Alaska Department of Transportation and Public Facilities

# Emerging Practices in Winter Highway Maintenance

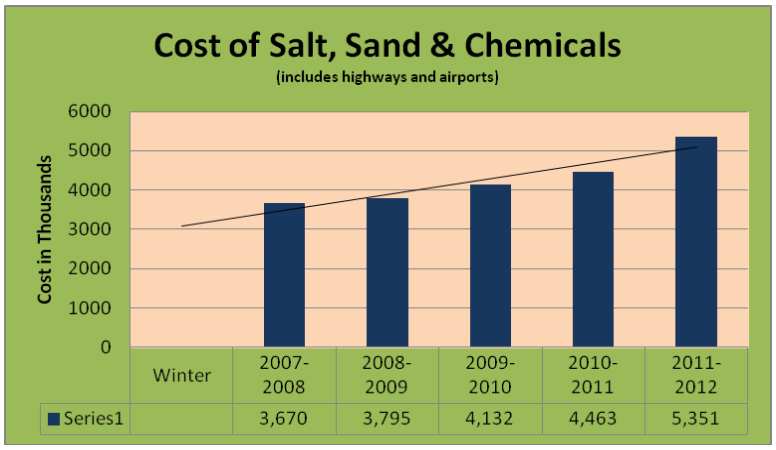

DOT&PF Equipment Operator Nick Herman Plowing Snow on the Alaska Highway, Photo by Dennis Bishop ADOT&PF

October 2012

Introduction

Winter maintenance on Alaska's highways and airports has always been a big challenge for the department's winter maintenance crews. Alaska's transportation system lies within one of the most extreme and challenging environments in the planet. Alaska is a land of extremes, with temperatures ranging from 100F to -80F, snowfalls as deep as 974 inches at Thompson Pass, and ice-rich permafrost underlying 80% of the state. Maintenance activities are conducted in a geographically diverse climate, ranging from maritime to arctic. Alaska's extreme geography and weather conditions create maintenance challenges faced by no other state transportation department. Motorists and snowplow operators face everything from frost and black ice on the roads, to severe winter storms that can drop several feet of snow in just a few hours. To meet the challenges of maintaining Alaska's highways and airports in the winter, the department has an arsenal of equipment, new technologies, sand and chemicals, and the best weapon of all, a highly trained and professional maintenance staff.

Winter road maintenance is mandatory, not discretionary. Crews must be mobilized quickly and materials must be available in sufficient quantities to maintain safe roads. The cost in materials can be




ADOT&PF Statewide Maintenance and Operations

considerable, as the accompanying graph illustrates. Overtime costs also climb during the winter. During the epic winter of 2011-2012, for example, maintenance crews tallied almost 61,000 hours of overtime at a cost of $2,710,000, to keep roads open and safe. The equipment fleet for winter highway maintenance comprises 131 front-end loaders, 246 8-yard dump trucks capable of being equipped with plows, 35 snow blowers, 139 road graders, 24 bulldozers and 145 sanders.

The department is in transition, from a reactive program that depends on scraping (ie, plowing) and sanding to a more proactive program that depends first on anti-icing, or treating the bare road surface with a salt brine solution to retard the build-up of snow and ice. Salt brining, and other technologies and practices including avalanche hazard mitigation, "heads-up" GPS displays in plow trucks, use of tow-plows, the increasing sophistication of the Road Weather Information System (RWIS), and pending implementation of the Maintenance Decision Support System (MDSS), will continue to improve the department's ability to respond more effectively and efficiently in addressing winter road conditions.

Road Surface Applications

**Anti-Icing**. Anti-icing involves treatment of the road surface prior to a storm, to slow or prevent the adhesion of snow and ice to the road surface. Historically, the department has used magnesium chloride for pre-treating road surfaces, however, rising costs have led to recent use of a salt brine using


Sanding Truck with Brine Tanks, Mike Coffey ADOT&PF

water mixed with sodium chloride to a 23.3% solution. Considered by many transportation experts to be the safest and most cost-effective anti-icing product available, salt brine is currently being used successfully in Juneau, Sitka, Valdez, Fairbanks, Homer, Klawock and Soldotna, and is expected to see wider application throughout the state.

Timing is critical for the successful application of an anti-icing solution. Crews pay careful attention to weather conditions, utilizing the 511 Road Weather Information System and other sources, to help assure that anti-icing is applied before snow accumulations build up. Salt brine is applied most effectively at temperatures of 20F and above. Since most snowstorms occur when the air temperature is between 20F and 32F, salt brine is an effective treatment. The department is also using an anti-icing additive that significantly lowers the working temperature of chloride salt, allowing longer working time, better adherence and reduced corrosion, resulting in a 30% to 40% savings in salt.

