

Deicing/Propylene Glycol (PG) Microbial Remediation Technology

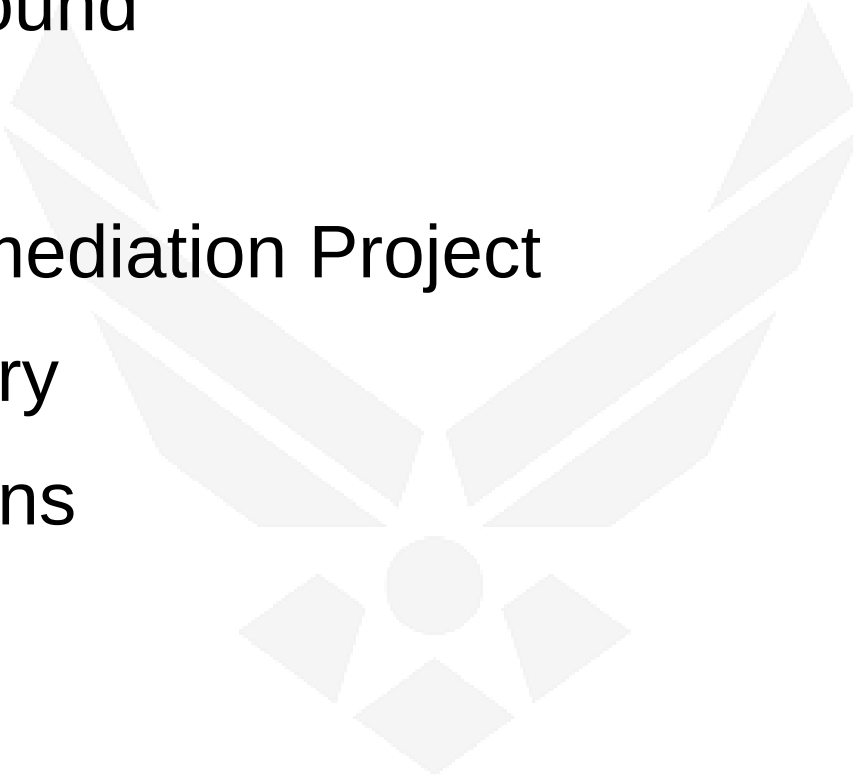
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Outline

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 - C. PG Remediation Project
 - D. Summary
 - E. Questions
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Background

- Aircraft deicing fluids (ADF) work  planes fly in the winter
 - Military uses ADF with propylene glycol (PG) per specifications
 - PG is purchased in a concentrated form and applied as a 40:60 fluid to water mixture
- Airports use significant amounts of PG-based ADF
 - Maine Air National Guard Base (ANGB), Bangor uses approximately 40,000 gallons a season
- Currently, no approved alternatives to PG-based ADF
 - Aeronautical Enterprise Deicing Working Group is actively seeking solutions

PG-Related Issues

- Deicing creates significant environmental compliance and pollution prevention issues
 - Heavily regulated by the EPA under the Clean Water Act and through the National Pollution Discharge Elimination System (NPDES) program
 - BOD concerns because biodegradation process of PG consumes free oxygen molecules in water and can stress or kill aquatic life
 - Toxicity concerns associated with the fire-suppression additives and corrosion inhibitors in ADF

PG Remediation Project

- USAF AFMC F-16 Corrosion Office, AFRL/RXSCP, and CTC will:
 - Conduct a requirements analysis and technology assessment
 - Conduct laboratory test on microbial solutions to determine their effectiveness at bench scale
 - Conduct a field demonstration at Maine ANGB, Bangor
 - Transition the most successful technology

Technology Assessment

- Identified 10 technologies, consisting of
 - Bioremediation
 - Standard Mechanical Filtration (RO & UF)
 - Evaporative Processes (MVR and TVR)
- Chose bioremediation because it is:
 - Less capital intensive
 - Requires less maintenance
 - Requires less oversight

Bioremediation

- Bacteria consume a targeted contaminant by
 - Consuming it and/or converting into something else (i.e., CO₂ & water)
- In general, well established and field-proven process
 - Use for deicing runoff needs to be validated



Deicing runoff is captured and sent to a treatment plant

PG Bioremediation Product

- Operator pours the microbial solution into runoff containing spent ADF
 - Amount will be predetermined given the holding container's size
- Some agitation may be required for mixing and aeration for oxygenating the solution into the spent ADF
 - Stirring should be minimal
- Runoff degrades PG content and then is sent to the Publicly Owned Treatment Works (POTW)
 - Amount of retention time to be validated by laboratory testing

PG Remediation Project

- **Military criteria for ADF Remediation Products**
 - Remediates spent PG-based ADF (at least 20,000 gallons per day) to <350 milligrams per liter (mg/L) chemical oxygen demand (COD)
 - Commercially available
 - Cost effective
 - On-site treatment
 - User friendly, low maintenance

Laboratory Testing

- Tested 3 microbial solutions on a 5% PG concentrate solution
 - Samples were taken at 0-, 48-, 96- and 144-hour intervals
- Used Maine ANGB's deicer runoff and a commercial deicer
- Validated all three products could remediate the PG at 5%

PG Remediation Project

- Laboratory test results example

Sample ID	Date Sampled	Hours Incubated	COD _{TOTAL} (mg/L)	COD _{SOL} (mg/L)	pH	SPC Bacteria (CFU/mL)	%PG (FTIR)	%PG (GC)
10-03330-C	9/17/10	0	81,700	59,700	5.52	830,000	5.64	5.97
10-03338-C	9/19/10	48	84,800	69,400	6.08	2,120,000,000	5.47	0
10-03346-C	9/21/10	96	104,700	61,400	6.06	3,800,000,000	5.08	0
10-03354-C	9/23/10	144	91,800	64,800	6.07	4,500,000,000	4.04	0

- Overall results showed the PG concentration was reduced to a non-detect level after 96 hours
- Additional testing occurred with 10% and 20+% concentrations

Field Demonstration

- Laboratory-proven products underwent field demonstration testing
- Maine ANGB, Bangor is home to 101st Air Refueling Wing (ARW) Medical Group (MDG)
 - Equipped with deicing pads with dedicated drains
- Site contains three 57,000-gallon underground tanks as well as three 6,000-gallon tanks
 - Microbes are added into the 6,000-gallon tanks

Field Demonstration Preparation



Three 57,000-gallon tanks that Maine ANGB uses as holding tanks prior to release of runoff to the POTW

Field Set Up



*Three 6,000-gallon tanks have been installed
for the application of the microbial products*

Field Equipment



Test Site Shed



*Control panel inside
shed*



*Pumps, filters and
gauges inside shed*

Summary

- PG bioremediation products have good potential
 - Additional testing is required prior to implementation
 - Maine ANGB has been a great partner and would support future endeavors
- Regulations will only get more stringent
- Knowledge gained can be directly applied to other Air Force and Department of Defense Weapon Systems as well as civilian applications

Questions



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