

Clear Roads Project Proposals February 2005

Page	Title	Description	Estimated Cost	Estimated Duration	Proposer
2	Calibration Accuracy of Ground Speed Controlled Salters	Compare ground speed controller settings with actual salt discharge amounts collected from the discharge point of the salt spreader both in the yard and on the highway during a winter storm event.	\$50,000	Fall 2005 to summer 2007 (two winter seasons)	Thomas Martinelli, Wisconsin DOT
3	Effectiveness and Efficiency of Underbody Plows	Compare the cost of underbody plow usage with the cost of salting operations for two winter patrol trucks attacking the same snow pack.	\$50,000	Fall 2005 to summer 2007 (two winter seasons)	Thomas Martinelli, Wisconsin DOT
4	Optimum Snowplow Design	Review existing research on snow plow designs and materials and investigate new materials and designs that may be better suited for a more pro-active approach to snow removal. The research will consider attack angle of the blade, proper throat dimensions and possible additions to the plow (slush blade, squeegee, broom, blower, etc.) that will enhance performance of the plow to provide a cleaner surface.	\$150,000	24-30 months	Dennis Burkheimer, Iowa DOT
5	Carbide Blade Insert Standardized Performance Testing	Identify a test or set of tests that can be conducted in a lab to measure performance of carbide inserts. The tests would serve as a national standard for carbide inserts, and agencies could request that manufacturers test their inserts at independent labs using the tests developed through this study.	\$100,000	24-30 months	Dennis Burkheimer, Iowa DOT
6	Anti-fogging/frosting Windshield	Identify methods, designs or materials that can be used on snowplow windshields to better keep them clear of snow, ice, frost or other moisture on both the inside and outside of the windshield	\$30,000	12-18 months	Dennis Burkheimer, Iowa DOT
7	Comparison of Bridge De-icer Systems Throughout the Country	Compare and evaluate the various bridge deicer systems. Summarize the benefits, disadvantages, maintenance issues, downtime, acceptance and usage from field personnel, training, malfunctions, etc.	?	9 months	Ben Zwart, Minnesota DOT
9	Investigation of LED Arrow Board Visibility	Review the eight currently approved light boards in production and conduct a field test to evaluate their night visibility and reliability. Use results to develop a new specification that will dictate minimum visibility under varying lighting orientations.	?	9 months	Ben Zwart, Minnesota DOT
10	Manufactured Low Cost Chemical De- and Anti-icer	Research and design a manufactured chemical that will be low cost, readily available, easy to handle, and environmentally friendly.	?	?	Ben Zwart, Minnesota DOT
11	Agricultural Products vs Salt Brine, Magnesium Chloride, and Calcium Chloride for Anti-icing and De-icing	Compare the anti-icing and de-icing effectiveness of liquid agricultural products to salt brine, magnesium chloride and/or calcium chloride.	?	Two winters	Dennis Belter, Indiana DOT
13	Correlation and Cost Effectiveness between Winter Maintenance and Safety	Determine if there is a correlation between winter operations and improved safety and cost savings.	?	1 year	Dennis Belter, Indiana DOT

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Calibration Accuracy of Ground Speed Controlled Salters

II. RESEARCH PROBLEM STATEMENT

Ground speed controllers have been used on snow plow/salt spreader trucks since the mid-1990's. While these units have assisted the operator in having better control over his salt application rates, to our knowledge, the accuracy of the equipment has never been determined. As part of a WisDOT research project on fine graded salt in two counties back in 1996-1998, it was discovered that the application rate settings on the ground speed controllers of the trucks used in the study did not match the prewetting rate or the amount of salt that was discharged by the salt spreaders.

III. OBJECTIVE

The objective of this study will be to document ground speed controller settings and actual salt usage and prewetting rate information from trucks with various types of ground speed controller units during winter storm events.

IV. RESEARCH PROPOSED

A yard study will be done to compare ground speed controller settings with actual salt discharge amounts collected from the discharge point of the salt spreader. The second phase of the study will involve documentation of actual ground speed controller settings and amount of salt used from trucks operating on the highway during winter storm events. A final report will present and analysis the data collected from both phases of the study.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: \$50,000

Research Period: Fall, 2005-Summer, 2007 (allowing for two winter seasons of data collection)

VI. URGENCY AND PAYOFF POTENTIAL

The results of this study will assist snow plow operators in calibrating ground speed controllers to a more accurate level. This re-calibration will result in less salt being used by the salt spreaders thus improving the efficiency of the spreaders.

VII. RELATED RESEARCH

No ground speed controller manufacture sponsored research found.