Corrosion caused by salt and other chemicals is a concern for both the motoring public and the department. To address concerns related to vehicle corrosion, the department uses an organic additive in the brine that results in a mixture only one-third as corrosive as salt alone. Maintenance staff and department researchers hope to find an in-state source of organic material, to reduce purchase and transportation costs. In addition to organic additives, automobile manufacturers have made significant improvements over the past thirty years to protect vehicles from corrosion. NACE International (formerly the National Association of Corrosion Engineers) found in a 1996 survey, that less that 1% of

six-year-old vehicles had any type of rust perforation, a dramatic decline from the first survey in 1976, when 90% of six-year-old vehicles showed rust perforation.

**De-Icing**. Salt brine is also used when sanding roads that have accumulated a snow and/or ice cover. Called '**pre-wetting**' in the maintenance trade, salt brine is sprayed onto sand as it is applied by sand trucks to the road surface, allowing the sand to better penetrate the ice, while retaining more of the sand on the road. Pre-wetting significantly reduces the amount of "free" salt that can migrate into groundwater and waterways. Crews spread just salt on the roads during freezing rain events to counteract the build-up of ice.

The department installed an **automatic bridge de-icing system** on the north and south-bound lanes of the Knik River Bridge on the Glenn Highway in 2007, in an effort to reduce a high rate of accidents on the bridge. Potassium acetate is pumped through lines laid in the bridge deck, and sprayed through multiple small nozzles triggered by a temperature-sensitive sensor. While costly to acquire and maintain, the number of accidents on the bridge has declined by over one-half since the system was installed.

Temperature Sensor in the Knik River Bridge Deck
Steve Banse, ADOT&PF

The department continues to use **sand** as a winter road treatment, at a cost of just over $1 million per year for materials. While neither an anti-icing nor a de-icing treatment, sand helps provide traction when pre-treating or pre-wetting are either unavailable, or in the case of pre-treating, incapable of being applied to the road surface prior to snowfall or ice buildup. Snowplowing also remains a mainstay of the winter highway maintenance program. Snowplowing hotlines are listed below in the brochure.

<u>Technological Advances</u>

**Smart Snowplows**. The department uses a state-of-the-art High Accuracy Differential Global Positioning System on several of its snowplows and snow blowers clearing snow in Thompson Pass and Valdez. This system provides a head-up display in the equipment that provides the operator with a virtual view of the highway. This allows crews from the Valdez maintenance station to clear snow in total whiteout conditions with zero visibility while avoiding guardrails, bridge approaches, traffic signs and other roadside


Heads-Up GPS Display in the Cab of a Smart Plow
Mike Coffey, ADOT&PF

improvements. This technology has been featured in two television specials, most recently (2012) in *Modern Marvels* on the History Channel, and earlier (2010), in *Dangerous Drives*, on Speed TV.

**Tow Plows**. Transportation departments across the country face increasing costs and demands for winter snow removal. The tow plow, a steerable trailer-mounted plow that is pulled behind a tandem axle snowplow truck, offers an opportunity for greater efficiency. The tow plow is able to swing out to

Tow Plow at Work in Missouri, Screengrab

one side, which doubles the plow width of the snow-plow truck. The tow plow is equipped with a 26' moldboard (ie, curved plow) and either a granular spreader or a tank for dispensing liquids for snow and ice control. The tow plow has been used successfully in Missouri since 2005 and is gaining acceptance in other states. The department has purchased two tow plows, one for Soldotna and one for Juneau, which will begin work this winter. Advantages include increased efficiency and production, reduction in manpower, reduced fuel use, safety improvements due to improved cycle times, and a longer service life than snowplow trucks.

**511 Traveler Information and RWIS - Road Weather Information System.** Maintenance personnel utilize information provided by the fifty-five Road Weather Information System (RWIS) stations located throughout the state, to improve the timeliness of maintenance actions such as when and where to snowplow or apply anti-icing/de-icing chemicals on highways. These stations provide real-time weather data invaluable for getting crews into the field at the right time.

RWIS Installation at Bird Point, Jack Stickel, ADOT&PF

The public uses 511 to learn about road conditions including conditions in mountain passes, see road and weather conditions via RWIS cameras, and obtain information on road construction (including future construction), delays, and road closures. 511 provides information in multiple formats including the department's webpage, by telephoning 511, via RSS feeds, Facebook and Twitter, and through an iPhone application.

**Maintenance Decision Support System (MDSS).** MDSS is a computer-based tool that will provide winter maintenance crews with route-specific weather forecast information and treatment recommendations. Benefits of MDSS include:

- providing route-specific weather and road condition forecasts at various intervals, and
- offering optimized treatment recommendations regarding the type and amount of material to be used, and its application times.

The department is currently testing the MDSS in the Fairbanks area in a study that began May 1, 2012, and is scheduled to run until May 1, 2013. The study will identify the tasks required to successfully deploy the MDSS as a demonstration project in Fairbanks, and in the central area of the state. State Departments of Transportation in Colorado, Illinois and Indiana, and the City of Denver, are successfully using MDSS technology.

