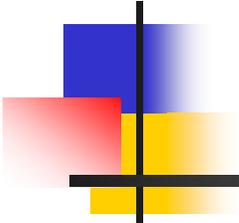


WINTER MAINTENANCE in NORDIC COUNTRIES



DENMARK
The county of Funen

Jens Kristian Fønnesbech

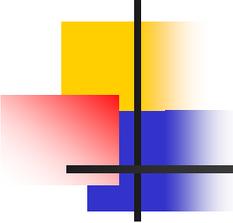
RIGA 2005

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



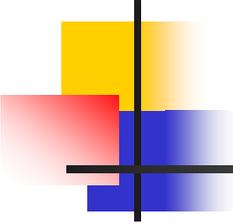
- Nordic Road Association
- Expertise without frontiers
 - Faeroe Islands (0,05 million inh.)
 - Iceland (0,3 million inhabitants)
 - Norway (5 million inhabitants)
 - Sweden (9 million inhabitants)
 - Finland (5 million inhabitants)
 - Denmark (5 million inhabitants)



Roads in km.

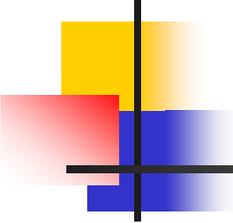
| Country | State | County | Municipality |
|-------------|--------|--------|--------------|
| ■ Denmark*) | 1.600 | 10,000 | 60.000 |
| ■ Finland | 50.000 | | 26.000 |
| ■ Norway | 27.000 | 27.000 | 38.000 |
| ■ Sweden | 98.000 | | 40.000 |

- *) From 2006 there is no county in Denmark



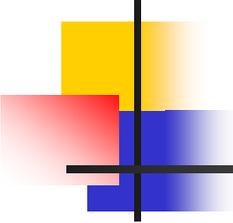
Climate

- Temperature
 - Around 0° C and many 0-point pass
 - Denmark and coast areas
 - Down to -30° 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



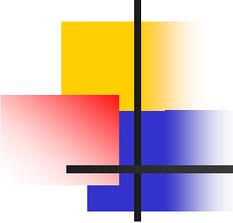
Rules and standard

- 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

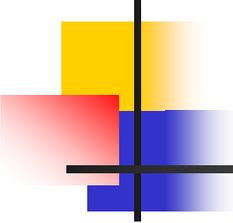
- Norway, Sweden and Finland
 - contractors plan, inspect and take the necessary actions
 - contractors are chosen on the ground of a price and quality competition
 - payment can be unit-price payment based on weather data statistics
 - a bonus system can be used to reduce salt consumption.
 - Traffic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

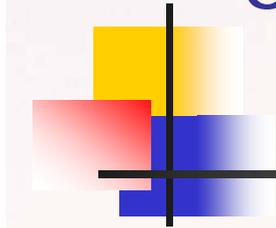
- All countries used road weather information systems, RWIS.
 - Air and road surface temperature
 - Relative humidity and precipitation