Salt Institute Snowfighter's Handbook contains salt spreader calibration procedures, www.saltinstitute.org/Snowfighting/6-calib.html .

SHRP-H-385, Development of Anti-Icing Technology, April, 1994 contains information on a "Proposed American Testing Protocol for Winter Maintenance Spreaders" (p.p. 187-194) and "Foreign Testing Protocols" (p.p 282-302) for Germany, England, Finland, and Denmark.

Ontario Ministry of Transportation has performed field testing of prewetted salt application rates as part of a "**Maintenance Technology Project**" (www.mto.gov.on.ca/english/transmek/m03-04/03-04fs.htm) but no reports have been issued (per Force America representative).

United Kingdom National Salt Spreading Research Group, "**National Salt Spreading Trials**", 2001. (www.trl.co.uk/nssrg)

IX. DATE AND SUBMITTED BY

February 27, 2004, April 23, 2004 Revised, January 21, 2005 Revised
Tom Martinelli, Winter Operations Engineer
WisDOT, Bureau of Highway Operations
4802 Sheboygan Ave., Room 501, Madison, WI. 53705
(608) 266-3745 (phone)/ (608) 267-7856 (fax)
Thomas.Martinelli@dot.state.wi.us

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Effectiveness and Efficiency of Underbody Plows

II. RESEARCH PROBLEM STATEMENT

Use of an underbody plow blade is an alternative to using higher salt application rates to remove snow pack. Which approach is more cost effective needs to be determined.

III. OBJECTIVE

Determine if a snow removal operation is more efficient when more scraping of snow pack is performed with an underbody plow blade or higher salt application rates of salt are used to remove or break up snow pack.

IV. RESEARCH PROPOSED

Document for two winter seasons the hours of underbody plow usage and cost and the cost of salting operations for two winter patrol trucks using two different approaches to snow pack removal.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: \$50,000

Research Period: Fall, 2005 till Summer, 2007 (including two winter seasons)

VI. URGENCY AND PAYOFF POTENTIAL

Urgency is difficult to determine. Payoff potential relates to a more efficient snow removal operation whereby either less salt or less use of the underbody plow would result in a cost savings to the operator.

VII. RELATED RESEARCH

None found.

IX. DATE AND SUBMITTED BY

Tom Martinelli, Winter Operations Engineer
WisDOT, Bureau of Highway Operation
4802 Sheboygan Ave., Room 501
Madison, WI. 53705
(608) 266-3745 (phone)/ (608) 267-7856 (fax)
Thomas.Martinelli@dot.state.wi.us

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Optimum Snowplow Design

II. RESEARCH PROBLEM STATEMENT

New materials are continually being developed that are lighter and stronger than the materials used in most plows. Many agencies are still specifying plows that are based on 1950's needs for brute strength to clear heavy snowfalls. Many agencies are now more proactive in their operations the need for brute strength may no longer be appropriate.

III. OBJECTIVE

This project will provide a background on past research done in plow designs and material. The project will also investigate new materials and designs that may be better suited for a more pro-active approach to snow removal. The research should consider attack angle of the blade, proper throat dimensions and possible additions to the plow (slush blade, squeegee, broom, blower, etc.) that will enhance performance of the plow to provide a cleaner surface.

IV. RESEARCH PROPOSED

Literature search followed by field test and evaluation of different materials, designs and attachments

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended funding: \$150,000

Research period: 24-30 months

VI. URGENCY AND PAYOFF POTENTIAL

Most agencies still use plows that weigh a ton or more and are more suited for plowing large amounts of snow. Often the plow will leave a ¼ to ½ inch layer of snow after the plow has passed requiring more materials to eliminate the ¼ to ½ layer plus any additional snowfall. The development of a new plow design and attachments would allow agencies to use equipment that will clean the road down to a bare surface with more finesse and increase snow removal speeds.

VIII. RELATED RESEARCH

“Development of a Computer Controlled Underbody Plow,” Annual Report Of Highway Division, Highway Research and Development in Iowa, December 2004.

http://www.dot.state.ia.us/materials/research/annual_report_03_04.pdf.

TR-412- Objective (Page 17): The objective of this proposed research is to develop a computer controlled underbody plow and then, through an expert system, capture and apply the experience of our best ice removal maintenance personnel.

“The Local Spotlight- City of Ketchum,” Gem State Roads (Idaho’s Technology Transfer Quarterly), Vol. III, Issue No. 1, January 1998.

<http://www.webs1.uidaho.edu/idahot2/newsletter/98jan.pdf>.

