Alex Klein-Paste

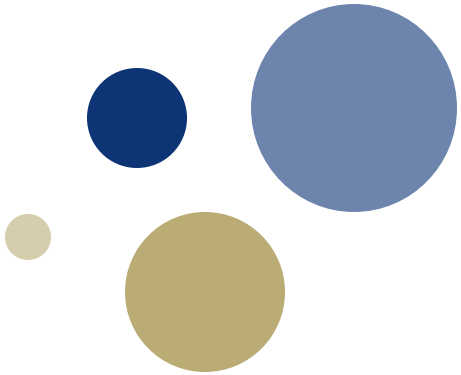
Norwegian University of Science and Technology

Morning Speaker August 2

Optimizing Salt Use during Snowstorms in Norway

SALT SYMPOSIUM

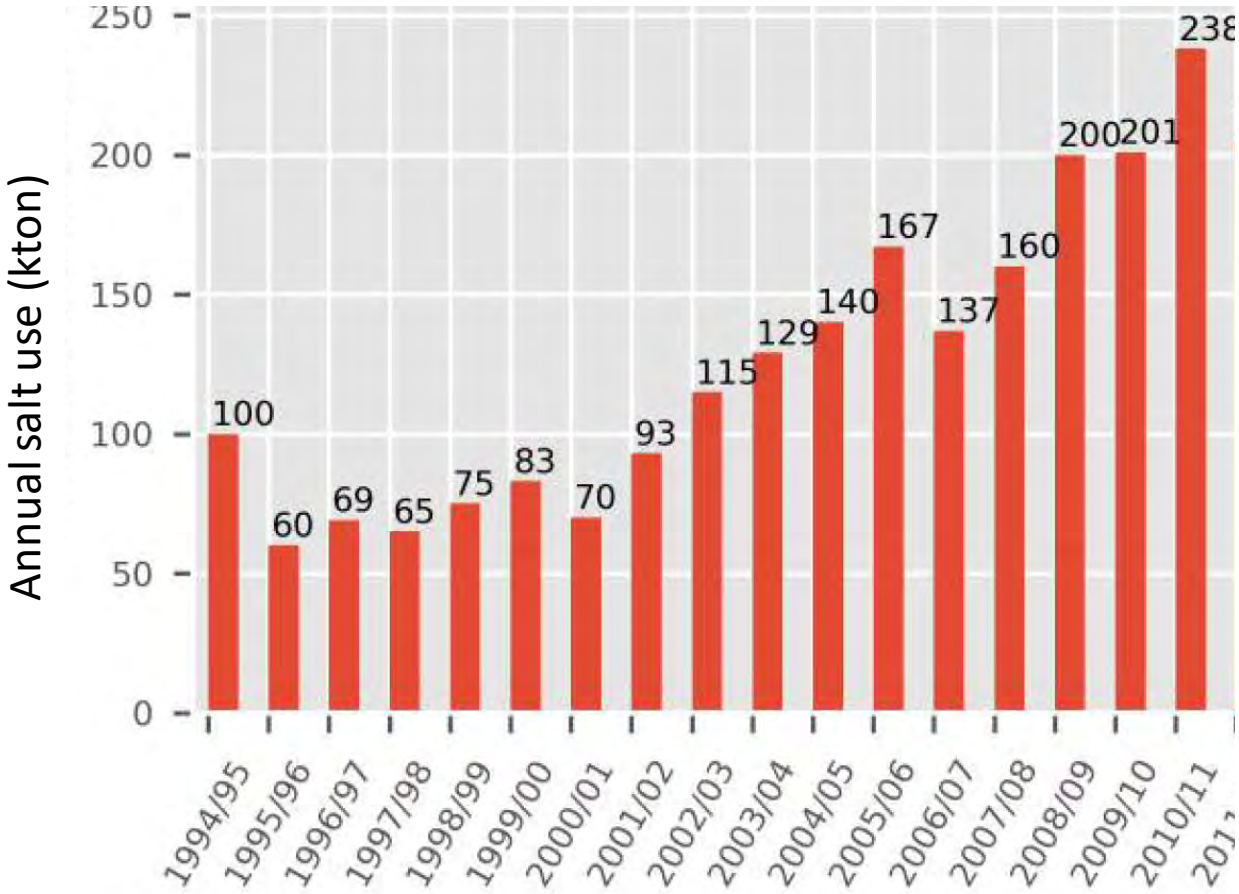
NTNU – Trondheim
Norwegian University of
Science and Technology



