Maintenance 2001 Project

1997-1998 2nd Season

Maintenance 2001: "Integrating Technology for Winter Road Maintenance"

Project Objectives

The introduction of new technology, techniques and practices will:

- reduce salt usage and negative impacts on the environment
- maintain a more consistent winter maintenance level of service
- measure the performance of winter maintenance contractors to ensure safety and standards are met
- disseminate information on winter road conditions
- foster opportunities for partnerships (MTO, municipalities, private contractors) to share information

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Project Description

- 30 km test route along Hwy 26, between Barrie and Stayner s
- chosen as test area for integrating new technology and practice
- this area experiences a significant number and variety of storm conditions
- results will be compared to traditional practices
- 3 categories of technology/practices under investigation

- Advanced Road Weather Information Systems (ARWIS)
- Advanced Winter Maintenance Procedures and Equipment
- Tools for Monitoring Maintenance Activities and Performance

- some of the equipment will be visible at the test site along the highway or in retrofitted vehicles

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Projected Products

Advanced Road Weather Information Systems

- evaluation of the costs, benefits and reliability of ARWIS, and networked ARWIS

Advanced Winter Maintenance Practices

- comparison of alternative anti-icing methods and variable salt application rates, including the use of liquid and pre-wet chemicals, with existing MTO practices
- evaluation of the use of ice detection and local forecast information to manage material applications and timing, and in distinguishing conditions which are suitable for alternative methods
- an expert system for selecting appropriate treatments and a database of treatment effectiveness under a wide range of conditions

Tools for Monitoring Maintenance Activities and Performance

- evaluation of the effectiveness of road surface friction measurements to monitor the quality of winter operations
- evaluation of the safety implications of proposed changes to winter sand application rates
- evaluation of equipment modifications to increase effectiveness while minimizing the use of salt

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Advanced Road Weather Information Systems (ARWIS)

Definition

- an advanced RWIS is a network of atmospheric data gathering and road condition remote sensing systems
- the addition of an ice detection/prediction system which uses pavement and atmospheric sensors on site, means that accurate pavement condition forecast information is available

Project Evolution

- 1990: researchers began investigating roadside sensor information to enhance ministry decision making in winter operations
- 1993: early testing of ice detection systems at Kitchener and Gormley led to the selection and expansion of one system type at Kitchener
- 1996-97: Maintenance 2001 project incorporates a full demonstration of ARWIS, advanced practices and monitoring tools
- 1997-98: expansion of ARWIS sites by the ministry along Hwy 401 corridor (Putnam Rd., Towerline Rd.) and continued demonstration at the Barrie site
- 1997-98: the beginning of an Ontario network: in addition to above sites, 3 ARWIS in Kitchener by the Ministry, several ARWIS sites along Hwy 401 from Windsor to St. Thomas by private contactor; ministry-installed ARWIS site linked to Regional Municipality of Ottawa-Carleton network of RWIS sites
- 1997-98: partnership between MTO and Environment Canada which has an extensive network of Canadian weather stations

Future Developments

- continued expansion of ARWIS sites across southern Ontario along Hwy 401 corridor
- Windsor-Montreal corridor to be ARWIS populated
- partnerships with municipalities (Ontario and outside), provincial transportation agencies, private contractors to install and ensure maintenance of instruments

Components

Atmospheric sensors

- measure air temperature, relative humidity, precipitation, wind speed and direction

Pavement sensors

- embedded in highway pavement and bridge decks
- measure road surface temperature
- monitor levels of precipitation (wet, ice, snow or frost)
- determine whether de-icing chemicals are present or needed

Video surveillance

- visual monitoring of roadway, visibility, and presence of precipitation

Pavement forecast

- real-time sensor information provided to meteorological service which combines data with weather forecast
- provides tailored forecast of pavement condition 24 hours in advance

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Advanced Winter Maintenance Procedures and Equipment

