

- Soil water content becomes a critical factor in retaining particles in the aggregate
- Loss of synthetic fluid through mechanical abrasion may be a key factor in the longevity of the fluid
- To retain soil water (and synthetic fluid?) in aggregate, fines content is a key design factor
## Example Results from One Month Maturation Period

<table>
<thead>
<tr>
<th>Mass of Particles less than 10µm (µg)</th>
<th>EK35A-30</th>
<th>EK35A-40</th>
<th>EK35A-60</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>0.19</td>
<td>0.75</td>
<td>1.22</td>
<td>391.00</td>
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<tr>
<td>standard deviation</td>
<td>0.32</td>
<td>0.37</td>
<td>1.31</td>
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<td>coefficient of variation</td>
<td>1.66</td>
<td>0.49</td>
<td>1.07</td>
<td>0.19</td>
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<tr>
<td>standard error</td>
<td>0.19</td>
<td>0.21</td>
<td>0.75</td>
<td>43.21</td>
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<tr>
<td>minimum mass</td>
<td>0.00</td>
<td>0.52</td>
<td>0.32</td>
<td>335.00</td>
</tr>
<tr>
<td>maximum mass</td>
<td>0.56</td>
<td>1.17</td>
<td>2.72</td>
<td>476.00</td>
</tr>
</tbody>
</table>
Example Results from One Month Maturation Period

Mean Total PM10 (µg)

- EK35A-30
- EK35A-40
- EK35A-60
- Control

Levels: 0, 0.5, 1, 1.5, 2, 300, 400, 500
Next Steps

1. Re-Run dust fall tests on samples to determine if variability is in the dust fall column or in sample preparation.
2. Continue 3 month maturation period testing
3. Continue runway aggregate testing
4. Continue developing an understanding of how synthetic fluids function
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