

TRAFFIC IMPACT ON THE ICE MELTING

Andorra
2014

AIPCR - PIARC



XIVth INTERNATIONAL

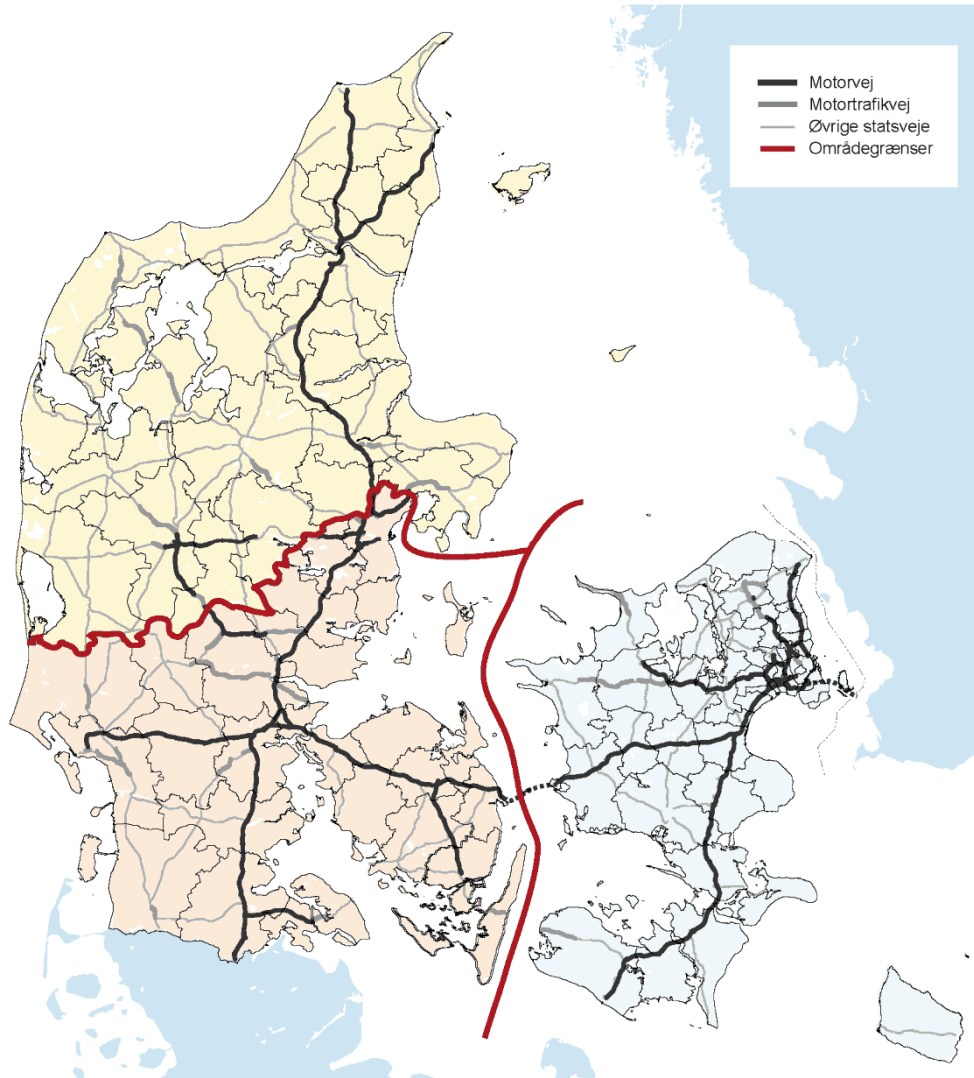
WINTER ROAD CONGRESS

February 4th to 7th 2014

MICHEL M. ERAM
Senior Consultant
Civil engineer M.Sc., eMBA
The Danish Road Directorate
E-mail: me5@vd.dk
Vejdirektoratet.dk



The Danish Road network



Road authorities	Road network	Motorway	Expressway and trunk roads	municipal road
State roads	3.791	1.145	2.646	0
Sound & Belt	41	41	0	0
98 Municipalities	70.276	8	66	70.202

The length of public roads 2013 [km] - Source: The Danish Road Directorate



Winter in Danmark...

- **Winter season:**

State: 1/10 – 30/4

Municipalities: ?

- **Winter road classes:**

Stats roads: class 1

Municipalities roads :...

- **Call-outs**

State: 100 call-outs

Municipalities : 60-80 call-outs

- **Salt consumption**

Staten: 55.000 tons/season

Municipalities : 245.000 tons/season

- **Salt consumption**

State roads: 1,10 kg/m² ~ 150-200 kg/passenger car

Municipalities roads : ?

- **Economy**

State roads ~ 29m. € (3.800 km.)