Page 3: The most unique piece of equipment used by the City of Ketchum is its snow bucket. The snow bucket is U-shaped with outside wings. Its concave shape rolls the snow back into the bucket. Most snow plows plow sheets, but these buckets are designed to roll the snow into a giant ball, which is then taken to an area on the edge of town.

IX. DATE AND SUBMITTED BY

Dennis Burkheimer- Iowa DOT
January 26, 2005

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Carbide Blade Insert Standardized Performance Testing

II. RESEARCH PROBLEM STATEMENT

Currently most winter maintenance operations use plow blades with carbide inserts to help remove snow and ice. Most agencies specify dimensions for the inserts but little is done to determine the performance level of the inserts.

III. OBJECTIVE

The objective of this research project is to identify a test or set of tests that can be conducted in a lab to measure performance of carbide inserts. Once the appropriate tests are identified agencies can then ask manufacturers to have their inserts tested at independent labs to determine which blades to purchase based on performance results. The tests could be used as a national standard for carbide inserts.

IV. RESEARCH PROPOSED

The research would require a literature search to determine the standards already used in the industry to measure hardness of the carbide and other features of the insert. The research would then develop standardized tests to measure performance of carbide inserts for durability and cutting power at a minimum.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended funding: \$100,000

Research period: 24-30 months

VI. URGENCY AND PAYOFF POTENTIAL

A set of carbide inserts cost approximately \$220 per plow and a truck may use 2-3 blades per year. Fleet size will determine the economic value of this project.

VIII. RELATED RESEARCH

"Evaluation Of Cracking In Pre-Service And In-Service Snow-Plow Carbide Wear Surfaces," Missouri Department of Transportation, December 2003.

Abstract:

<http://trisonline.bts.gov/detail.cfm?ANNUMBER=00969836&STARTROW=1&CFID=1132812&CFTOKEN=13852317>. The purpose of this study was to determine the source of defect propagation in carbide/steel snowplow blade inserts and qualify a nondestructive testing technique that will: a) locate and determine whether or not defects originating in the manufacturing process have an impact on blade service life, b) monitor in-service blades to determine the rate of carbide insert and bond breakdown in the field, and c) evaluate various carbide insert configurations in the field.

Full report:

<http://168.166.124.22/RDT/reports/Ri01023/RDT03015.pdf>.

It is believed that manufacturing defects in the wear surface are present prior to state purchase, and that they are either caused by improper heat application during the brazing process, or excessive cold forming while straightening the finished blade at the manufacturer. We have shown that ultrasound examination can divulge pre-service and in-service defects in single layered carbide insert blades. The inspection of these blades in the lab is easy, and the techniques work well in the field as long as the blade surface of the inspection area is not damaged. Ultrasound examination can divulge the cause of in-service defects so that engineering can; (a) require that the manufacturing process be changed if needed, (b) determine if the Rockwell hardness of the carbide inserts needs to be lowered, (c) recommend adding a protective cutting edge to the front of the carbide wear surface plate, and/or (d) recommend a change in snowplow operation practices. Such data would allow Missouri to improve the design, specifications and/or operational requirements for these products.

IX. DATE AND SUBMITTED BY

Dennis Burkheimer- Iowa DOT, January 26, 2005

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Anti-fogging/frosting Windshield

II. RESEARCH PROBLEM STATEMENT

Windshields on snowplow trucks are an important safety feature in a snowplow. Often times they become covered with snow, ice, frost and other precipitation during winter storms making visibility difficult for snow plow operators. To keep the interior of the windshield clean operators often have to resort to operating the air conditioner or opening windows to make sure there is adequate ventilation to keep the windshield clean.

III. OBJECTIVE

The objective of this project is to identify methods, designs or materials that can be used on snowplow windshields to better keep them clear of snow, ice, frost or other moisture on both the inside and outside of the windshield.

IV. RESEARCH PROPOSED

Survey of states and manufacturers to determine the best methods, materials and designs used to keep windshields clean of winter precipitation on both interior and exterior surfaces

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: \$30,000

Research Period: 12-18 months

VI. URGENCY AND PAYOFF POTENTIAL

Safety for operators and immediate payoff

VIII. RELATED RESEARCH

“Keeping Windshields Clear,” Canadian Driver, March 1, 2003.

<http://www.canadiandriver.com/articles/jk/030319.htm>.

