

# Measuring salt on road surfaces

A discussion of salt concentration versus salt amount

**PhD-student Kai Rune Lysbakken**

The Norwegian University of Science and Technology

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# The background for the interest of salt measurements:

- A research problem:  
*How does the salt amount develop after salt application?*
- Required measurements of salt on road surfaces
- What unit of measure is appropriate and how can it be measured?

# What is the appropriate unit of measure for salt on road surfaces?

- A discussion of principles
- Technical aspects with salt measurements are not regarded
- From the decision making point of view

# Winter maintenance in Norway

## Maintenance

- Since 2003 all maintenance are on tender and performed by private contractors
- Performance based contracts

## Decision making

- Large spatial and timely variations in weather
  - The decision making are made by contractor at local level and at low organizational level
  - Often a low level of formal skills but high level of practical knowledge
- ⇒ Information from decision support systems has to be intuitive and coherent

# Salting of roads

- A key to success is to perform proactive actions
  - Anti-icing – to prevent freezing of water and the deposition of ice
  - Anti-compaction and anti-adhesion – to prevent snow from forming compacted snow cover on road surfaces
- What information is required to perform proactive actions?
- What information about the amount of salt is required?



# Measuring salt on road surfaces

## Two principle units of measure:

- Salt concentration:
  - Gram salt per litre water (solvent) or expressed as freezing point
- Salt amount:
  - Salt amount per unit area

*“Due to historical reasons and for the sake of descriptiveness it has become customary to express salt amount as freezing point” Turunen, 1997*

Is salt concentration always sufficient as a unit of measure for the amount of salt on road surfaces?

# Measuring salt on road surfaces

- Examples of instruments presented for contractors as feasible for controlling amount of salt on road surfaces:



refractometers



Sobo 20



road sensors

Does these units of measure express the same information?

# The robustness of a road surface

- A road surface capacity to meet the expected weather and traffic conditions
- Robustness of a road treated with salt is the **capacity against freezing** caused by temperature drop or dilution due to precipitation
- Robustness of the road is a useful concept related to importance of proactive actions



**How to assess the robustness of a road with salt present?**

**What is the appropriate unit of measure?**

# A bare road becoming slippery by (freezing can occur) :

1. Supply of water on a cold, dry road – precipitation or dew
2. Increase of water on a wet, cold road – precipitation
3. A drop of road temperature on a wet road

How to assess the robustness by measuring salt if these situations are expected?

Note!

- *A high concentration do not always mean high amount salt per unit area*
- *A high salt amount do not always mean a high concentration*

# Assessment of the robustness under different conditions

<b>Expectant weather conditions:</b>	<b>Information needed to assess the robustness:</b>
1. Supply water on a dry, cold road	salt amount
2. Increase of water amount on a wet road	salt amount and salt concentration
3. Dropping temperature on a wet road	salt concentration

1. The salt amount in unit area has to be known to assess the risk for freezing for supply of certain amount of water (amount of precipitation)
2. Both the salt amount and the degree of dilution has to be known to asses the risk for freezing for certain increase of water (amount of precipitation)
3. Only the salt concentration has to be known to asses the risk of freezing

# Assessment of the robustness under different conditions

- The robustness can not always be assessed by knowing only the salt concentration on the road surface
  - In some conditions both the salt amount and the degree of dilution has to be known
  - On a dry road there is meaningless to talk about concentration but salt can be present
- ⇒ Using only salt concentration as a unit of measure is not always sufficient

# Relating salt measurement to other part of the system for decision making

- The control unit of a spreader –  $\text{g/m}^2$
- The guidelines for application rates –  $\text{g/m}^2$

How to relate this to a freezing temperature given from a road sensor?

⇒ **The approach using salt concentration is problematic**

# Conclusion

- Salt concentration is not always a sufficient unit of measure when assessing the robustness of a road surface
  - At a wet road with a expected drop in road temperature, salt concentration is sufficient
  - At a wet road with expected precipitation, both salt amount and salt concentration has to be known
  - A dry road with expected precipitation or dew, salt amount has to be known
- It can be difficult to relate readings from road sensors expressed as freezing point to other part of the system for decision making

# Conclusion

## **My original research problem:**

- Salt concentration would not reflect the movements of salt on and off road surfaces
- Unit of measure: salt amount

## **The ideal instrument:**

- Measure salt per unit area
- Measure both dry and dissolved salt
- Measure on all types of pavements (both dense and open graded)
- Copes with the variations in amount of salt on road surfaces

**Thank you!**