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



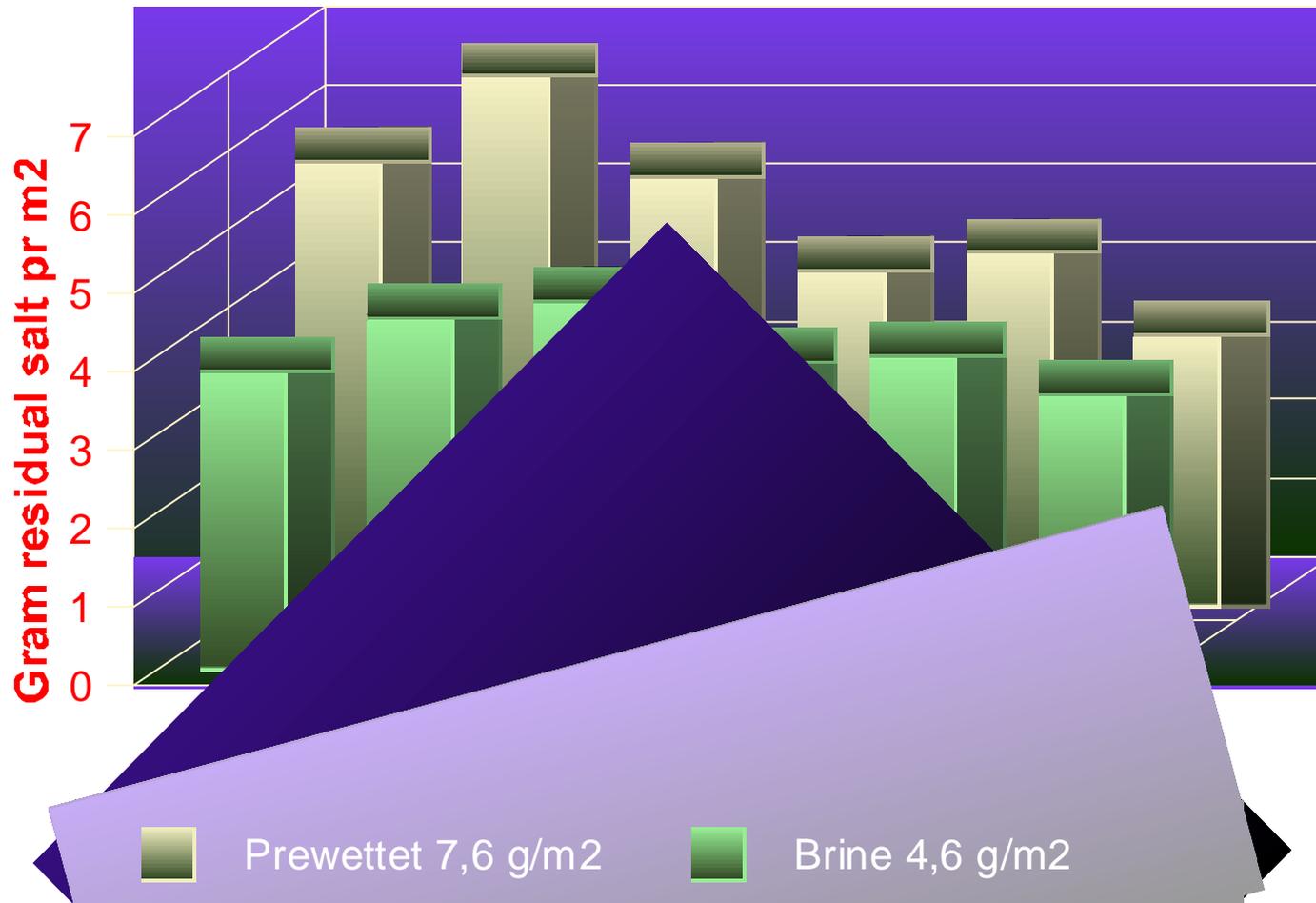
- 3 m spreading width, 0-4 mm sand,
- 200 g/m², 30 % 95°C water, 25-30 km/hour

E6 ascros Dovre, days after spreading.



Brine versus prewetted salt

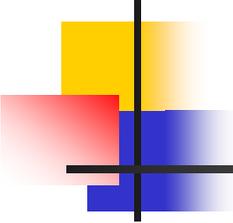
Residual salt 2 hours after spreading



Prewetted lost 20% (uneven spreading)

