ACRP Problem No. 12-02-28

*Impacts of Airport Deicers/Anti-icers on the Surrounding Environments*

**ACRP Staff Comments:** There are numerous completed and ongoing ACRP studies that touch on this topic, including ACRP Web-Only Document 3: Formulations for Aircraft and Airfield Deicing and Anti-Icing: Aquatic Toxicity and Biochemical Oxygen Demand; ACRP Web-Only Document 8: Alternative Aircraft Anti-Icing Formulations with Reduced Aquatic Toxicity and Biochemical Oxygen Demand; ACRP Report 14: Deicing Planning Guidelines and Practices for Stormwater Management Systems; ACRP Project 02-29, Guidance for Treatment of Deicing-Impacted Airport Stormwater; and ACRP Project 02-32, Understanding Nuisance Microbial Biofilms in Receiving Waters Impacted by Airport Deicing Activities. Should this topic be selected, the research would need to consider these projects to avoid duplication of effort.

**TRB Aviation Group Committees Comments:** ENVIRONMENTAL IMPACTS OF AVIATION CMTE - Do not support. General potential for impacts are described in available literature and studies. Actual impacts are highly site specific. However, one area where research is needed is that of the environmental fate and effect of additives. However, that is removed from ACRP's focus on applied research.

**Review Panel Comments:** Not recommended — Evaluation of impacts is too site-specific to address at a global level.

**AOC Disposition:** No funds allocated. No discussion.
I. PROBLEM TITLE

Impacts of Airport Deicers/Anti-icers on the Surrounding Environments

II. RESEARCH PROBLEM STATEMENT

For aviation agencies, snow and ice control operations are also crucial to their efforts of maintaining high levels of service at airports enduring winter weather. While urea and glycols have been traditionally used for winter maintenance of airfield pavements, the last decade or two has seen them increasingly replaced by acetates and formates in deicing and anti-icing formulations, mostly due to water quality concerns. Based on responses to a recent U.S. Environmental Protection Agency questionnaire distributed in April 2006 to airports, 130 of the 139 respondents conducted deicing or anti-icing activities. Responses representing approximately 100 airports indicated that potassium acetate and sand were most widely used at U.S. airports for snow and ice control of airfield pavements. Formulations based on glycols - propylene or ethylene glycol - are generally used for winter maintenance of aircrafts. For deicing and anti-icing applications respectively, agencies use Type I and Type II snow and ice control fluids with or without thickeners in glycols respectively, often containing more than 10% of additives such as corrosion inhibitors and surfactants in them.

While deicing and anti-icing products are essential tools to use and lead to significant safety, mobility and productivity benefits, there have been ever-increasing concerns over their potentially detrimental effects on the surrounding environment (vegetation, soil, surface water, groundwater, etc.). For instance, the environmental issues associated with glycol-based deicers are increased biological oxygen demand (BOD) and carcinogenic effects to stream fauna. Additives, other than glycols, used in snow and ice control for aircrafts, can be found in aquatic systems and may be of greater risk than previously believed.

Best Management Practices (BMPs) have been developed and are constantly evolving to minimize the impacts of snow and ice control materials (chemicals and abrasives) on the environment. Nonetheless, there is a lack of knowledge base regarding the fate and transport of deicers, anti-icers, and their additives in soil, vegetation, or water bodies, whereas such knowledge is much needed to guide the design, monitoring and evaluation of BMPs in treating contaminants-laden stormwater from airports or in minimizing the damage of snow and ice control materials to the environment adjacent to the runways or taxiways. Existing studies generally either focused on dynamics in a laboratory setting or an actual field setting, with the former lacks the field variables and the latter tends to produce site-specific results with limited transferability. As such, it is desirable to conduct such research in a controlled field environment where a comprehensive test program can be formulated to examine selected processes or to test significant hypotheses.

