WINTER MAINTENANCE in NORDIC COUNTRIES

DENMARK
The county of Funen

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Safe and Efficient Winter Maintenance Practices

- Nordic Road Association
- Nordic Countries
  - Demographics & Roads
  - Climate
  - Rules and standard
  - Organisation
- Research and studies
  - Sand heated with hot water
  - Brine or prewetted salt
  - Other studies
Nordic Road Association
Expertise without frontiers

- Faeroe Islands (0.05 million inh.)
- Iceland (0.3 million inhabitants)
- Norway (5 million inhabitants)
- Sweden (9 million inhabitants)
- Finland (5 million inhabitants)
- Denmark (5 million inhabitants)
## Roads in km.

<table>
<thead>
<tr>
<th>Country</th>
<th>State</th>
<th>County</th>
<th>Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark*)</td>
<td>1.600</td>
<td>10,000</td>
<td>60.000</td>
</tr>
<tr>
<td>Finland</td>
<td>50.000</td>
<td>26.000</td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>27.000</td>
<td>27.000</td>
<td>38.000</td>
</tr>
<tr>
<td>Sweden</td>
<td>98.000</td>
<td></td>
<td>40.000</td>
</tr>
</tbody>
</table>

*) From 2006 there is no county in Denmark
Climate

- **Temperature**
  - Around 0º C and many 0-point pass
    - Denmark and coast areas
  - Down to -30º C or lower
    - In other areas

- **Snow**
  - Roughly 200 cm pr year (not in Denmark)
  - In Mountains in Norway often closed road in winter (Snow up to 4 m). Open again May or June
Rules and standard

- Main roads (AADT > 5,000)
  - 2-3 hours action time to remove snow
  - Friction when dry > 0,25 (0,35)
  - Salt to prevent slippery
  - Sand to prevent slippery, when it is very cold (perhaps heated with hot water)
Organisation

- Norway, Sweden and Finland
  - contractors plan, inspect and take the necessary actions
  - contractors are chosen on the ground of a price and quality competition
  - payment can be unit-price payment based on weather data statistics
  - a bonus system can be used to reduce salt consumption.
  - Traffic information is given through mass media
Organisation

- Denmark
  - administrator plan, inspect and take the necessary actions
  - contractors are chosen on the ground of unit price and have only trucks.
  - The administrator have the equipment

- All countries used road weather information systems, RWIS.
  - Air and road surface temperature
  - Relative humidity and precipitation
Research and studies

- Sand heated with hot water (Norway)
- Brine versus prewetted salt (Denmark)
- SOBO20 Measurement of residual salt
- Create a Winter Model (Sweden)
- Customer satisfaction bonus, Finland.
- Measurement of friction, Norway.
- Follow up of maintenance contracts. Norway
Spreading of sand heated with hot water

- 3 m spreading width, 0-4 mm sand,
- 200 g/ m², 30 % 95°C water, 25-30 km/ hour
E6 across Dovre, days after spreading.
Brine versus prewetted salt
Residual salt 2 hours after spreading

Prewetted lost 20% (uneven spreading)

Prewetted 7.6 g/m²
Brine 4.6 g/m²
Measurement of saltspreading on 4 lane main road
Measurement, examples

- Sobo 20 measurement 1,75 m to the left and to the right from middle of the road
- Arne 22 5
- Helge 18 4
- Jeppe 19 5
- Allan 18 3
- Jens Kr. 21 3

- Mean value 19,6 4
From example

15 g/m² prewetted "7m" 60 km/hour
(40101-208 VD-86) Epoke Combrispreader SH4502 Year. 2002 Asymmetrical

From centre line

Gram salt/m²

0 5 10 15 20

3.75 3.25 2.75 2.25 1.75 1.25 0.75 0.25 0.75 1.25 1.75 2.25 2.75 3.25 3.75

Målt med SOBO20
Udspredt
Dish 6 m assymmetrical

Epoke and Falköbing rotate opposite.

10 g/m² prewetted salt "6 m" 60 km/hour
(80101-151) Epoke saltspreader SW3501 year. 1996

10 g/m² brine + 3 g/m² salt "6 m" 60 km/hour (slurry)
(80101-207) Falköbing Combrisplier CLC-546 Year. 2001
SOBO 20 (saltstick)

- Don’t use acetone!
- Only clear water with conductivity < 10 mikroSiemens/cm.
- The quantity of water in the measure room have to be 43 or 44 ml
- Measure room must repeatedly be cleared with paper
Thank you

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