Measurement of saltspreading on 4 lane main road





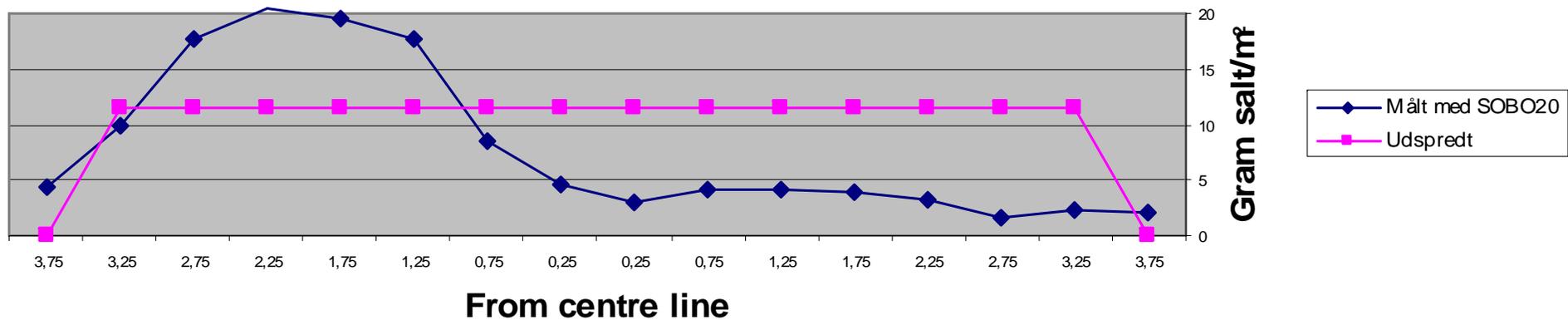
Measurement, examples

- 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

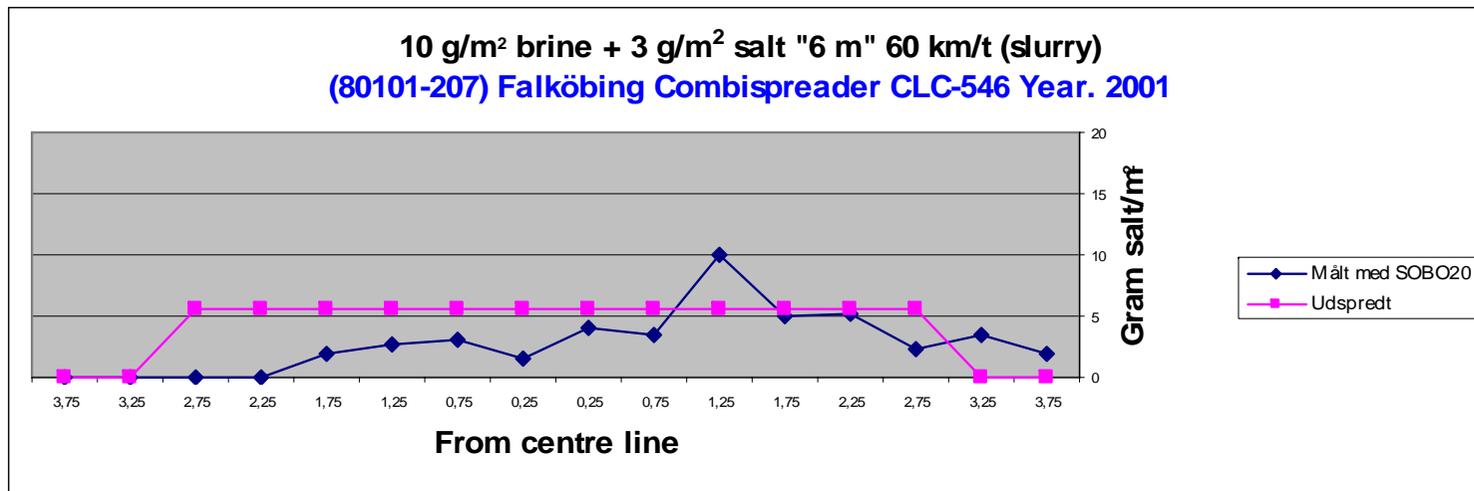
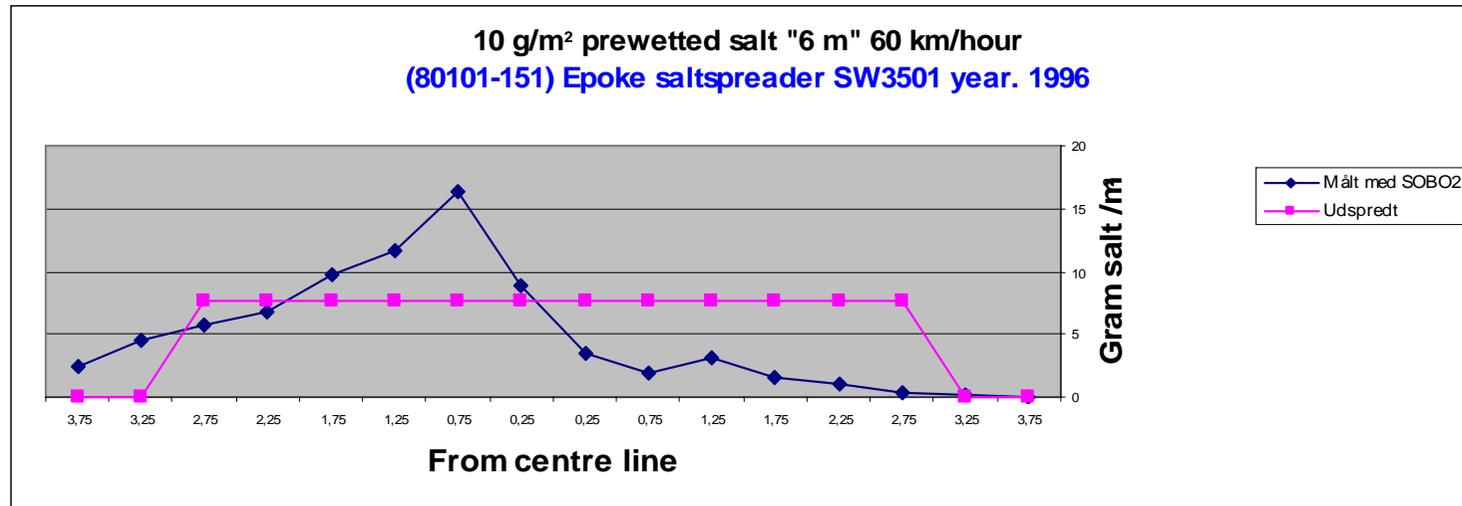
From example

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



Dish 6 m assymmetrical

Epoke and Falköbing rotate opposite.



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

jkf@vej.fyns-amt.dk