Relation of Road Surface Friction and Salt Concentration

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Friction and Salt Concentration

• Purpose of the research
  – How does friction depend on salt concentration and temperature?

• Research conducted during 2010-2011
  – collecting samples from road surface
    • layer thickness, conductivity, friction, temperature
Phase Diagram of NaCl

- Non Saturated Brine
- Salt and Saturated Brine
- Ice and Saturated Brine
- Dihydrate and Saturated Brine

T (°C) vs x (%NaCl)
Friction vs. Layer Thickness
Salt Amount and Concentration

![Graph showing the relationship between Salt Amount (g/m²) and Salt Concentration (%).]
Strength of Salty Ice

Allocation to Wet and Brittle or Dry and Icy States

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Concentration of NaCl (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-25</td>
<td>4.0</td>
</tr>
<tr>
<td>-20</td>
<td>3.5</td>
</tr>
<tr>
<td>-15</td>
<td>3.0</td>
</tr>
<tr>
<td>-10</td>
<td>2.5</td>
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<tr>
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<td>0.0</td>
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</tbody>
</table>

- Dry and Icy
- Wet and Brittle

Sea Ice 0.20 MPa
Sea Ice 0.40 MPa
Sea Ice 0.60 MPa
Phase Diagram of NaCl

T (°C) vs. x (%NaCl)

- Ice and Saturated Brine
- Non Saturated Brine
- Salt and Saturated Brine
- Dihydrate and Saturated Brine
Conclusion

• Ice formed from salty solution is brittle
  – friction is higher than supposed
• Optimal winter maintenance
  1. Presalt at the right time!
     – avoid hard ice
  2. Follow development of friction!
     – refreezing is a slow process,
     – there is time to resalt
  3. Apply more salt, only if needed
     – right amount can be fairly low!
     – 0.1 mm * 1 % = 1 g/m²