Now there is a new way to remove frost and ice: heated windshield washer fluid. It has been tried before, but the systems had a few flaws, such as heating the fluid too hot and cracking the glass. Now a new electronically controlled system from HotShot is on the market and it is available as an add-on to any vehicle. The trucking industry is showing a lot of interest in this system. Installation: power and ground wires connect to the vehicle's electrical system under the hood; the heater module is mounted on the vehicle's body close to the washer spray nozzles; and the hoses for the windshield washer are connected to the heater. Tap the control button and the system's automatic mode quickly heats the washer fluid to 63 degrees C and sprays fluid in timed intervals to clear frost. By holding the button for a few seconds, the heater is placed in "standby" mode, where fluid is kept hot while you drive for instant clearing. If large amounts of washer fluid are sprayed, the heater is bypassed until the fluid is hot again and then it automatically switches to the hot fluid. Retail price is about \$500 for an aftermarket kit, plus any installation fees.

“Focus on Anti-Icers, Deicers: Keep Ice at Bay,” Better Roads, August 2001, Product Focus.

<http://www.betterroads.com/articles/prod801.htm>.

Ice-melting compound: Alcohol-based Ice-MC spray is designed to prevent ice and frost from forming and rinses clean with water. For use on maintenance windshields, windows, headlights, taillights and door locks the SHH Company liquid can be sprayed in advance of cold weather to prevent ice from forming. Applications include stopping misting and fogging on windows, dissolving ice and frost from windshields and thawing frozen locks.

“Tin,” Radiochemistry Society, 2003 posting.

<http://www.radiochemistry.org/periodictable/elements/50.html>.

Forms: Tin salts sprayed onto glass are used to produce electrically conductive coatings. These have been used for panel lighting and for frost-free windshields.

IX. DATE AND SUBMITTED BY

Dennis Burkheimer- Iowa DOT, January 26, 2005

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Comparison of Bridge De-icer Systems Throughout the Country

II. RESEARCH PROBLEM STATEMENT

Several different types and manufacture of bridge deicer systems have been installed all over the country. A summary report of the bridge deicer systems in the USA would be extremely helpful in planning for future installations.

III. OBJECTIVE

With bridge deicer systems popping up all over the country, we could provide accurate information to other agencies inquiring about these systems.

IV. RESEARCH PROPOSED

Compare and evaluate the various bridge deicer systems in Minnesota. An evaluation report summarizing the benefits, disadvantages, maintenance issues, downtime, acceptance and usage from field personnel, training, malfunctions, etc. would be written.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: ?

Research Period: 9 months

VI. URGENCY AND PAYOFF POTENTIAL

Include a statement concerning the urgency of this particular research. Identify and, if possible, quantify the potential and magnitude of payoff from the achievement of the project objectives.

VIII. RELATED RESEARCH

“Implementation of Conductive Concrete Overlay for Bridge Deck Deicing at Roca, Nebraska,” Christopher Y. Tuan [University of Nebraska–Lincoln] and Sherif A. Yehia [Western Michigan University]. (From -- Sixth International Symposium on Snow Removal and Ice Control Technology, Transportation Research Circular No. E-C063, June 2004.)

<http://gulliver.trb.org/publications/circulars/ec063.pdf>, Page 363.

Conductive concrete is a relatively new material technology developed to achieve high electrical conductivity and high mechanical strength. In research sponsored by Nebraska Department of Roads, a conductive concrete mix specifically for bridge deck deicing was developed. In this application, a conductive concrete overlay is cast on top of a bridge deck for deicing and anti-icing. This technology has been successfully implemented in a demonstration project at Roca, about 15 miles south of Lincoln, Nebraska. The Roca Spur Bridge has a 117-foot long and 28-foot wide conductive concrete inlay.

Temperature sensors and a microprocessor-based controller system were installed to monitor and control the deicing operation of the inlay. The construction was completed and the bridge was opened to traffic in the spring of 2003. Data from the first deicing event showed that an average of 500 W/m² (46 W/ft²) was generated by the conductive concrete to raise the slab temperature about 9°C (16°F) above the ambient temperature. The details of the construction and deicing operation of the conductive concrete inlay are presented.

“State-of-the-Art Fixed Automated Spray Technology,” Jerry R. Waldman, Surface Systems Inc. -- Quixote Transportation Safety Inc. (From -- Sixth International Symposium on Snow Removal and Ice Control Technology, Transportation Research Circular No. E-C063, June 2004.)

<http://gulliver.trb.org/publications/circulars/ec063.pdf>, Page 379.

Applying anti-icing chemical at the optimum time is critical for an effective anti-icing program. The timing of anti-icing chemical applications is especially critical for bridge structures, where icing can occur in advance of icing on normal pavements. Advances in technology have given highway operators a new tool to enhance the effectiveness and efficiency of their anti-icing program. This tool is the fixed automated spray technology (FAST) system. The FAST system is a permanent installation of a pump, a tank, nozzles and a controller that dispenses anti-icing chemicals directly on a predetermined area of pavement. These systems can initiate chemical applications either on manual command or be integrated with RWIS to operate automatically based on detected highway conditions.

