Dry sand on winter roads provides little benefit

Any benefits are temporary unless steps are taken to make the abrasives adhere to the snow or ice surface.

FRICTION or traction gains from sanding winter roads are minimal. This is one of the preliminary conclusions of research conducted by Wilfrid A. Nixon, professor and research engineer at the Iowa Institute of Hydraulic Research, University of Iowa. Nixon developed his conclusions and recommendations for the use of abrasives in winter maintenance by analyzing several studies.

What we've known for 50 years

For decades, winter road maintenance in the United States consisted mainly of plowing and spreading sand or other abrasive materials intended to increase friction between vehicles and the snow- or ice-covered pavement. However, as early as the 1950s, studies conducted in Germany indicated that sand was swept from snow-covered highway surfaces after only 10 to 12 vehicle passes.

A more recent study in Ontario showed that at low temperatures (below 5º F or –15º C) the friction gains due to application of abrasives were substantially reduced by the passage of relatively light traffic consisting of five to 10 vehicles and three to five logging trucks.

The Ontario study also showed that high abrasive application rates had to be used to obtain appreciable gains in friction. The table below shows the results of one series of tests performed on hard packed snow under cold conditions (below 5º F or –15º C). The stopping distance is that required for a passenger vehicle with an initial speed of 25 mph (40 kph).

Although traffic did not reduce the effectiveness of abrasives so dramatically at warmer temperatures, a major finding of Nixon's study is that, even at warmer temperatures, abrasives have little friction enhancing value on a road with any substantive level of traffic. Any benefits are temporary unless steps are taken to make the abrasives adhere to the snow or ice surface.

Recommendations

In developing recommendations for abrasive use, Nixon has considered five different road types (see sidebar) and two different types of abrasive application—dry abrasives (deicing chemicals may have been added in small quantities to the stockpile to avoid caking) and abrasives that have been pre-wet with liquid deicers at the spreader or tailgate.

Applying recommendations to current practice in Iowa

A detailed survey conducted by Wilfrid Nixon and Norman Foster in 1996 examined use of abrasives and other winter maintenance practices for all 99 Iowa counties and the 30 largest municipalities in Iowa. The amount of sand used in a typical winter for these agencies ranged from zero to 26,000 tons. The average number of paved miles of road for each agency was 219, versus 635 miles of unpaved road.

The average application rate (over the whole winter) per lane mile of unpaved road is 9,050 pounds or 2,550 kilograms per lane kilometer (kg/lkm). Assuming an application rate of 1,240 to 1,775 pounds per lane mile (350 to 500 kg/lkm), this suggests about five to 10 applications of abrasives each winter over the whole network. Of the 88 agencies responding to the survey, fewer than 10 indicated that they were using pre-wetting of sand in the truck, but most agencies pre-wet sand stockpiles to avoid caking.

On paved roads, a number of agencies use salt/sand mixes except in very cold conditions or when

	Untreated Roadway (hard-packed snow cover)	Treated Roadway (freshly applied abrasive—1,065 lbs. per lane mile or 300 kg per lane)	Treated Roadway (following light traffic)
Friction Factor	.18	.40	.23
Stopping Distance	115 ft. (35 m)	52 ft. (15.7 m)	97 ft. (29.5 m)

drifting is a possibility. In these situations, the salt will act as a deicer and eventually remove or diminish the snow-pack or ice cover. Nixon says it would be better to apply such mixtures pre-wet at the spinner because they will stay on the road after application and the pre-wet with brine effectively "jump starts" the melting process.

On low speed paved roads with either high or low volumes, pre-wet materials will stay on the surface longer than dry materials.
Photo courtesy of Wilfrid Nixon.

Contact information
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Because speeds on high volume paved roads will typically be in excess of 43 mph (70 kph), pre-wetting abrasives will ensure that they stay on the road for a much longer period than dry abrasives will.

Abrasives on five road types

IN HIS STUDY, Wilfrid Nixon considered five road types.

Abrasives on high volume paved roads
Because speeds on these roads will typically be in excess of 43 mph (70 kph), pre-wetting abrasives will ensure that they stay on the road for a much longer period than dry abrasives will. Pre-wet abrasives can also melt into the snow-pack surface to provide a more lasting increase in road surface friction.

Low volume paved roads
Although the reduction in the friction enhancement of abrasives will occur more slowly than on a high volume road, pre-wet abrasives will stay on the pavement longer.

Low speed paved roads (high or low volume)
In many urban areas there may be significant lengths of roads with high traffic volumes but relatively low vehicle speeds of less than 31 mph (50 kph). Again, pre-wet materials will remain on the road surface longer than dry materials.

Unpaved roads
Deicing chemicals are not used on gravel roads as they may cause the pavement base to thaw and become unstable. The only option is to apply dry abrasives.

Urban intersections
Since these are not high-speed traffic areas, dry abrasives could be used, but pre-wet abrasives will remain in place longer. •