Development of Standardized Test Procedures for Evaluating Deicing Compounds (Project Number: 07-02)

Progress Report #2

Covering the period of
Jan. 1 – Mar. 31, 2008

Submitted by

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Overview

Problem
Every year manufacturers introduce new deicing chemicals, additives or mixtures for use in snow and ice operations. Users do not currently have a comprehensive methodology for evaluating the performance of these new products prior to purchasing.

Objective
The goal of this project is to establish laboratory tests that can be applied to all deicing chemicals, additives and mixtures to measure performance. Manufacturers would then be required to have the tests run at independent laboratories before they can be marketed or used by Clear Roads states.

Expected Results

A standard set of performance tests for deicing chemicals, additives and mixtures that will help agencies anticipate how products may work in their specific environment is expected.

Progress

The project is estimated to be on budget and on schedule, with approximately 22% of the scope completed. During this reporting period, the research team had an interim teleconference with the technical advisory committee (TAC) to discuss the results of Task 1 and plans for proceeding to Task 2. The team then developed a survey and, with approval from the TAC, distributed it nationwide to several relevant groups. The analysis of the survey results is currently underway.

Task Report

Task 0: Project Management (22% Complete)

The research team maintained communication with the TAC throughout the reporting period. The research team also hired an undergraduate student to assist in the survey data entry and analysis.

On January 8, 2008, an interim teleconference provided an opportunity for the TAC and research team to discuss the results of the Task 1 literature review.

Task 1. Comprehensive literature search (100% Complete)

The literature review was finished during this quarter after receiving feedback from the TAC during the interim teleconference. The research team reviewed available literature to survey the state of the practice and the state of the art related to this project, focusing on relevant research and guidelines from around the country to identify existing and proposed standards for evaluating deicer performance. The literature review provides a comprehensive inventory of test procedures that have been experimentally developed or standardized for the evaluation of the performance of deicing products. Tests measuring the effects of deicers on infrastructure

materials (metals and pavements) and the environment (terrestrial and aquatic organisms) were also reviewed.

Task 2. Needs identification and recommendations (40% Complete)

The research team developed an interactive survey to gauge the needs of maintenance personnel for tests used to evaluate deicing products. Additionally, the survey provided an opportunity for agencies to indicate if previously developed tests had been used. The survey was distributed to members of the Clear Roads technical advisory committee as well as members of other relevant programs: Pacific Northwest Snowfighters association, Aurora, and SICOP, as well as participants to the 1st National Winter Maintenance Peer Exchange (August 2007, Columbus, OH). Finally, the survey was also posted on the Snow-Ice ListServ.

Thus far 32 responses have been received from the states shown in Figure 1, in addition to the following entities: AASHTO; Region of Waterloo, Ontario; Region of Peel, California; New York City, New York; Cargill Deicing Technology; Dow Chemical Company; EnviroTech Services; Paradigm Chemicals; and Redmond Minerals.

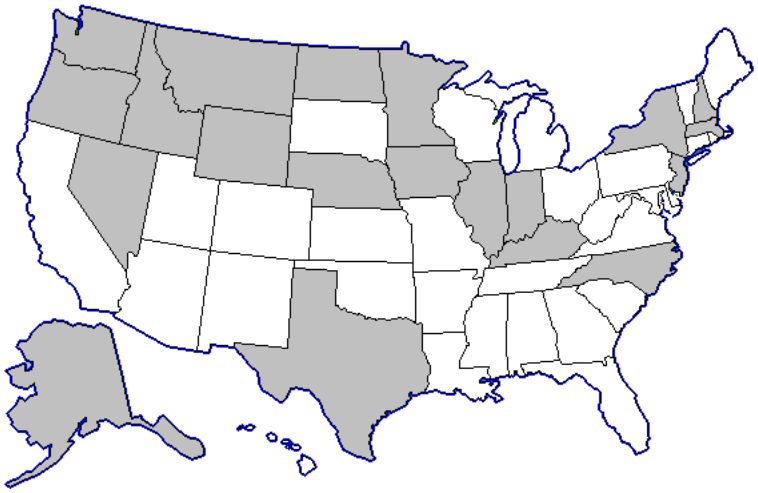

Figure 1: States responding to survey

The analysis of the survey responses has recently begun and will continue into the next quarter. To date the results provide some indication of the aspects of deicer performance most desired. Effective temperature and melting capacity received the highest average response, followed by the ability to prevent or undercut a bond between snow/ice and the pavement (Figure 2 and Table 1). Several test methods are available to quantify various performance aspects of deicers. A list was included in the survey to determine whether these tests had been implemented; however, about 16% of respondents skipped this question while approximately half indicated that they did not use any of the listed tests (Table 2). Thus, a follow-up question to obtain users' perceptions of the usefulness, reliability, and ease of use of the various tests applied to only 3 to 28% of the respondents, depending on the particular test method. While the number of respondents for this portion was fairly limited, none of the tests scored particularly high (Figure 3).

