Quick Reference Guide

During-Storm Direct Liquid Applications (DLA)
A New Tool for the Winter Maintenance Toolbox

For Clear Roads by EVS
9/17/2010

DLA Rules-of-Thumb

Parameter	Most Favorable For DLA	Consider DLA	Notes
Pavement Temperature[1]	25°F or above	20°F or above	
Storm Intensity (inches/hour)	0.5 inches/hour or below	1.0 inches/hour or below	
Moisture Content	Ordinary	Dryer Snowfall	Dry/powder snow - consider plow only Wet snow – can dilute chemical quickly "Ordinary" approx. 10:1 snow/liquid ratio

Notes:

1) Consider temperature trends (increasing/decreasing temperatures)
2) Note that these are ***rules-of-thumb***. In practice, all parameters will have to be considered together along with other factors such as traffic, equipment availability, timing, etc.
3) Cycle times will vary depending on location. Shorter cycle times help reduce refreeze potential, and longer cycle times increase dilution-refreeze potential. Generally about 1.5 or 2 hours is considered a preferred cycle time. As cycle times increase, supplementing DLA with direct granular should be considered. Also, caution should be used if you are depending on a short cycle time for this parameter because of variations due to slow moving traffic, liquid loading, etc.

Application Rates - for during-Storm DLA (For Illustration Only)

Agencies have had success with application rates generally from **30 gplm to 90 gplm**, depending on conditions, timing, if granular is also being applied, level of service, and other local factors. Your experience will allow you to fine-tune application rates.

The following is one chart that provides a good starting point for DLA application rates

Example During-Storm Direct Application Rates for Salt Brine (NaCl)[2,5]
Illustration Only (adjust based on local factors and experience)
Gallons Per Lane Mile (gplm)
Pounds Per Lane Mile (pplm) shown in parentheses

	Pavement Temperature			
Event Type	32-30°F	29-27°F	26-24°F	23-21°F
For 2-Hour (or less) Cycle Times				
Light Snow (less than 0.5"/hour)	20 (45)	35 (80)	40 (91)	55 (125)
Medium Snow[1] (0.5"/hour to 1.0"/hour)	35 (80)	45 (102)	55 (125)	NR
For 3-Hour Cycle Time[3]				
Light Snow (less than 0.5"/hour)	35 (80)	50 (114)	65 (148)	80 (182)
Medium Snow[1] (0.5"/hour to 1.0"/hour)	50 (114)	65 (148)	80 (182)	NR

Notes:

1. Only consider using DLA for medium snow events based on your experience, and when other factors are highly favorable such as pavement temperature and moisture content.
2. It is suggested to generally **supplement the DLA application with a light direct pre-wet granular application** (70 pplm) when possible (especially as dilution-refreeze potential increases).
3. **For cycle times greater than 2 hours**, supplementing DLA with direct granular is strongly suggested (see Note 2).
4. NR = Not recommended
5. For enhanced chemicals and blends, work with vendors. Verify that these rates are reasonable or where they should be adjusted.