III. OBJECTIVE

The objective of this research is to investigate the impacts of airfield and aircraft deicers/anti-icers used at airports on the surrounding environments, through investigations both in a laboratory and in a controlled field test-bed environment.
IV. RESEARCH PROPOSED

Task 1. Literature Review and Agency Survey. In this task the literature review will follow up on the ACRP Synthesis 6, ACRP Report 14, and completed or ongoing research to provide information on currently used deicing/anti-icing products at airports, BMPs that are currently used to handle runoff of deicers/anti-icers, and the impacts of deicers/anti-icers on the environment adjacent to runways. In this task a survey should be conducted that seeks input from stakeholder groups such as the FAA, airports, deicer manufacturers, environmental agencies, and others to document the state of the practice and to collect information that will be used to shape the experimental design in Task 2.

Task 2. Experimental Design. In light of Task 1 findings, this task will identify the deicers/anti-icers of interest as well as the water, soil and vegetation environments to simulate in the laboratory setting and/or in the field setting. As a starting point, the deicers/anti-icers to be investigated may include urea, potassium acetate, sodium acetate, sodium formate, propylene glycol-based fluids, and ethylene glycol-based fluids. The water, soil and vegetation types may include those typically seen in major eco-regions. The experimental design will be formulated to examine selected processes or to test significant hypotheses. ACRP review and approval will be sought before proceeding to subsequent tasks.

Task 3. Laboratory Investigation of Environmental Impacts. This task will first involve laboratory tests according to the finalized experimental design, in an environmental chamber where air temperature and other parameters can be easily regulated or monitored. Accelerated test protocols will be designed to simulate the field conditions experienced in the environment adjacent to runways or taxiways, taking into account precipitation/dilution, humidity, wind speed, solar radiation, residence time, etc. via the use of soil column tests and green houses.

Task 4. Field Investigation of Environmental Impacts. This task will involve tests in a controlled field test-bed environment where key environmental conditions can be easily regulated or monitored and testing can be conducted without concerns over researcher safety and with confidence in reproducibility. Deicers/anti-icers will be applied on a test-track of the test-bed, and their components of interest will be monitored as they migrate into the adjacent environments. Water, soil and vegetation samples will be collected and analyzed for impacts from the applied products. Furthermore, the field data along with the laboratory data will be statistically analyzed in an effort to establish a correlation between the two. If necessary, the laboratory test protocols will be modified to validate selected field results.

Task 5. Final Report. In this task the laboratory and field test results will be summarized and the findings and conclusions of the research will be clearly presented, including recommendations for implementation.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $450,000.
Research Period: 36 months (including 3 months for review and revision of a draft final report).

VI. URGENCY AND PAYOFF POTENTIAL

The proposed research is of critical importance to preserve and maintain a healthy and functioning ecosystem in environments adjacent to runways and near airports. By utilizing a controlled field testing environment deicers/anti-icers tested can be thoroughly investigated from the time of application to the runway through migration in the adjacent environments, while doing so on active runways would be much less feasible or reproducible.

VII. RELATED RESEARCH


VIII. PERSON(S) DEVELOPING THE PROBLEM

Laura Fay, Research Scientist, Western Transportation Institute, PO Box 174250, Montana State University, Bozeman, MT 59717-4250. Phone: (406) 600-5777; Fax: (406) 994-1697. Email: laura.fay@coe.montana.edu

Xianming Shi, PhD, PE, Associate Research Professor, Western Transportation Institute, PO Box 174250, Montana State University, Bozeman, MT 59717-4250. Phone: (406) 994-6486; Fax: (406) 994-1697. Email: Xianming_s@coe.montana.edu

IX. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement was developed by the Western Transportation Institute based on observed needs. This research is directly related to ACRP topic identified in RRD 5- Environmental and Energy Sustainability.

X. DATE AND SUBMITTED BY

Date: April 14, 2010. Submitted by: Laura Fay, Research Scientist, Western Transportation Institute, PO Box 174250, Montana State University, Bozeman, MT 59717-4250. Phone: (406) 600-5777; Fax: (406) 994-1697. Email: laura.fay@coe.montana.edu