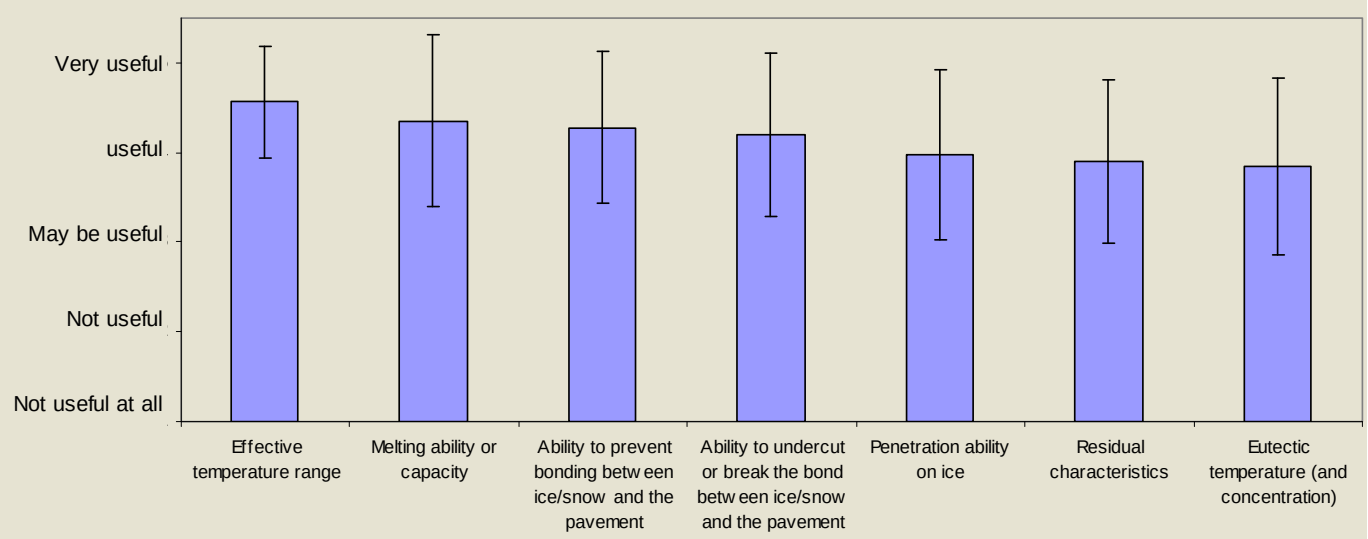

Figure 2: The average (± 1 standard deviation) for the usefulness of various performance aspects of deicers

Table 1: The number of responses for each available category for the performance aspects of deicers

	Not important at all	Not important	May be important	Important	Very Important
Melting ability or capacity	0	3	1	9	18
Penetration ability on ice	1	0	8	12	10
Penetration ability on compacted snow	1	1	10	11	8
Ability to undercut or break the bond between ice/snow and the pavement	0	2	4	11	14
Ability to prevent bonding between ice/snow and the pavement	0	1	5	10	16
Effective temperature range	0	0	2	10	20
Eutectic temperature (and concentration)	1	1	9	12	9
Residual characteristics	1	0	8	14	8

Table 2: Number of responses to various degrees of implementation of standard test methods

	Skipped this one	Have used	Currently use	Modified Procedure	Don't use	Never Heard Of
SHRP H-205.1 Test Method for Ice Melting of Solid Deicing Chemicals	5	7	1	2	16	3
SHRP H-205.2 Test Method for Ice Melting of Liquid Deicing Chemicals	5	6	2	1	15	4
SHRP H-205.3 Test Method for Ice Penetration of Solid Deicing Chemicals	5	5	1	1	17	4
SHRP H-205.4 Test Method for Ice Penetration of Liquid Deicing Chemicals	5	6	0	1	17	4
SHRP H-205.5 Test Method for Ice Undercutting by Solid Deicing Chemicals	6	4	0	1	18	4
SHRP H-205.6 Test Method for Ice Undercutting by Liquid Deicing Chemicals	6	3	0	1	19	4
Anti-Bonding Endurance Test (Transport Canada, Airports Group)	6	0	0	0	16	10
ASTM D 1177 Standard Test Method for Freezing Point of Aqueous Engine Coolants	5	5	2	0	16	5