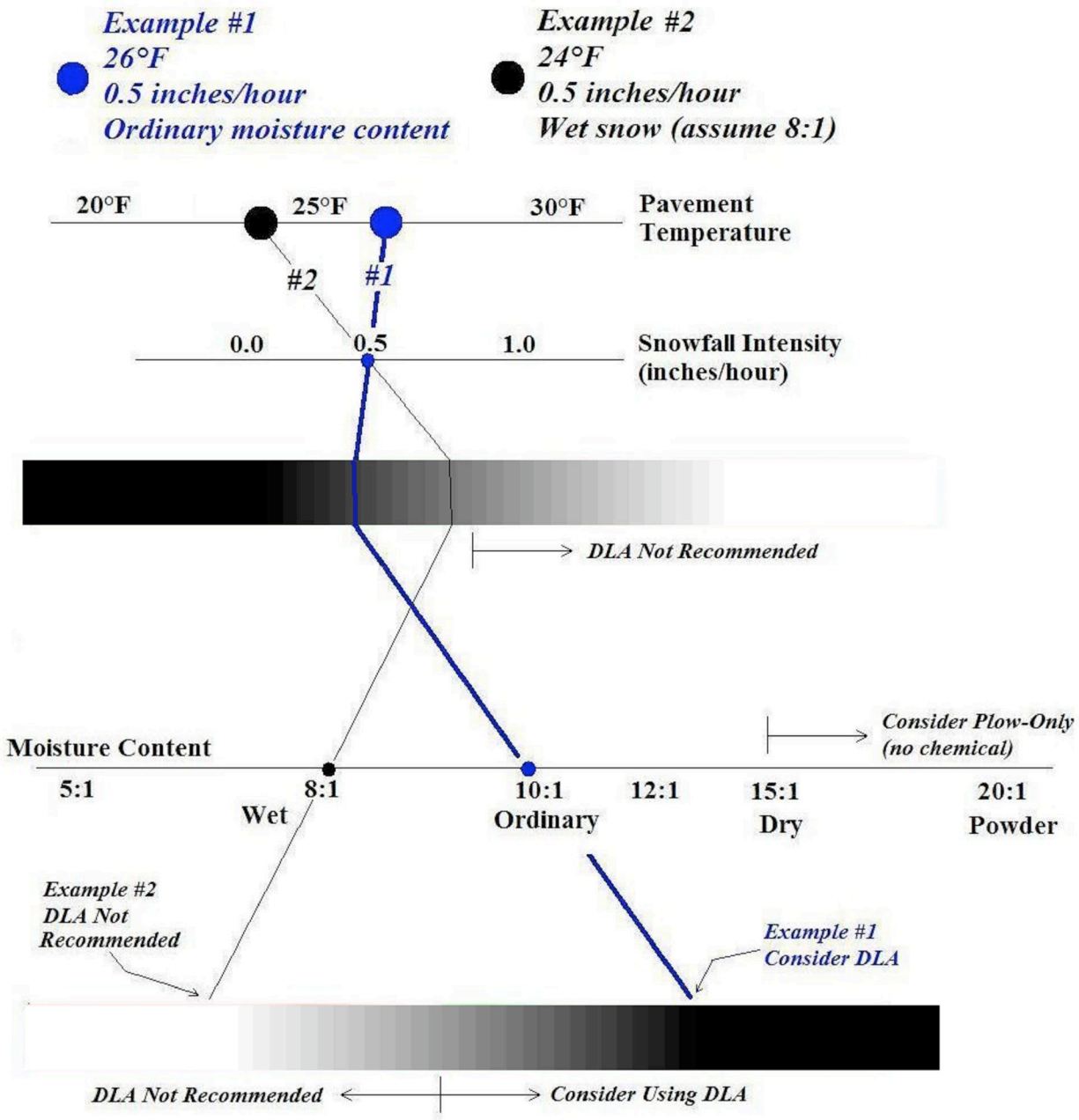
General Tips

- Training is very important
- Supplementing DLA with granular can achieve a "best of both worlds" solution by producing the full road liquid "coating" (to prevent bonding), and also by producing some "grit" (granular) and also allowing the granular to slow down the dilution of the chemical
- If storm is tapering off and sun is out then a light DLA "shot" (20-40 gplm) is a nice "finisher"
- It takes some time and effort to get "buy in" and trust of the products
- If storm is severe, go to "plow only" mode, and then resume with chemicals (on DLA and granular routes) when storm tapers off
- Low speed city roads are a good place to start or try during-storm DLA
- DLA can be especially effective at the end (last plow pass) of a lighter storm
- During-storm DLA can enhance and existing pre-storm liquid anti-icing program

Tips for Gaining Buy-In

Set DLA up to succeed	One approach (when starting during-storm DLA) is to supplement existing granular applications with liquids. As success is observed and confidence gained, dial back granular rates.
Visit sites	Many have found quicker team buy-in when they visit shops first-hand who have had some success with liquids.
Partner as much as possible	If you do not have brine-making and blending facilities, consider purchasing from a nearby agency.
Contact experts	This report includes a list of experts in DLA. Contact experts and visit nearby sites. This will help you get the latest on lessons learned.
Utilize existing equipment	Utilize and convert/retrofit existing equipment as much as possible to save costs. Consider different strategies that best match your equipment.
Communication	For example, one supervisor's area had problems with an initial direct liquid application. The supervisor quickly communicated to all concerned that the supervisor was responsible for the problem, and noted the lessons learned. This helped avoid the potential for the team to quickly turn against the new tool.
Know Limitations	Some agencies have expected "too much" initially from this one tool. This produced initial frustrations and slowed down buy-in. The "big toolbox" generally applies.
Acknowledge and Support Success	It is important to listen to and support success stories (for both directly and indirectly related success). This will help with overall buy-in of liquid chemicals.

