

Gravel Runway Surface Maintenance and Environmental Impact

SWIFT 2013

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Challenges

Gravel runways have to be built and maintained in cold regions. The loss of fines and the dust is a problem. Maintenance is a concern. Cost is an issue. The environment requires protection. Challenges:

- Loss of gravel resulting in poor air quality and poor surface integrity
- Aircraft damage (FOD)
- Runway lifecycle costs
- Safety of the products used
- Transportation and storage during winter
- Short construction and maintenance window



Challenges

- Safety: Ten gravel runway related accidents per year in Alaska (NTSB)
- Loss: 2 – 5 cubic meters of fines can be lost per take off or landing
- Cost: 75' x 3000' runway
2" of gravel loss
\$200,000+ cost to replace gravel



Jet take-off



Current State - Dust Suppression

- Immediate dust control
- Adequate performance over one season
- New start every year
- Do not necessarily maintain “as constructed surface”



Future State - Fines Preservation

- Immediate dust suppression
- Maintain “as constructed” surface
- Builds ground inventory year over year
- With fines preservation you get dust control



Fines Preservation



Purpose

- **Overview of Dust Suppressants**
 - To provide an overview of dust suppressants; their chemistries, how they work, where they come from and potential unintended consequences associated with their use.
- **Evaluation of Environmental Safety of Dust Suppressants**
 - A review of past and current practices by regulatory agencies for testing, evaluating or determining which products are safe.
- **Recommendations and Considerations for Specifications**
 - To provide recommendations and considerations for building third-party analysis into specification to advert unintended consequences – environmental and total cost of ownership.

Overview of Dust Suppressant Chemistries and What We Know about Performance in Cold Regions

Dust Suppressant Product Chemistries

- Water
- Salts and Brines
- Organic Non-petroleum Products
 - Lignin sulfonates
 - Tall oil emulsions
 - Vegetable and sugar based
- Synthetic Polymer Products
 - Polymer emulsions
 - Water soluble polymers
- Organic Petroleum Products
 - Oils / Mineral oil
 - Asphalt emulsions
 - Cutbacks; Petroleum resins
- Synthetic Fluids
 - Synthetic Organic Dust Control
- Surface Active Agents

Water

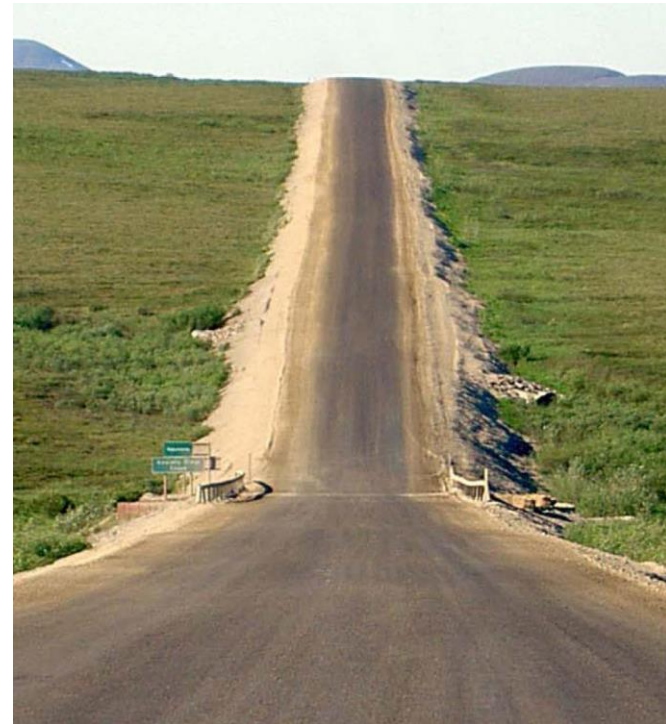
- Works by agglomerating surface particles
- Evaporates quickly
- Application depends on weather
- Labor intensive due to frequent applications.
- Must have readily available water supply
- Extensive watering destabilizes runway surfaces, thereby increasing dust
- Negative impact on water quality due to surface erosion
- Cost to maintain – high
- Overall effectiveness - low

Salts and Brines

- Calcium chloride, magnesium chloride, sodium chloride
- Slows evaporation of water
- Aids in soil compaction
- “Re-activated” by watering
- Corrosive to metal, hard on equipment
- Negative impact on water quality and plant life
- Toxic to many aquatic organisms
- Persistent, does not biodegrade
- Cost to maintain – moderate to high
- Overall effectiveness - low