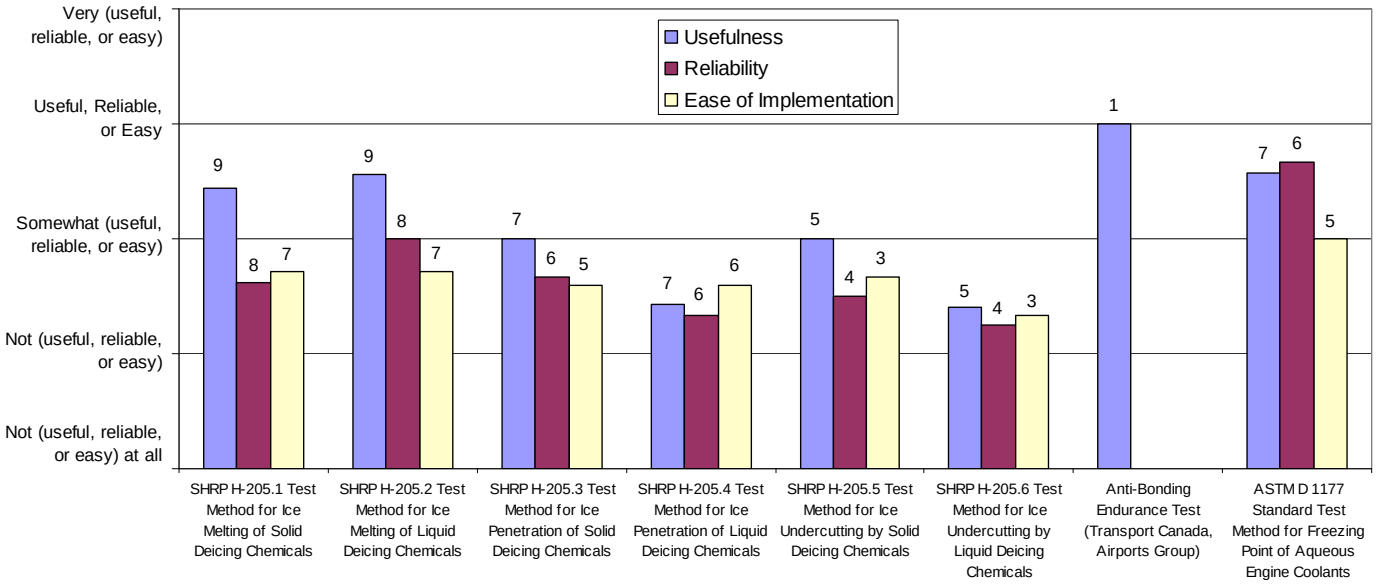

Figure 3: Average response for usefulness, reliability, and ease of implementation of various deicer performance tests, with number of responses shown above each bar

Once a deicer has been found to meet performance requirements, potential effects of the chemical may be desired before full implementation. The effects of deicers associated with safety issues were found to be more important than infrastructure or environmental issues, with most respondents indicating "very important" or "important" for safety issues and "important" or "may be important" for other issues (Figure 4 and

Table 3). Thus far, no respondent has chosen "not important at all" for any of the listed effects.