Optimizing Salt Use During Snowstorms in Norway

Alex Klein-Paste
Professor
Norwegian Winter Maintenance Research Center

Foto: Knut Opeide


Annual salt use (kton)
250
200
150
100
50
0
100
60
69
65
75
83
70
93
115
129
140
167
137
160
200
201
238
1994/95
1995/96
1996/97
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
2010/11

Hoarfrost
Wet road

Hoarfrost
Wet roads

Black ice
Compacted snow/ice

Hoarfrost
Wet road

Black ice
Compacted snow/ice

snowstorms

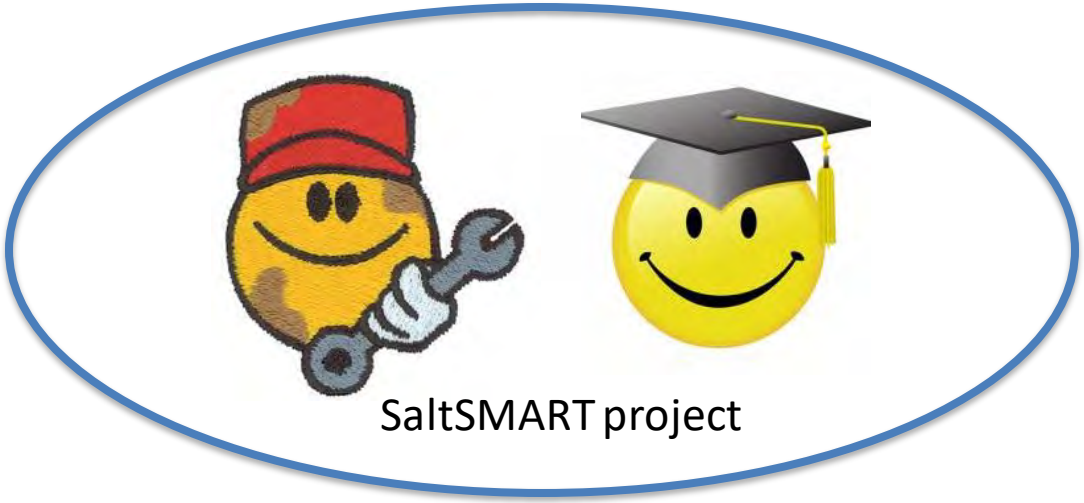
$$Total\ salt\ use = \sum_{i=1}^{n}(area\ \times application\ rate)$$

Do we really need to salt on this all this area?

Do we really need to drive so often?

Do we really need that much?

$$Total\ salt\ use = \sum_{i=1}^{n}(area\ \times application\ rate)$$


SaltSMART project

Practical considerations

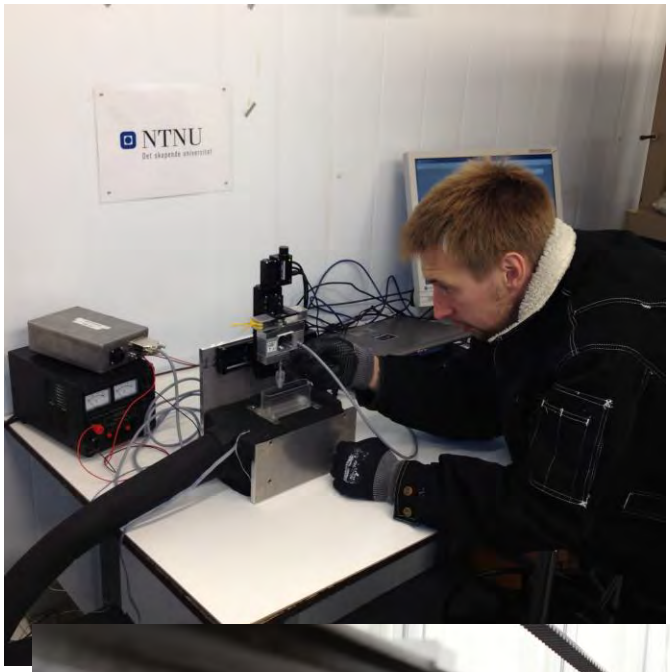
- Sensible level of service
- Know where your environmental problems are
- Contracts that do not encourage over usage
- Application methods
- Operator training
- GPS data collection on all vehicles

