Literature Search 613: Investigate Sustainable Equipment Design Options
July 2, 2020

Prepared for: Marcus Bekele
Prepared by: Karen Neinstadt

Resources searched: TRID, Transport, PooledFund.org, MnDOT Library Catalog

Summary: I have included results that mention some sort of innovative technologies in relation to maintenance equipment and/or sustainability. There were a number of results that mentioned a “highway maintenance concept vehicle” and/or “next-generation maintenance vehicle technology”, but those results appeared to be primarily focused on the performance of the vehicle for snow and ice control operations, and not so much for the innovation of the vehicle maintenance itself. There are a few results listed under “least relevant” that were more of passing mentions of sustainable equipment, but nothing specific was listed.

Most Relevant Results

Title: Compressed Natural Gas Snow Plows - Canada's First Alternative Fueled Snow Plows.
Author: Abercrombie M
Abstract: On June 24, 2015, County Council unanimously passed a motion to commit to 100% renewable energy by 2050. Oxford County was the first municipal government in Ontario to commit to a 100% renewable energy target at the time, and only the second in Canada after Vancouver, British Columbia. Oxford's renewable energy commitment stems from the Future Oxford Community Sustainability Plan (2015), which includes specific targets and actions to reduce greenhouse gas emissions (GHG), promote green construction, and promote low-carbon transportation options. Efficiency and conservation measures are considered the first steps towards realizing a 100% renewable energy target. With exhaust emissions from trucks, buses, and automobiles being major contributors to GHG, exploring what the County could do to lessen its impact was, and remains, a priority. Exhaust emissions are major contributors to health issues, including triggering lung diseases such as asthma, emphysema, and chronic bronchitis in vulnerable members of society. Municipal fleet operators, in general, are increasingly aware of their fleet's impact on the environment. It is estimated that Ontario's municipal fleets, including transit, contribute approximately 43% of Canada's estimated 1.74 MT of municipal fleet emissions. At Oxford County, we have chosen to take a leadership role in dealing with these concerns. Not only out of a sense of environmental responsibility, but also for financial considerations: fuel is the fleet's second largest operating expense for the County after salaries and wages. To assist the County in understanding its current fleet and the potential opportunities, in 2015, Oxford County, in conjunction with Fleet Challenge, developed a "Green Fleet Plan." The Green Fleet Plan outlines opportunities to reduce engine and GHG with strategies based on technology and implementing or refreshing best practices.

Title: A BUSINESS CASE FOR WINTER MAINTENANCE TECHNOLOGY APPLICATIONS: HIGHWAY MAINTENANCE CONCEPT VEHICLE.
Authors: Kroeger D A; Sinhaa R
Conference Title: Mid-Continent Transportation Research Symposium. Location: Ames, Iowa. Sponsored by: Center for Transportation Research and Education. Held: 20030821-20030822. 2003. 10p(1 Apps., 1 Figs., 3 Refs., 1 Tabs.)

Abstract: This paper demonstrates the benefits of using technology applications in winter maintenance operations from a business perspective. This business case for the technology applications on the highway maintenance concept vehicle project is documented by examining the business implications of its benefits, such as increased safety, reduced environmental impacts and increased efficiency. A benefit-cost framework is developed in which the current methods of performing the analysis can be compared to other proposed winter maintenance technology improvements. The benefit cost analysis demonstrated that the integration of emerging technologies in the concept vehicle plays a beneficial role in reducing accidents, increasing mobility, reducing adverse environmental impacts, and has a direct bearing on the economic impacts in the area. Findings also suggest that although cost savings are possible with the use of anti-icing technologies, the level of service to travelers were increased with the same or less usage of materials.