Organic Non-Petroleum Products

- Lignin sulfonates, tall oil emulsions, vegetable oils
- Bind small particles together
- Typically have an odor, dark in color
- Many are washed away by heavy rains
- Many are re-workable
- Availability and cost volatile
- Biodegradable
- Negative impact on storm water runoff
- Cost to maintain – moderate
- Overall effectiveness – low to moderate



Synthetic Polymer Products

- Polyvinyl acetates, acrylics, polyacrylamides, polyvinyl alcohols
- Emulsion polymers are typically not water soluble and are not re-wettable
- Performance attributes and environmental impact vary depending on polymer chemistry
- Products sensitive to temperature and precipitation
- Biodegradable
- Cost to maintain – moderate to high
- Overall effectiveness – low to high



Organic Petroleum Products

- Used oils, asphalt emulsions, cutback asphalts, petroleum resins
- All are considered oils - Bind surface particles
- Can be very effective dust suppressants in extreme traffic situations when used properly
- All petroleum products, including mineral oil may have regulatory recordkeeping and reporting requirements.
- May require specialized storage and spill prevention
- Because all are petroleum based products they all contain polycyclic aromatic hydrocarbons (PAH) which can negatively impact the environment and human health
- Cost to maintain – moderate
- Overall effectiveness – moderate to high

Synthetic Fluids

- Based on environmentally sound synthetic isoalkanes
- Synthetic Fluid with binders - those formulated with unique binder systems give an added level of stability
- Works to control dust and stabilize surface by weighing down and agglomerating particles
- Requires no water for application, not water soluble or dilutable
- 100% active - Produces a continuously active, re-workable surface well suited for traffic areas
- Low potential for negative impact to water quality
- Cost to maintain – moderate to high
- Overall effectiveness - moderate to high

Surface Active Agents

- Surfactant or soap based products
- Allows water to penetrate better into surface
- Reduces volume of water required for control
- Labor intensive
- Like watering, will wash away fines
- Negative impact on storm water quality
- Cost to maintain – moderate to high
- Overall effectiveness – low to moderate

Other

- Lime
- Portland cement
- Calcium sulfate (gypsum)
- Starches
- Guar gum
- Polysaccharides

Evaluation of Environmental Safety of Dust Suppressants

Current Environmental Considerations and Testing

- MSDS review
- Bulk analysis
 - Volatile organic compounds (VOC), EPA 8260
 - Semi-volatile organic compounds (SVOC), EPA 8270
 - Inorganics / heavy metals (various methods)
- Leachate analysis
 - Toxicity Characteristic Leaching Procedure (TCLP), EPA 1311
 - Synthetic Characteristic Leaching Procedure (SPLP), EPA 1312
- Aquatic Toxicity
 - Various species
 - Acute and Chronic

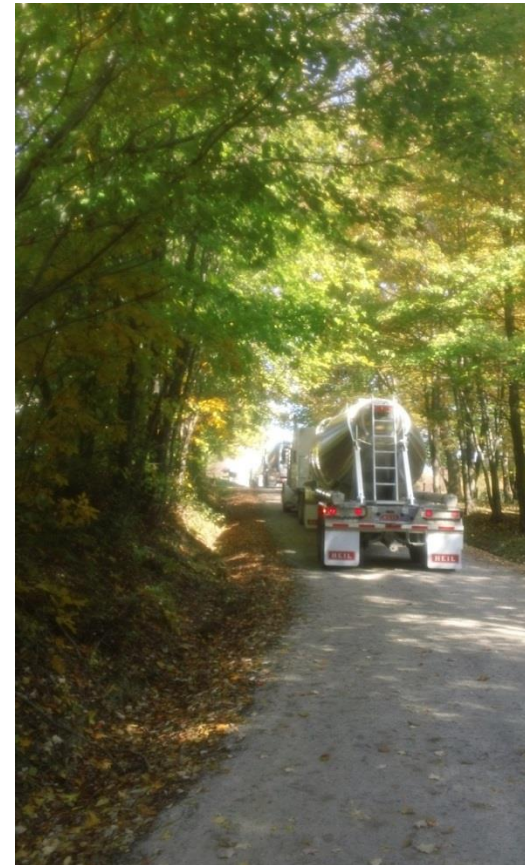
Current Environmental Considerations and Testing

- BOD / COD (Chemical Oxygen Demand)
- Biodegradability
- pH
- Soil Toxicity
- Genotoxicity
- Performance Testing
- Degradation toxicity

Recommendations and Considerations for Specifications

Effective Dust Suppression

- Effective dust suppression is defined differently by every user, regulator and manufacturer. The definition must be site and need specific to balance:
 - Efficiency, longevity and durability
 - Cost – benefit economically
 - Potential environmental and human health impacts



To get what you want and expect – TRUST BUT VERIFY!