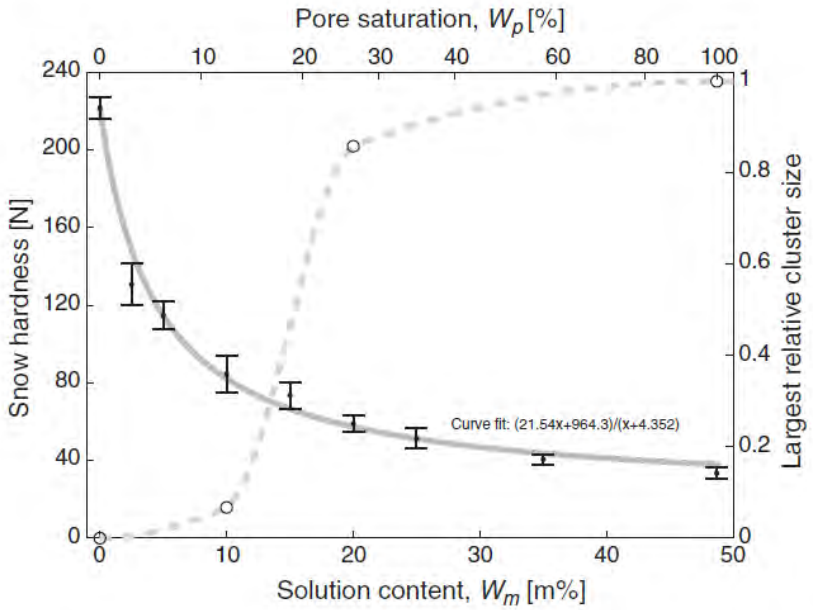
Understanding

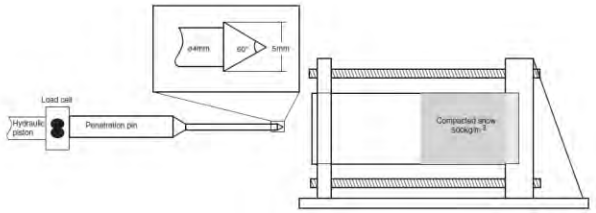
How does salt work in snowstorms?

anti-icing

de-icing


NTNU





Wåhlin, J., Leisinger, S., and Klein-Paste, A.(2014) *The effect of sodium chloride solution on the hardness of compacted snow.* Cold Regions Science and Technology, Vol. 102, pp. 1-7.

0 w%	5 w%	10 w%	20 w%	40 w%
				
compacted	compacted	Partly bare	bare	bare

Guidici, Klein-Paste and Wåhlin (2020) *The influence of aqueous solutions, a field investigation,* Journal of Cold Regions Engineering, Volum 34.(1) Suppl. 04019015

anti-icing

anti-compaction

de-icing


0 min


30 min

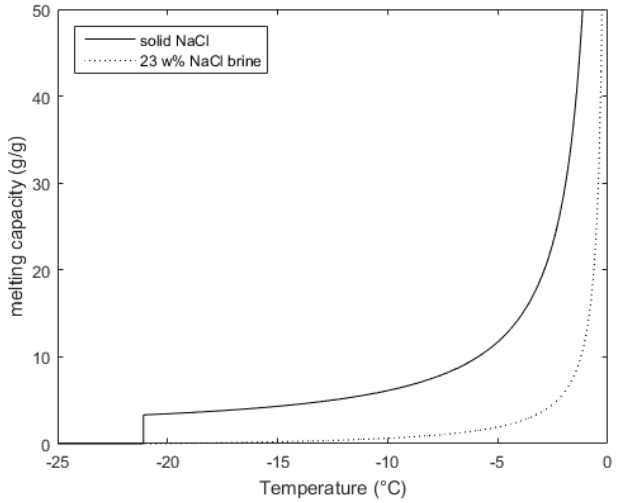

1 h


2 h


4 h

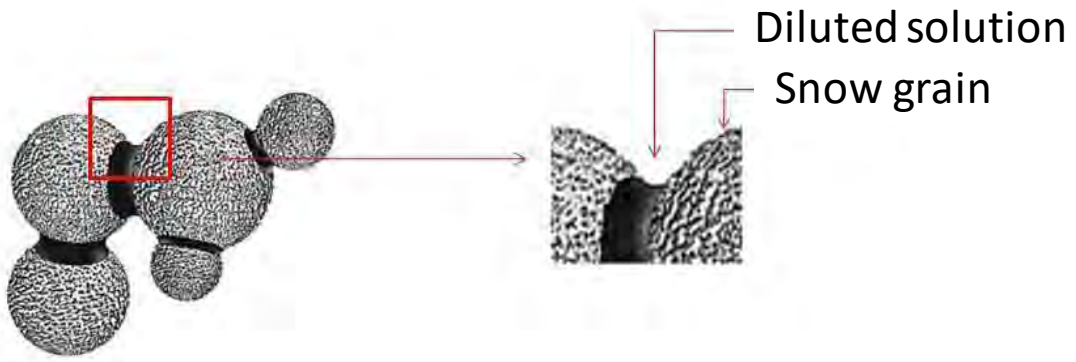
Anti-compaction mechanism

1. Salt is applied just before the snowfall
2. Salt melts the first fallen snow
3. Road surface gets wet with diluted salt solution (meltwater)
4. Melting continues until the melting capacity is reached



Anti-compaction mechanism

5. Diluted salt solution gets mixed with the snow
6. This solution prevents bonds between snow crystals
7. Anti-compacted snow is plowed away
8. New salt needs to be added when snowfall continues



Based on Denoth (1999)

Salt keeps the snow plowable

How much salt is needed to anti-compact 1 inch of snow?