Abstract: The 2012 International Conference on Winter Maintenance and Surface Transportation Weather was held April 30-May 3, 2012 in Coralville, Iowa. The conference was conducted by the TRB Committees on Winter Maintenance and Surface Transportation Weather in cooperation with Iowa Department of Transportation, AASHTO, and FHWA. This conference included papers and presentations on Environmental Stewardship and Sustainability, Road Safety Under Winter Conditions, Decision Support Systems, Winter Surface Friction, Blowing and Drifting Snow, Winter Mobility and Maintenance Performance, Road Weather Data Management, Climate Trends and Large-Volume Snow Control, Winter Maintenance Policy and Management, Data Networks and Quality, Delivery Approaches and Performance Measures, Optimizing Winter Maintenance Materials, Measuring and Forecasting Pavement Surface and Subsurface Conditions, Innovations in Winter Maintenance Equipment, and Weather Information to Improve Driver Decisions. Maintenance managers, engineers, and researchers from the following countries presented their papers: Canada, China, Japan, Korea, Norway, Sweden, and the United States. The papers were not subjected to the TRB peer review process.

Publisher: Transportation Research Board

Title: Waterless Sweeping Gains Popularity.

Author: Kinter Mark

Citation: Pavement. 2005/10. 20(7) pp 24, 26-29(2 Figs., 2 Photos.)

Abstract: Street sweepers traditionally have used water to wet the roadway for dust control. This practice consumes a tremendous amount of water and is very time-consuming. This article discusses a waterless alternative for street sweeping that uses dry-filtered technology. Dry-filtered technology can be applied to both broom sweepers and regenerative air sweepers. The waterless sweepers offer several advantages, including greatly reduced water consumption, reduced air pollution because of improved sweeping efficiency with small particles, reduction of silt that can contribute to storm water pollution, and the ability to sweep in freezing weather. Waterless sweeping is being widely used in northern climates because of this ability to sweep in freezing weather as well as to control the large amount of traction material that must be cleaned up frequently. Waterless sweeping is also gaining acceptance in southern areas of the U.S. because of its productivity gains.

Publisher: Cygnus Publishing, Incorporated

Title: Optimized and Sustainable Winter Operations in Canada and the United States

Abstract: Climate change is becoming a reality in Canada and United States bringing record setting winter storms with some of the lowest temperatures and heaviest snowfalls and ice storms experienced in modern times. These massive storms caused major impacts to the economy, resulting in billions of dollars lost. However, it could have been much
worse without the right snow removal equipment, advanced RWIS and chemical application technologies and a trained workforce. This paper documents how research findings, from the comprehensive U.S. Strategic Highway Research Program (SHRP), combined with discoveries, from the International Winter Maintenance Technology Scanning tours produced better methods to accomplish winter maintenance, improve transportation safety and reliability and enhance winter hazard mitigation. Successful courses of action used to take SHRP winter maintenance research in road weather and forecasting, anti-icing, snow and ice control equipment, and new chemistry from theory to operational state-of-the-practice are presented. Although these proactive snow and ice control operations in Canada and the US are reported to be more efficient and effective, their negative impact to the receiving natural environment remains a concern. This paper examines how those negative impacts are being minimized by using improved and more comprehensive road/weather forecasts, optimized treatment recommendations and better snow and ice control equipment. The paper will then illustrate how these optimized operations will evolve into more sustainable solutions that will integrate into the PIARC B-5, Winter Services Committee, "triple bottom line" (economic concerns, societal interests, and environmental protections) concept models being developed for world-wide use. (A) For the covering abstract of this conference see ITRD record number 201211RT334E.


Corporate Authors:
Transportation Association of Canada (TAC)
Ottawa, Ontario Canada
Authors: SMITHSON, LD
Confrence: 2012 CONFERENCE AND EXHIBITION OF THE TRANSPORTATION ASSOCIATION OF CANADA - TRANSPORTATION: INNOVATIONS AND OPPORTUNITIES
Location: Fredericton New Brunswick, Canada
Date: 2012-10-14 to 2012-10-17

Title: Sustainability and Climate Change Considerations in Winter Operations
Abstract: This report has tried to summarize the knowledge of Climate Change Considerations in Winter Operations. The first step to this project was to source relevant literature on climate change and winter maintenance and sort it into six categories; Level of service for road owners, Maintenance of roads, Forecast models (RWIS), Indicators to find the variation of climate and operations, Different methods, and Infrastructure. Of the papers that were sourced 45 were selected and read and sorted into the six topics. In each topic one paper was chosen to represent that topic. It further describes "best practice", i.e. the most sustainable and innovative methods used today. It contains examples on topics such as different ways to inform road users about the road maintenance policies and traffic information about congestion, road work or accidents. It also describes different preventive methods to avoid slippery roads. This report also lists some new equipment and technologies to help in both the planning and delivery of winter service.