- Review of current guidelines, input from other customers and regulators, and experience show a couple of **basic necessities** for evaluation of chemical dust suppressants:
 - MSDS review indicating the presence of no listed hazardous ingredients per RCRA (listed hazardous wastes).
 - Willingness and ability of manufacturer to provide 100% ingredient disclosure upon request and confidentiality of end user or reviewing party.
 - Application, expected longevity and storage guidelines specific to site.

TRUST BUT VERIFY! - Build Third-Party Analysis into your Specifications

To insure against unintended consequences, we recommend the following tests:

- **Bulk Analysis:**
 - Performed on the concentrated chemical (chemical as received)
 - VOC (EPA 8260)
 - SVOC (EPA 8270)
 - PAH (Polycyclic Aromatic Hydrocarbons) and heavy metals
- **Aquatic Toxicity (acute and chronic)**
 - Ceriodaphnia dubia
 - Fathead minnow
 - Mysid shrimp
 - Rainbow trout
- **Leachate Analysis**
 - toxic constituents can leach out in the ground

TRUST BUT VERIFY! - Build Third-Party Analysis into your Specifications

- Scientifically determine whether a material is right
- Avoid the potential unintended consequences of using oil dust suppressants
 - Regulatory recordkeeping and reporting
 - Specialized storage and handling
 - Specialized response and cleanup
 - Recommend synthetics:

Fourier Transform Infrared Spectroscopy (FTIR)

- Comparing an FTIR chemical analysis of fluid with a spectral library scan indicates whether a product is an synthetic fluid or a petroleum feedstock.

Gas Chromatography Mass Spectrometry (GC-MS)

- Separates and quantifies carbon chain lengths in complex hydrocarbon mixtures - Oil-based products have a wider range of carbon chain lengths and heavier average weight - The heavier the chain, the greater the negative impact on the environment.

Consider Synthetic Fluids

- Carry fewer regulatory requirements with regard to spills, reporting, storage, etc.
- Have an overall lower cost of ownership
- Build strength with use
- Immediate use of area after application
- Withstand extremes in temperature and precipitation
- Do not wash out
- Do not have a harmful effect on the environment



Choosing a Product for Fines Preservation?

- Research the company before you decide on a dust suppressant. They should work with you to choose the best suppressant for your application including information on the human health and environmental impacts of their products
- Work with a company that can provide you the total solution, not just a dust suppression product
- There must be balance between:
 - Performance
 - Environmental Health and Safety
 - Cost

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Midwest Industrial Supply, Inc.

- Founded in 1975 – nearly 40 years of experience in dust and erosion control and soil stabilization
- First dust and erosion control product, Soil-Sement[®], introduced in 1978
- Development of products using new technologies
- Application techniques and design
- Environmental compliance
- Quality Control and Assurance
- Development of product standards



MISI List of Treated Runways

- *Nunavat*
 - Hope Bay
 - Arviat
 - Pangnirtung
 - Taloyoak
- *Northwest Territories*
 - Aklavik
 - Colville Lake
 - Fort Good Hope
 - Deline
 - Fort Liard
 - Gameti/Rae Lakes
 - Letselk'e
 - Tuktoyaktuk
 - Tulita
 - Wekweeti
 - Wha Ti
- *Yukon*
 - Beaver Creek
 - Burwash
 - Dawson City
 - Carmacks
 - Mayo
 - Old Crow
- *Saskatchewan*
 - Patuanak
- *Manitoba*
 - Cross Lake
 - Churchill
- *Ontario*
 - Pikangikum
- *Labrador*
 - Goose Bay
- *Quebec*
 - Eastmain River
 - Wemindji
 - Waskaganish
 - Kuujjuaq
 - La Tabataire
 - Kuujjuarapik
 - Puvirnituaq

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