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Snow needs to contain at least **5 w%** salty meltwater

1 inch snow requires about 1650 lb/lane mile of meltwater

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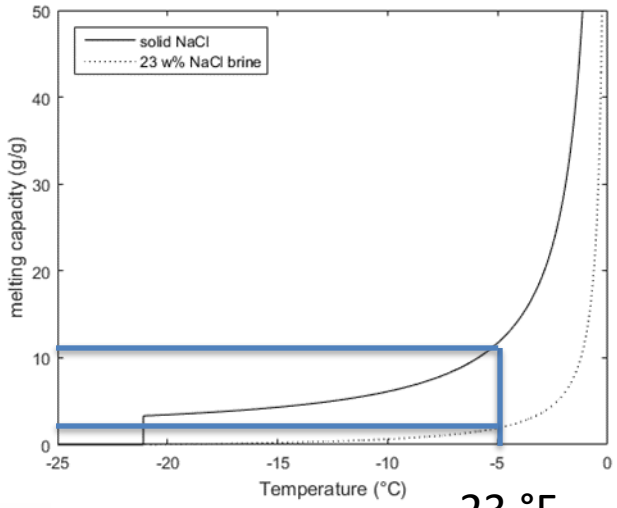
So, how much salty meltwater can I produce?

That depends on your spreading method and temperature

11.7

1.7



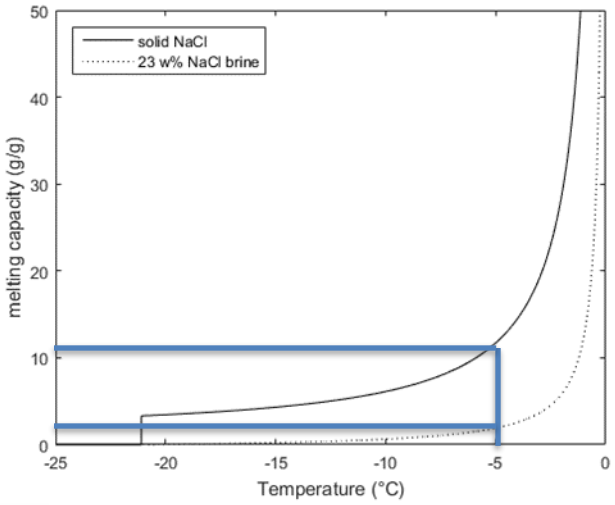
23 °F

At 23°F, you get 11.7 lb of meltwater for every lb of NaCl

But you only get 1.7 lb per lb brine

11.7

1.7



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So brine is not very efficient to anti-compact?

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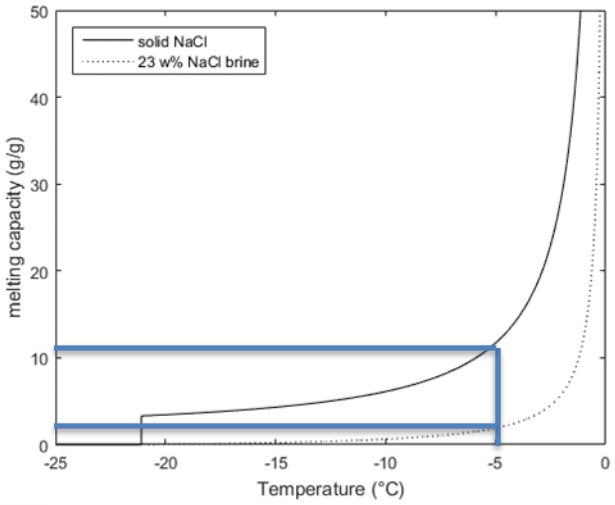

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So brine is not very efficient to anti-compact?

Nope. Not during the storm. But it is great to keep the salt on the road before the storm hits you

So what application rates are reccomended in Norway?

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40 g/m^2 (520 lb/lane mi) of brine before the storm

Only 5 g/m^2 (65 lb/lane mi) of granular NaCl during the storm

And 10 g/m^2 (130 lb/lane mi) of granular NaCl when it stopped snowing

So what application rates are reccomended in Norway?

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That's a big complement! thanks

Q & A