When operational, the MDSS will allow department maintenance crews to combine weather data from multiple sources including RWIS, mobile temperature and moisture sensors mounted on department equipment in the field, the National Weather Service, and other weather information sources, to

Thompson Pass in the Winter, Mike Coffey ADOT&PF

determine road treatments, and road treatment locations, based on real-time weather data. It will help take the "guesswork" out of maintenance decisions, by providing site-specific and timely treatment recommendations, resulting in more efficient use of equipment, materials and manpower.

Statewide Maintenance Concerns

Many department-wide concerns are also concerns regarding winter maintenance. These include:

- recruiting and retaining qualified operators
- the increasing cost and sophistication of road maintenance equipment
- the increasing cost of materials (see earlier graph on the cost of winter salt and chemicals)
- static budgets
- more frequent, intense and unpredictable weather events, including storms and winter warming periods.

Winter weather poses special difficulties for department crews in the field. Temperatures can fall to as low as 60 degrees below zero. Snowfalls in excess of 900 inches can fall at Thompson Pass north of Valdez. High winds and blowing snow can create whiteout conditions. Ice storms in the Interior can create extremely hazardous driving conditions, while the prospect of avalanches is a recurring threat in the winter, and especially in the spring.

Avalanches

The department annually undertakes avalanche hazard reduction in Juneau, on the Seward Highway, on the Dalton Highway at Atigun Pass, and on the Richardson Highway at Thompson Pass north of Valdez. Avalanche hazard reduction will begin on the Klondike Highway in Skagway beginning in the winter of


Avalanche on the Seward Highway, Matt Murphy ADOT&PF

2012-2013. These areas include over 160 avalanche paths located above approximately 155 miles of highway. Most of the paths and highway mileage are on the Seward Highway, where avalanches have closed the highway for up to 4 ½ consecutive days, and have been as large as 50 feet deep and 3,000 feet wide. High frequency avalanche seasons occur approximately every fifteen years. Avalanches have buried the Seward Highway as early as November and as late as May. Check 511 for information about planned traffic delays due to avalanche work during these months.

Using a 105 MM howitzer or 105 MM recoilless rifle, the department attempts to trigger avalanches during planned road closures. Started in 1955, and in place full-time since 1983, the avalanche hazard reduction program has achieved slightly better than a 50% success rate; that is, slightly more than half of significant avalanches (a snow depth of ten feet or more on the highway) are triggered, while slightly fewer than half occur naturally. The effectiveness of the department's avalanche program can be measured by the fact that the Avalanche Hazard Index on the Seward Highway has dropped from a Very High rating before full-time implementation of the program, to a Moderate rating with the program.

95% of avalanches large enough to bury the highway typically occur during a storm, or within 24 hours following a storm occurrence, but also occur during periods of rapidly warming weather in April and May, often during periods of intense afternoon sunshine. As a caution to the public, avoiding driving during a winter storm or in its immediate aftermath, and exercise care at other times, to reduce the chance of being struck, or stranded, by an avalanche.

105 MM Howitzer Firing on the Dalton Highway, Matt Murphy ADOT&PF

<u>Winter Driving Tips</u>

- Make sure your vehicle is properly equipped for winter driving conditions
- Drive according to road and weather conditions
- Watch for moose and caribou crossing the highway
- Leave plenty of room for stopping
- Drive with your headlights on and always wear your seatbelt
- Watch for ice on bridges and overpasses
- Never drink and drive
- Pull over to use a cell phone
- Pull over if conditions become dangerous
- Never stop along the highway in designated Avalanche Areas

Snowplow Safety

Always remember that motorists and department crews are all in the storm together. Be patient if you are behind, or being slowed down by, snow removal equipment. If you are stuck in traffic, then so are the equipment operators.

- Watch for snowplows and other snow removal equipment and give 200 feet clearance
- Never drive into a 'snow cloud' coming from a snowplow
- Snowplows travel slower than the posted speed limit because it is the safest and most effective method for cleaning the roads
- Stay behind the snowplow. The road behind the plow is safer for driving

DOT Snowplowing Hotlines

- Anchorage: 338-1466
- Dalton Highway: 451-2206
- Denali Highway: 451-2226
- Fairbanks: 451-2205
- Juneau: 465-1787 or 465-1799
- Kenai area: 262-2199
- Mat-Su area: 745-3117
- Nome area: 443-3443 or 443-3520
- SE Region: 465-1787 or 465-1779
- Tazlina: 822-3222
- Tok: 883-5128
- Valdez: 834-1059
- Municipality of Anchorage: 343-8277

Statewide Chief of Maintenance and Operations Mike Coffey can be reached in Juneau at 465-3904.