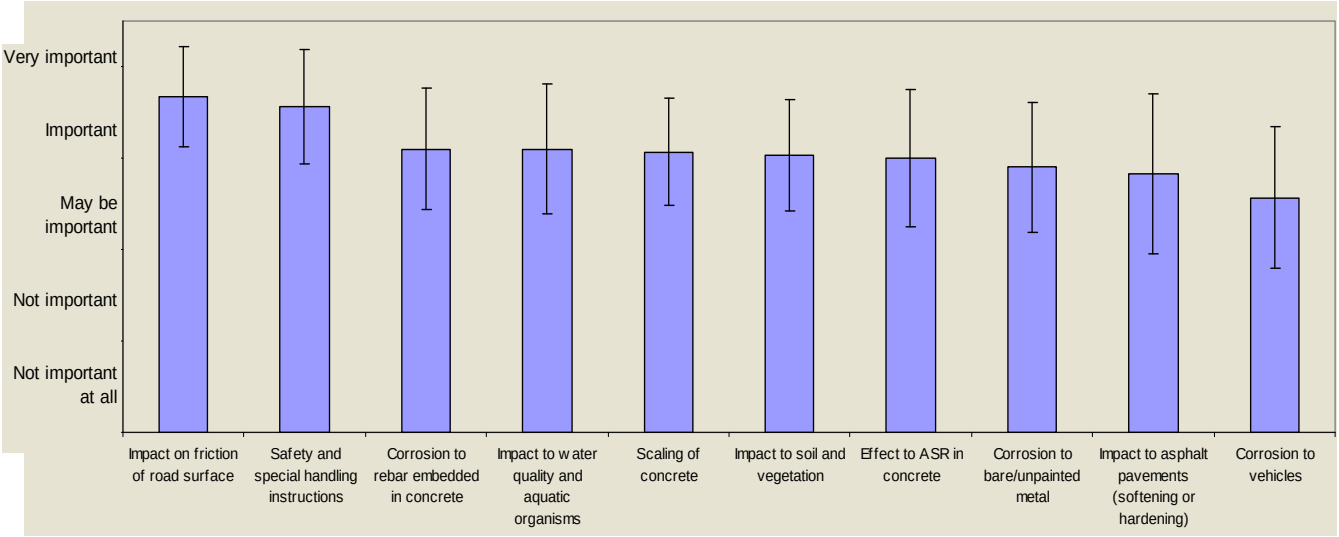

Figure 4: The average (± 1 standard deviation) of responses for the importance of various possible effects of deicers

Table 3: The number of responses for each available category for the effects of deicers

	Not important at all	Not important	May be important	Important	Very Important
Impact on friction of road surface	0	0	1	8	21
Safety and special handling instructions	0	0	2	9	19
Corrosion to rebar embedded in concrete	0	0	5	17	8
Scaling of concrete	0	0	4	20	6
Effect to ASR in concrete	0	0	8	14	8
Corrosion to bare/unpainted metal	0	0	9	15	6
Corrosion to vehicles	0	2	12	13	3
Impact to asphalt pavements (softening or hardening)	0	2	8	13	7
Impact to soil and vegetation	0	0	5	19	6
Impact to water quality and aquatic organisms	0	1	3	18	8

This brief discussion of the survey results does not include any information from the comment sections or other areas where respondents had the opportunity to write regarding performance aspects, other test methods, or other effects.

Task 3. Develop testing protocols, procedures and ranges (0% Complete)

No work has been completed on this task.

Task 4. Conduct baseline tests (0% Complete)

No work has been completed on this task.

Task 5. Final report (0% Complete)

No work has been completed on this task.

Upcoming Activities (April. 1- June 30, 2008)

Task 2 will continue with the survey analysis and recommendations for the Task 3 laboratory testing. Several more surveys responses are anticipated, especially from Wisconsin counties because the counties have the authority to select/test deicers instead of the state DOT (according to a survey response). The interim report of the literature review and survey will be available at the end of May, at which point a teleconference with the TAC will occur to discuss both the proposed laboratory testing and whether commercial and/or reagent chemicals should be used.

Task 3 is expected to begin in June after approval of Tasks 1 and 2 from the TAC. Several performance-based tests are expected to comprise Task 3. As discussed during the teleconference in January, tests for the effects of deicers on infrastructure materials and the environment will not be included in this project.

Project Schedule

Figure 5 shows the project schedule by month. The project is on schedule.

		2007		2008											2009			
Tasks	***Milestones***	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
Task 0. Project Management																			
Project kickoff	*11/13/2007*																		
Quarterly progress reports	*End of each quarter*																		
Task 1. Comprehenstive Literature Review																			
Interim Conference Call Meeting/Presentation	*1/8/2008*																		
Task 2. Needs Identification and Recommendations																			
Interim Report: Needs Identification and Recommendations Summary	*May-08*																		
Task 3. Develop Testing Protocols, Procedures and Ranges																			
Task 4. Conduct Baseline Tests																			
Task 5. Final Report																			
Draft final report	*Feb-09*																		
Face-to-face TAC meeting	*Mar-09*																		
Final report	*Apr-09*																		

Figure 5: Project schedule by month

References

Chappelow, Cecil C., A. Dean McElroy, Robert R. Blackburn, David Darwin, Frank G. de Noyelles, and Carl E. Locke (1992) *Handbook of Test Methods for Evaluating Chemical Deicers* Strategic Highway Research Program, National Research Council, National Academy of Sciences, Washington D.C.