Corporate Authors: World Road Association (PIARC). Technical Committee on Rural Roads and Earthworks (D.4), Paris, France
Publication Date: 2016
ISBN: 9782840604372
Report/Paper Numbers: 2016R31EN

Title: Recent Advances in Sustainable Winter Road Operations – A Book Proposal
Abstract: Investing in winter transportation operations is essential and beneficial to the public and the economy. The U.S. economy cannot afford the cost of shutting down highways, airports, etc., during winter weather. In the northern U.S. and other cold-climate areas, winter maintenance operations are essential to ensure the safety, mobility, and productivity of transportation systems. Agencies are continually challenged to provide a high level of service and improve safety and mobility in a fiscally and environmentally responsible manner. To this end, it is desirable to use the
most recent advances in the application of materials, practices, equipment, and other technologies. Such best practices are expected to improve the effectiveness and efficiency of winter operations, to optimize material usage, and to reduce associated annual spending, corrosion, and environmental impacts. Currently, no professional societies, scientific journals, or textbooks are dedicated solely to sustainable winter road operations, and key information is scattered across a variety of disciplines. The objective of the proposed book is to summarize the best practices and recent advances in sustainable winter road operations for the purposes of education and workforce development. This book is now in press and can be cited as follows: Shi, X., Fu, L. (2017). Sustainable Winter Road Operations (Eds.). ISBN: 978-1-119-18506-2. Wiley-Blackwell.

Record URL: http://cem.uaf.edu/media/241028/cesticc-final-report-124556_final.pdf
Record URL: https://rosap.ntl.bts.gov/view/dot/32505

Corporate Authors:
University of Alaska, Fairbanks
Center for Environmentally Sustainable Transportation in Cold Climates
Duckering Building Room 245, P.O. Box 755900
Fairbanks, AL United States 99775-5900

U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC United States 20590

Authors: Shi, Xianming
Publication Date: 2017-5

Least Relevant Results

Title: WINTER HIGHWAY MAINTENANCE: A LOOK FORWARD.
Author: Nixon W A
Citation: Transportation in the New Millennium. 2000. 6 p.
Abstract: The field of winter maintenance has advanced significantly in the United States during the past 2 decades. The new technology is concentrated in a few technical areas, which promise the most benefit for the smallest investment of both funds and human resources, in terms of training and technology transfer. This paper discusses the areas in which significant advances have been made and in which there is potential to make significant new advances: weather forecasting; anti-icing strategies; tools, equipment, and techniques; and training, education, and technology transfer.
Publisher: Transportation Research Board, 500 Fifth Street, NW, Washington, DC, 20001, USA

Title: INTELLIGENT TRANSPORTATION SYSTEMS AND WINTER OPERATIONS IN JAPAN.
Authors: Pisano P; Nelson R; Balckburn R; Brandau S; Clonch D; Doherty J; Jones D; Kain C; Lariviere P; Mandt G; McCarthy J; Nixon W; Roosevelt D
Citation: 2003/9. 58 p.(3 Apps., 3 Photos.)
Abstract: U.S. transportation agencies seek to improve the efficiency and effectiveness of winter maintenance operations by developing advanced systems and equipment. The Federal Highway Administration, American Association of State Highway and Transportation Officials, and National Cooperative Highway Research Program sponsored a scanning study of Japan to investigate advanced technologies for winter maintenance operations and implementation of those advances in Japan's intelligent transportation system (ITS) architecture. The U.S. delegation visited Hokkaido, Japan, to review advances in winter operations procedures, winter maintenance equipment development, and road weather data collection. The team also observed that significant advances are being made in Japan on improving communication systems and protocols used between road weather information system sensors and operations centers. The scanning team's recommendations for U.S. application include testing several advanced winter maintenance vehicle systems, investigating integration of weather-related information into ITS corridors, developing performance-based standards for winter maintenance, and establishing a data-sharing project involving the National Weather Service and transportation agencies.