IX. DATE AND SUBMITTED BY

Sue Lodahl, Maintenance Research and Training Engineer, 395 John Ireland Blvd, St. Paul, MN 55155,
651-282-2281, 651-296-6758, sue.Lodahl@dot.state.mn.us.

Clear Roads Contact: Ben Zwart

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Investigation of LED Arrow Board Visibility

II. RESEARCH PROBLEM STATEMENT

A review of LED board visibility needs to be done. Areas of particular concern are visibility from various angles and brightness, including day/night adjustments.

III. OBJECTIVE

Improve work zone safety through improved signs. A new specification that will dictate minimum visibility under varying lighting orientations could be created.

IV. RESEARCH PROPOSED

Review of the eight currently approved light boards in production. A field test should be included along with a review of night visibility and reliability.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: ?

Research Period: 9 months

VI. URGENCY AND PAYOFF POTENTIAL

VIII. RELATED RESEARCH

“Legibility Distances of Smaller Letter Light-Emitting-Diode Changeable Message Signs,” TRB 84th Annual Meeting Compendium of Papers CD-ROM, 2005.

Abstract: In this paper, researchers present the results of a legibility study of 9-inch and 10.6-inch letters on light-emitting diode (LED) changeable message signs (CMS). The study, conducted in Dallas, Texas, consisted of 60 subjects, demographically balanced with respect to age, gender and education. The subjects drove a test vehicle as they approached CMSs with one of the above letter heights. Study administrators recorded the distance from the sign at which the participant could correctly read a three-letter word. Data were recorded for three trials on each of the letter heights for each participant. Data were collected during daylight (sun overhead) and nighttime conditions. The 85th percentile legibility distance for the 9-inch letter height was 228 feet during daytime conditions and 114 feet for nighttime conditions. With the 10.6-inch letter height, the 85th percentile legibility distances were 324 feet and 203 feet for daytime and nighttime conditions, respectively. The 85th percentile legibility distances for each letter height were used to estimate available viewing times under various approach speeds. These available viewing times dictate the units of information that can be presented on a CMS of a particular letter size.

“Research Improves Highway Work Zone Sights,” Texas Transportation Researcher, Vol. 40, Issue 1, 2004.

<http://tti.tamu.edu/researcher/newsletter.asp?vol=40&issue=1&article=8>.

In a TxDOT sponsored study, TTI researchers developed a scientific, measurable and objective method to determine if the boards and signs could truly be seen by motorists. TTI researchers recommended a minimum illumination, or brightness, for daytime driving and at night. They considered vehicle speeds and roadway alignments, as well as night and day situations, in setting the standards. From this, TxDOT has created a test (TEX 880) that measures the visibility of arrow boards. Using the results of this project, TxDOT has successfully tested arrow boards purchased from one manufacturer and will test others as they are procured.

IX. DATE AND SUBMITTED BY

Benjamin Zwart, Maintenance Operations Research Engineer, 395 John Ireland Blvd, St. Paul, MN 55155, 651-282-5434, 651-296-6758, ben.zwart@dot.state.mn.us.

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Manufactured Low Cost Chemical De- and Anti-icer.

II. RESEARCH PROBLEM STATEMENT

There is a great need for a low cost, readily available, easy to handle, environmentally friendly, de-icing and anti-icing chemical. Since there has not as yet been a natural chemical or element discovered that fits these criteria it is becoming more apparent that a manufactured chemical will be needed to address this issue.

III. OBJECTIVE

Research and design a manufactured chemical that will provide the needed characteristics for de-icing and anti-icing.

IV. RESEARCH PROPOSED

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: ?

Research Period: ?

VI. URGENCY AND PAYOFF POTENTIAL

VIII. RELATED RESEARCH

“Assessment of Safecote: New Deicer Product,” Marilyn Burtwell, Transportation Research Laboratory Limited. (From -- Sixth International Symposium on Snow Removal and Ice Control Technology, Transportation Research Circular No. E-C063, June 2004.)

<http://gulliver.trb.org/publications/circulars/ec063.pdf>, Page 529.