During Storm DLA Guidance Chart



Notes:
- This chart provides general guidance for considering DLA to assist the tool selection decision
- This chart focuses on when liquid-only (DLA) can be effective. Combination applications will span a wider "green" (effective/consideration) zone.
- Some agencies prefer to "sprinkle" direct granular with all DLA applications if equipment permits
- Approximately 1.5 to 2 hours is a common cycle time
- Longer cycle times will increase dilution-refreeze potential (shorter cycle times will decrease potential)
- Always consider temperature "trends" (forecasted change in temperature through and after storm)
- Consider other factors such as traffic, pavement type, hazard spots, etc.

DLA = During-Storm Direct Liquid Application

Equipment Tips

<table>
<tr><th>Equipment</th><th colspan="2">Tips</th></tr>
<tr><td rowspan="2">Applicator Loading Pump[1]</td><td colspan="2">• Chemical pump
• Ensure it is designed for a specific gravity of approximately 1.5 (not a water pump)
• Minimum 2” port (larger preferred)
• As short of discharge hose length as possible
• Consider applicator tank inflow line size
• Consider storage tank outflow lines and valve sizes to match pump capacity
• Design loading setup to be user-friendly</td></tr>
<tr><td><u>Minimum</u>
• 2” port
• 140 gpm max
• 110 gpm @ 20 psi
• $1,500</td><td><u>Preferred</u>
• Larger than 2” port
• 300 gpm max
• 275 gpm @ 20 psi
• $2,500</td></tr>
<tr><td>Applicator Discharge Pump and Plumbing</td><td colspan="2">During Storm DLA typically requires higher application rates than pre-storm anti-icing. Therefore, consider larger pumps (capacity). Actual size will depend on applicator spread width (number of lanes), etc. In one case, an agency suggested 370 gpm pumps over 210 gpm</td></tr>
<tr><td>Retrofitting/building liquid applicator trailers</td><td colspan="2">Do not use electric brakes (ie convert to air brakes).</td></tr>
<tr><td colspan="3">Notes
(1) Tips for applicator loading pump (and plumbing from storage tank):
• Leaks in seals can occur, resulting in liquid (ie brine) leaking into the motor. This can burn out the pump motor. To prevent this, consider using units that have pump and motor separated by shaft.
• May consider filling applicator tank into top of tank (bypassing applicator tank inflow line if smaller). <u>However</u>, this may not be as user-friendly, and may discourage “buy-in” for using liquids.
• The number of pumps required for loading will vary depending on the number of DLA liquid application trucks supported. It is important to get applicator tanks loaded fast and back on the road.</td></tr>
</table>

DLA Expert Contact List

Area	Special Notes
City of Beloit, WI www.ci.beloit.wi.us	buy-in strategies, partnering
City and County of Denver, CO www.denversnowplan.com www.denvergov.org/Street_Maintenance 720-913-1311	special environmental considerations
Colorado DOT www.coloradodot.info/topcontent/contact-cdot David.Wieder@dot.state.co.us Phillip.Anderle@DOT.STATE.CO.US 970-350-2100	enhanced (cold- temperature) chemicals, corrosion considerations
Colorado DOT - Region 2 www.coloradodot.info/topcontent/contact-cdot Phillip.Anderle@DOT.STATE.CO.US 970-350-2100	combination units, utilizing MDSS, optimizing application rates
Colorado DOT - Glenwood Canyon www.coloradodot.info/topcontent/contact-cdot Phillip.Anderle@DOT.STATE.CO.US 970-350-2100	combination units, determining "no plow" conditions, optimizing application rates
Iowa DOT District 5 – Fairfield http://www.iowadot.gov/district5/maint_garages.htm	liquid trailers, combination units, customized equipment, optimizing liquid/granular application rates
McHenry County, IL (815) 334-4000	retrofitting equipment, slide-in units, cold climate DLA, seasonal DLA
Missouri DOT - Kansas City District (816) 622-6500 **kristy.hill@modot.mo.gov**	use of tankers in during-storm DLA strategy
Ohio DOT - District 4 (330) 786-3100	high ADT routes, building up large liquid storage capacity
Indiana DOT – Winamac 574-946-3732	loading pumps, Overall benefits of liquids
Vermont Agency of Transportation, District 8 http://www.aot.state.vt.us/ops/dist8.htm	buy-in Strategies
Utah DOT - Parley's Canyon Parley's Station 234 (801) 582-2115	combination units, shortened cycle times for reduced temperature DLA
Ask for winter maintenance expert when contacting above references	