CLEAR ROADS
research for winter highway maintenance

RESEARCH BRIEF

AUGUST 2014

AUTOMATED SPREADING SYSTEMS FOR WINTER MAINTENANCE

RESULTS SUMMARY

Researchers assessed the current state of automation technology for material spreaders, defined a vision of a totally automated spreader to help guide manufacturer development and created three guides to help agencies implement currently available automated spreader technologies.

PROJECT DETAILS

Project Title: Development of a Totally Automated Spreading System

Project Number: No. CR11-03

Project Cost: $72,025.00

Report Date: February 2014

Project Champion:
Cliff Spoonemore
Wyoming Department of Transportation
cliff.spoonemore@wyo.gov

Investigator: Gregory Thompson
Thompson Engineering Company
greg@statisticsinc.com

Improper application of winter maintenance chemicals during storms may result in poorly cleared roads or adverse impacts on the environment. Chemical application rates are typically set based on agency guidelines before the truck leaves the garage, although the operator may make adjustments along the route based on his judgment.

Automating the material application rate setting, either based on data collected by sensors on the snowplow or by allowing an experienced snowfighter to regulate rates remotely based on current conditions and forecasts, may improve the effectiveness of the material spreader by reducing the potential for human error. This is of particular importance as winter maintenance agencies face the prospect of a shrinking, less-experienced workforce as operators age and retire.

Need for Research

The state of automation in winter maintenance chemical spreading in the United States is not as advanced as it is in Europe. Clear Roads sponsored this research to assess exactly what automated spreading technology is currently available and to help snowfighters implement technology in a way that makes sense based on their local circumstances. The project also helps define what features are feasible and desirable for automated spreaders in the future.

Objectives and Methodology

Researchers conducted a literature search to identify and evaluate currently available automated salt spreaders. As part of this step, researchers grouped available spreaders by the sophistication of automation they offer. Researchers also examined material spreading technologies currently used in agricultural applications for potential applicability to winter maintenance.

Two surveys were given to winter maintenance professionals to gather their views about the current state of technology and prospects for the future. Researchers received 161 responses to the first survey from snowfighters in 19 U.S. states and Canadian provinces; 12 equipment vendors responded to the second survey.

CONTINUED

Implementing automated spreader technology could improve service and safety by allowing winter maintenance operators to focus on vehicle operation.

Using this information, researchers wrote three guides: an introduction to spreader automation technology, a hierarchy of automation elements that snowfighters can use to assess their current equipment and an overview of available systems comparing the features of different products.

Results

The surveys suggest that spreader automation is generally feasible and its use is likely to increase in the coming years. Winter maintenance professionals were somewhat skeptical about automation, leading researchers to encourage education as part of the implementation process.

In Guide #1 researchers defined the desired system capabilities of a fully automated spreader system, including automated setting of average application rate; automated variation from this rate based on road surface temperature, location, current and forecast weather conditions and traffic conditions; automated variation in spread pattern based on location; and automated recording and archiving of material application.

The literature search revealed many available winter maintenance material spreaders that include some automation features. Researchers described four potential levels of automation in Guide #2:

- No automation.
- Sensor-driven automation, most commonly a closed-loop ground-speed controller that adjusts chemical application rates based on the truck's travel speed or pavement temperature.
- Position-driven automation, where chemical application rates at any point on the route are preprogrammed based on roadway characteristics such as bridge decks, hills or intersections. The system uses the truck's GPS-measured location to adjust application rates to the truck's location.
- Remote control automation, in which a supervisor at a central location remotely adjusts chemical application rates on a single truck or entire fleet based on current or forecast weather conditions or traffic rates. Researchers found no commercially available systems at this level of automation, although it is a current area of research and testing.

Guide #3 compares available systems and also reviews the experience of the precision agricultural industry, which uses highly advanced automated spreaders. However, salt spreaders cannot currently achieve the same level of accuracy as spreaders in agricultural use because the winter maintenance spreaders travel at significantly higher speeds, outpacing the rate of data processing from the sensors.

Benefits and Further Research

This research offers a vision of the features of a totally automated spreader system, which can serve as a guide for equipment manufacturers and state and local agencies contemplating purchases.

One of the most significant gaps in the existing literature is field testing the accuracy of automated spreading technology. Researchers found only two quantitative studies, both from Europe and both conducted in 2010. Current accuracy testing in the United States would be valuable.

One notable challenge in implementing GPS or remote control automation options in rural areas is the lack of universal cellular coverage needed for location identification and communication.

> "Hopefully these guides will get information about the availability of automation to the snowfighting industry. Once we know what is feasible, we can create the demand that will prompt manufacturers to develop advanced systems."

Project Champion Cliff Spoonemore
Wyoming Department of Transportation
cliff.spoonemore@wyo.gov

Produced by CTC & Associates LLC on behalf of the Clear Roads pooled fund project #TPF-5(218), led by the Minnesota Department of Transportation.