Safecote Ltd, a company based in the United Kingdom, introduced a new deicer product based on extensive experience of its application in the United States and with the potential to help reduce chemical contamination of the environment. In 2000, Transportation Research Laboratory Limited was commissioned to investigate the effect of this deicer product, when used in precautionary salting, as an additive or prewetting agent for salt products. As a prewetting agent to salt, the primary aims are to reduce the chloride component of the treatment in order to mitigate the damaging effects of salt to the environment and to reduce the level of damage that occurs to both concrete and steel when chloride-based deicers are used for winter maintenance. The study was carried out in two phases and various properties of Safecote were evaluated. This paper summarizes the findings from both phases of the study.

“Reducing Environmental Impact of Road Salts,” Ontario Corn Producers’ Association Newsletter, November 2003.

<http://www.ontariocorn.org/ocpmag/news1103.htm#REDUCING>.

An environmentally safe and cost competitive road deicer and sand encapsulant has been developed by Producers Renewable Products, LLC, North Oaks, Minnesota, in collaboration with South Dakota State University, Minnesota Department of Transportation, and corn ethanol producer Corn Plus. Trials demonstrated that increased concentrations of condensed corn distillers solubles dramatically decreased corrosion from road salt, and that corrosion was largely eliminated if the deicing solution contained equal weights of salt and corn stillage from the dry milling ethanol process. The solubility, viscosity and low temperature freezing point of stillage were improved by the addition of salt. A mixture containing 15 percent condensed corn distillers solubles, 10.5 percent NaCl, and 4.5 percent CaCl₂ was found to be cost competitive with NaCl when consideration was given for the better deicing properties and minimal corrosivity.

IX. DATE AND SUBMITTED BY

Benjamin J. Zwart, P.E., Maintenance Operations Research Engineer
Minnesota Department of Transportation, MS 722
Phone: 651-282-5434, Fax: 651-296-6758

ben.zwart@dot.state.mn.us

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Agricultural Products vs Salt Brine, Magnesium Chloride, and Calcium Chloride for Anti-icing and De-icing

II. RESEARCH PROBLEM STATEMENT

Manufacturers of liquid agricultural products claim effectiveness of their products at low temperatures, ease of use, easy applications, decreased corrosiveness, and effective lower cost. However, liquid agricultural products are considerably more expensive. Are the liquid agricultural manufacturer claims correct? Does the use of agricultural liquids provide a way to lower cost vs salt brine, mag chloride and calcium chloride?

III. OBJECTIVE

The objective is to see if the liquid agricultural products are a better alternative to salt brine, magnesium chloride and/or calcium chloride for anti-icing and de-icing.

IV. RESEARCH PROPOSED

Use the ag products in anti-icing and e-icing applications, along side the salt brine, mag chloride and the calcium chloride. Compare the effectiveness, ease of use, corrosiveness, problems with application, and costs at different temps.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: ?

Research Period: Two winters.

VI. URGENCY AND PAYOFF POTENTIAL

The use of salt and other chlorides is a concern for the environment. If cost effective, safer products are available, all transportation departments would benefit.

VIII. RELATED RESEARCH

University of Iowa

“Agricultural By-Products for Anti-Icing and Deicing Use in Michigan: Summary,” Steve Kahl, Michigan Department of Transportation. (From -- Sixth International Symposium on Snow Removal and Ice Control Technology, Transportation Research Circular No. E-C063, June 2004.)

<http://gulliver.trb.org/publications/circulars/ec063.pdf>, Page 552.

When agricultural by-products (ABP) liquids are used appropriately for anti-icing, they can be a powerful tool in providing safer roads to the traveling public at less cost. This report combines evaluating anti-icing as a winter maintenance tool and the use of ABPs for anti-icing. Evaluation included application of ABPs on trial roadways, analysis of cost-effectiveness, ABP prewetting effect on salt usage, use of ABPs for anti-icing and deicing operations, and accident statistics review. Because ABPs are supplied from different manufacturers they are subject to variability in composition, and therefore specifications for ABPs were developed. One Michigan DOT maintenance garage used APBs exclusively for deicing operations at a cost of \$30.22 per lane mile. The application rate of 25 gallons per lane mile for deicing corresponded to a dry weight of 97 pounds per lane mile. Compared with the prewetted salt rate of 250 pounds per lane mile, the environmental impact of salt is reduced 61 percent, albeit at considerable expense. However, chloride-free deicers would have cost considerably more. Using calcium magnesium acetate (CMA) at 400 pounds per lane mile (application rate needs to be increased to match performance of salt) at a unit cost of \$600 per ton would have cost \$120 per lane mile. The pilot program serves to emphasize that ABP liquids should be used for anti-icing operations and prewetting rock salt, rather than for deicing. Costs for the cleanup of compacted snow and ice vary but reportedly are reduced in terms of man-hours and equipment. Further, the corrosion-inhibiting APBs reduce equipment maintenance by preventing or minimizing rusting of the truck hoppers, spinners and other parts. Cost-effectiveness of ABPs is sometimes difficult to determine, as many highly variable local costs (e.g., unit materials cost, labor rates, storage) need evaluation. Indirect costs (e.g., travel delay costs) should also be considered.