Anti-icing and Pre-wetting Strategies

anti-icing: *early salt application to prevent adhesion of snow to the pavement and to allow plowing operations to be more effective, using less material*

prewetting: *spraying sodium chloride brine on de-icing materials before application on the road*

- MTO has practiced anti-icing strategies for 20 years using crushed salt, at a standard rate of application and without benefit of pavement sensor information
- new anti-icing procedures use detailed pavement information to determine

when salt brine or other liquid chemicals should be applied to the road to help keep material on the road and enhance rate of melting
- alternatively, finer gradation of salt applied at variable application rates . key advantage to early application and to prewetting is potential to minimize use of de-icing chemicals during storm
- de-icing material may become effective quicker with more retained on the road
- liquid de-icers may be more effective under conditions where air temperature falls below the dew point and pavement temperature is below freezing, or in anticipation of light snow and temperatures slightly below freezing

De-icing Anti-icing Response Treatment Program (DART)

- computer program under development for MTO to assist operational staff in selecting anti-icing, de-icing methods appropriate to weather and pavement conditions
- maintains database of treatment effectiveness
- anti-icing strategies based closely on "*Manual of Practice for an Effective Anti-icing Program: A Guide for Highway Maintenance Personnel*" published by U.S. Department of Transportation, Federal Highway Administration, 1996
- requires input from ARWIS for strategy selection

Test Site Equipment

Liquid Spreader

The Anti-icer spray system consists of a 5670 litre tank with a series of nozzles mounted on a spray bar. The system has a road speed sensor and an in-cab mounted electronic controller. The controller has five separate nozzle controls so that the operator can spray up to 3 lanes at a time. The control system displays the quantity of liquid per one lane km. On-board signs inform motorists that liquid salt brine is being applied.

Pre-wetting Spreader

The Pre-wet system consists of an electronic controller, electric liquid pump, tanks and nozzles. This system sprays liquid brine or other solution on the salt or sand as it is being discharged from the spreader. Various application rate settings are available.

Zero Velocity Spreader

Material is ejected rearwards from the truck at the same velocity as the vehicle is moving forward. This gives the ejected material a net zero velocity; thus the material falls directly on the road and does not scatter. This spreader also has pre-wetting capabilities.

Brine Maker

The brine maker consists of a large plastic tank with a salt hopper and a holding tank for the salt brine. Fresh water is fed into the bottom of the hopper where it filters through the salt and then overflows into a holding tank. Fresh water is added to the overflow stream to bring it to a 23.3% solution.

Infrared Thermometer

This device is fixed to the vehicle and provides air temperature as well as road surface temperature. Pavement temperature is a critical parameter for selecting appropriate salt applications. Infrared thermometers provide understanding of surface temperature variations at distances from the ARWIS.

On-board Video Camera

Mounted in a research van to provide a visual record of test conditions.

On-site Video Camera

Pole mounted video camera at weather sensor site for visual record and observations as a check on sensor data output. It provides a permanent record of anti-icing/de-icing effectiveness.

Voice Recognition System

Computer system in the monitor van records voice description of road surface conditions and converts it to a digital record with time and GPS position annotation. The system can be used to automate the MTO winter road condition report.

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Tools for Monitoring Maintenance Activities and Performance

Road Surface Friction Trailer

- quality standards for winter operations specify proportion of road-surface to be cleared of snow immediately, and time allowed to achieve bare pavement - surface friction measuring device may be able to classify the degree to which standard is met
- sand and salt application rates may be adjusted continuously in response to friction measuring device which is attached to a spreader vehicle

Mobile Electronic Data Collection System (MEDCS)

- developed as a tool for monitoring operation of contracted equipment
- TRAXIS system includes:
    - data collection system to interpret and record sensor data electronically
    - Global Positioning System (GPS) to calculate vehicle speed and distance
    - sensors to record spreader operation and application rates
    - sensors to record plow position and presence of snow on plow blade

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