Aircraft Deicing Operations

1.231/16.781/ESD.224 Airport Systems Planning & Design

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Introduction and Motivation

- A layer as thin as 0.4 mm (1/64 in.) thick of ice or snow can disrupt the airflow over aircraft surface
  - lift is reduced, drag is increased
  - ice and snow buildup adds weight, increasing lift required for takeoff of aircraft

- FAA and ICAO require “clean aircraft concept”

Ramifications:
* 1982 Air Florida flight out of Washington-National Airport, DC.
* 2004 China Eastern Airlines flight from Baotou to Shanghai, China
Current Deicing Practices

• Aircraft Deicing Fluids (ADFs): organized into 4 classes and composed of either propylene glycol or ethylene glycol.

• Society of Automotive Engineers set technical standards for ADFs.

• During severe weather conditions, an estimated 1,000 to 4,000 gallons of ADF may be needed to deice a commercial jet.

• Type I fluids (used for deicing) and Type IV fluids (used for anti-icing) are most common in US.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Average Total Airport Use/Purchase (million gallons/year)</th>
<th>Percentage of ADF Use/Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I Propylene Glycol Aircraft Deicing Fluid</td>
<td>19.305</td>
<td>77.1</td>
</tr>
<tr>
<td>Type IV Propylene Glycol Aircraft Anti-Icing Fluid</td>
<td>2.856</td>
<td>11.4</td>
</tr>
<tr>
<td>Type I Ethylene Glycol Aircraft Deicing Fluid</td>
<td>2.575</td>
<td>10.3</td>
</tr>
<tr>
<td>Type IV Ethylene Glycol Aircraft Anti-Icing Fluid</td>
<td>0.306</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Current Deicing Practices cont.

Other practices:

• hot water deicing
• forced air deicing
• centralized deicing

Toronto Pearson Int.: largest centralized deicing facility
Environmental Concerns

US airports are required to obtain discharge permits for stormwater through National Pollutant Discharge Elimination System (NPDES) program.

EPA has identified a few environmental impacts of deicing discharge:
- dead zones for aquatic life
- groundwater and surface drinking water contamination
- foaming, noxious odors, discolorations of surface waters
- headache, nausea complaints from those who are exposed to deicing stormwater odors

EPA has reported the following chemical oxygen demand (COD) discharge for various type airports in the US:

<table>
<thead>
<tr>
<th>Airport Hub Size</th>
<th>ADF Application Site COD Discharge (pounds/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>70,287,571</td>
</tr>
<tr>
<td>Medium</td>
<td>28,433,086</td>
</tr>
<tr>
<td>Small</td>
<td>9,863,368</td>
</tr>
<tr>
<td>Nonhub</td>
<td>17,382,976</td>
</tr>
<tr>
<td>General Aviation/Cargo</td>
<td>2,412,898</td>
</tr>
<tr>
<td>Total</td>
<td>128,379,900</td>
</tr>
</tbody>
</table>
Collection and Containment Methods

Glycol Recovery Vehicles

Containment Ponds

Storage Tanks
Proposed New Regulations

1) Airports that have 10,000 or more annual departures will be required to collect and treat 20% of deicing operation discharges.

2) Airports that have 10,000 or more annual departures will be required to collect and treat 40% of deicing operation discharges.

3) In addition to 1) requirement, airports using 460,000 or more gallons of glycol fluids annually will be required to collect and treat 60% of deicing operation discharges.

4) Airports that have 1,000 or more annual jet departures will be required to collect and treat at least 20% of discharges on top of 3) requirements.

<table>
<thead>
<tr>
<th>Proposed Regulatory Option</th>
<th>Number of Airports Subject to Option</th>
<th>ADF COD reduction (million pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>110</td>
<td>9.0</td>
</tr>
<tr>
<td>Option 2</td>
<td>110</td>
<td>18.8</td>
</tr>
<tr>
<td>Option 3</td>
<td>110 (14 to 60% requirement, 96 to 20% requirement)</td>
<td>27.2</td>
</tr>
<tr>
<td>Option 4</td>
<td>218 (14 to 60% requirement, 204 to 20% requirement)</td>
<td>29.3</td>
</tr>
</tbody>
</table>
Proposed New Regulations cont.

- Option 3 or 4 would require some of US major airports – NY JFK, Chicago O’Hare, Cleveland-Hopkins Int., Newark Liberty Int., Boston Logan, NY LaGuardia – to contain 60% of their applied ADFs.

- These rules are quite costly. Is the current case-by-case basis system more applicable – not all places and airports have the same issues and do not discharge to the same waters.
Future of Deicing Technology

Infrared Deicing Systems: InfraTek®

Currently three InfraTek® systems in the US (biggest at JFK), and one in Oslo, Norway.
Future of Deicing Technology cont.

Advantages:
- InfraTek® system can significantly reduce the amount of glycol use.
  - 90% reduction per aircraft documented for JFK facility for 2006-2007 season
- InfraTek® type systems allow for more accurate winter operations budgets.

Possible issues:
- Physical size of InfraTek® can be difficult to accommodate.
- InfraTek® system can present a bottleneck.
- IR systems do not provide anti-icing protection. ADFs are still required.
- JFK InfraTek® facility reported to have cost $9.5 million. Need some sort of a commitment by airlines to make use of it.
Future of Deicing Technology cont.

Infrared Deicing Systems: Ice Cat®
Future of Deicing Technology cont.

Improved weather forecasting: Weather Support to De-icing Decision Making (WSDDM)
Conclusions

• Process of aircraft deicing is vital part in not just aircraft safety but in airport design and management as well

• Deciding and installing new systems is a complex process, especially with the expansion of various technologies and environmental regulations.

• At this stage, no technology can escape ADF use.

• Does it make more sense for airports to invest and modify their systems to accommodate new deicing technology or invest in advancing new glycol collection and recycling systems.

• Large capital expenditures cannot be avoided.