“Reducing Environmental Impact of Road Salts,” Ontario Corn Producers’ Association Newsletter, November 2003.

<http://www.ontariocorn.org/ocpmag/news1103.htm#REDUCING>.

An environmentally safe and cost competitive road deicer and sand encapsulant has been developed by Producers Renewable Products, LLC, North Oaks, Minnesota, in collaboration with South Dakota State University, Minnesota Department of Transportation, and corn ethanol producer Corn Plus. Trials demonstrated that increased concentrations of condensed corn distillers solubles dramatically decreased corrosion from road salt, and that corrosion was largely eliminated if the deicing solution contained equal weights of salt and corn stillage from the dry milling ethanol process. The solubility, viscosity and low temperature freezing point of stillage were improved by the addition of salt. A mixture containing 15 percent condensed corn distillers solubles, 10.5 percent NaCl, and 4.5 percent CaCl₂ was found to be cost competitive with NaCl when consideration was given for the better deicing properties and minimal corrosivity.

IX. DATE AND SUBMITTED BY

Proposer: Mike Rivers, INDOT

Contact Person: Dennis Belter, Program Support Manager

Indiana Department of Transportation

IGCN RM N925, 100 N. Senate Ave.

Indianapolis, IN 46202

Phone: 317-232-5424, Fax: 317-232-5551

dbelter@indot.state.in.us

January 24, 2005

Clear Roads Problem Statement
Pooled Fund #TPF-5(092)
Federal Fiscal Year 2006

I. PROBLEM TITLE

Correlation and Cost Effectiveness between Winter Maintenance and Safety

II. RESEARCH PROBLEM STATEMENT

Safety is the primary concern of all State DOTs. As a result, large expenditures are made annually to remove snow and ice from highways. How do winter operations impact safety statistics both during plowing/salting and as a result of snow and ice removal activities? Can we determine the number of lives and accidents that were saved? Also, can this be translated into dollars saved?

III. OBJECTIVE

The objective of this research is to determine if there is a correlation between winter operations and safety statistics and a corresponding cost savings.

IV. RESEARCH PROPOSED

Obtain and compare safety statistics to winter operations costs as a whole or to changes in operations.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: ?

Research Period: If research can be completed based on existing records, approximately one year would be needed to complete the research.

VI. URGENCY AND PAYOFF POTENTIAL

Statistics showing a savings from performing snow and ice removal activities could assist DOTs in obtaining or sustaining budgets.

VIII. RELATED RESEARCH

“The Winter Model: A Winter Maintenance Management System,” Carl-Gustaf Wallman, Swedish National Road and Transport Research Institute. (From -- Sixth International Symposium on Snow Removal and Ice Control Technology, Transportation Research Circular No. E-C063, June 2004.)

<http://gulliver.trb.org/publications/circulars/ec063.pdf>.

The goal of the winter model project was to provide a model for assessing the most important effects and the monetary value of alterations to winter maintenance strategies and operations. The effects are assessed for road users, road administrators, and environment. In this paper, the accessibility model and the accident risk model are treated.

Results (Page 90): Accident rates for the salted and unsalted road networks in Central Sweden are displayed in Figure 3. The accident rates for ice and snow conditions are much larger for the salted network and still larger if the rates are related to the rate at dry, bare ground. The striped area in Figure 4 shows the effect of improved maintenance. The vehicle mileage is decreased on ice and snow. The optimistic model states that the accidents decrease by a number, corresponding to the area of the striped square. Conversely, the accident rate on ice and snow may increase, because drivers will have fewer occasions and less time for adapting their driving behavior to icy and snowy conditions. If this is the case, the accidents increase on ice and snow corresponding to the striped area in Figure 5.

“Research on the Level of Winter Road Management,” Takashi Yamada [Hokuriku Construction Association], Akira Sugimura [Hokuriku Regional Development Bureau], Teruhiko Maruyama [Nagaoka University of Technology]. (From -- Sixth International Symposium on Snow Removal and Ice Control Technology, Transportation Research Circular No. E-C063, June 2004.)

<http://gulliver.trb.org/publications/circulars/ec063.pdf>.

This study focuses on the level of winter road management and analyzes regional characteristics, snow removal cost, and degree of road-user satisfaction to study the level of winter road management that should be provided in a heavy snow region.

Cost-Benefits (Page 149): A cost-benefits analysis of present snow removal was performed based on the prerequisite conditions presented in Table 1. The analysis obtained the driving time reduction to measure this as the snow removal effects based on the difference between the driving speed with and without snow cover on the road surface. As a result, the cost-benefits ratio is 1:4, and a measurement based only on the driving time reduction benefits satisfies the efficiency standard. Because the total

benefit presumably includes driving expense benefits, traffic accident reduction benefits, and more, the benefits of actual snow removal are probably several times larger than shown here.

“Icy Road Management with Calcium Magnesium Acetate to Meet Environmental and Customer Expectations in New Zealand,” Alan Burkett [Transit New Zealand] and Nick Gurr [Opus International Consultants]. (From -- Sixth International Symposium on Snow Removal and Ice Control Technology, Transportation Research Circular No. E-C063, June 2004.)
<http://gulliver.trb.org/publications/circulars/ec063.pdf>.

This paper summarizes the environmental monitoring of calcium magnesium acetate (CMA) in the central North Island, the results obtained, the benefits and costs involved, and management practices.

Costs and Benefits (Pages 274-275): To provide a comparison of the cost and benefits of using CMA against grit, an assessment of the relative economic differences has been undertaken using a 25-year analysis period. In the case of CMA these benefits are obtained through:

-- Reduction in accidents. The analysis of accident reductions is difficult because of the variability of the winters. To allow for this in a benefits analysis, the effectiveness of CMA at reducing ice-related accidents was treated as a variable.

-- Decrease in travel time. The replacement of grit with CMA results in a net decrease in travel time when icy conditions are prevalent because of increased speed. Skid-resistance tests indicated a 24 percent increase in grip when CMA was used in place of grit and therefore provided a safer surface for motorists.

-- Reduction in road closure durations. The most significant benefit to the road users is obtained through reductions in road closures. A network model to determine the effects on road users when the Desert Road is closed has been developed (10). The model considered vehicle operating costs, vehicle occupant time and benefits lost because of canceled trips.

The reduction in road closures due to the use of a deicer or anti-icer is difficult to quantify, and so this factor also was adopted as a variable. The benefit-cost ratio (BCR) of CMA is the ratio of the combined benefit streams (travel time reductions, accident reductions, and reductions in road closure durations) over the differential cost of CMA compared with gritting. In looking at the BCR of using CMA as a replacement for grit (Table 1), it is evident that CMA's greater costs can be offset by the increased benefits to the road users with just a small reduction in accidents or closures.

“A Benefit/Cost Review of the Use of Safecote Additives to Rock Salt for the Winter Maintenance of Roads in the UK,” Dr J. E. Thornes, November 2003.

<http://www.safecote.com/SafecoteBenefit-Cost2003Final.doc>.

Abstract: A number of “value-for-money” studies have been undertaken and the benefits and costs of winter maintenance have been assessed in several individual countries. This paper attempts to review these international benefit/studies and examine their relevance for the United Kingdom.

Introduction (Pages 2-3): Table 1 shows the benefits and costs of the use of salt as estimated in a number of studies around the world. Different studies have included different elements of benefits and costs in their calculation and one has to be careful therefore when comparing the results of one study with another. The US studies are based on the use of rock salt as a de-icer to remove snow at much greater application rates than in the UK. The concept of pre-salting (anti-icing) is still very new in North America.

The Darmstadt Technical University (OECD 1989 p107) carried out a detailed study of the accident rate before and after the salting of roads in Germany. The number of accidents analyzed was more than 4,700 on 650km of rural roads with just under 1,900 casualties over four winters. It was found that the average accident rate on these roads on ice-free days was approximately 1.6 per million vehicle kilometres (MVK). In the four hours prior to salting the accident rate rose to 9.5 per MVK - six times the rate for ice-free days, falling to 2.6 per MVK in the four hours after salting. In terms of benefits it was shown that the costs of salting the roads were met after 140 vehicles were driven over the de-iced road, or expressed in another way a salt spreader paid for its costs after half an hour of operation.

IX. DATE AND SUBMITTED BY

Proposer: Dave Unkefer, FHWA Indiana Division Office

Contact Person: Dennis Belter, Program Support Manager, Indiana Department of Transportation
IGCN RM N925, 100 N. Senate Ave., Indianapolis, IN 46202

Phone: 317-232-5424, Fax: 317-232-5551

dbelter@indot.state.in.us

January 24, 2005