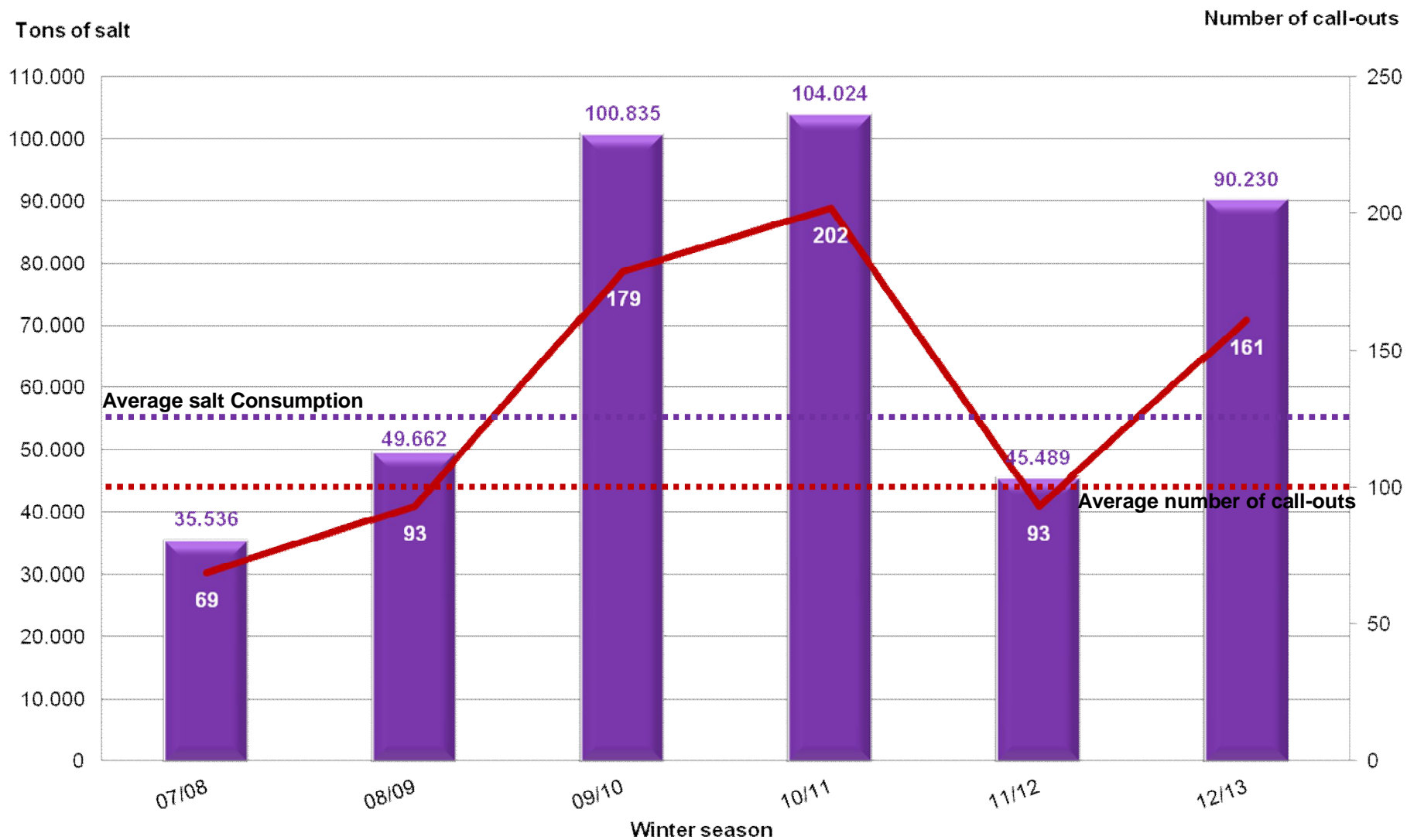
Municipalities roads ~ 106m. € (70.000 km.)

Salting: 530t. € pr. salting on entire Danish roads

Snow removal: 7m. € pr. day on entire Danish roads



Historically salt consumption and the number of call-outs on the state road network



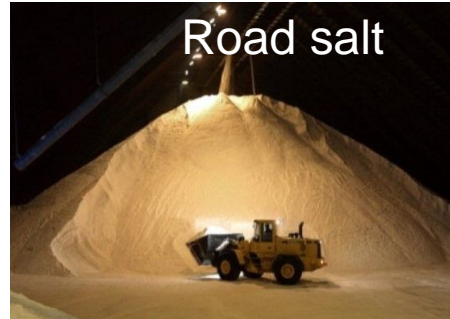
Winterservice – Road Directorate

Winter Surveillance center in Aalborg



Calling out, managing and monitoring

Tender of:



Road salt



Road weather stations



Workshops



Equipments

States roads - Winter:

≈ 3.800 km (6.096 km route length)

≈ 125 salt routes

≈ 50 km in avr. length

≈ 97 contracts

≈ 150 contractors

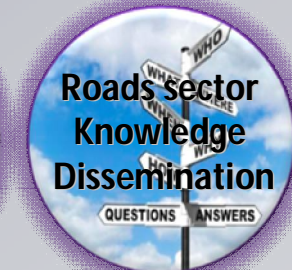
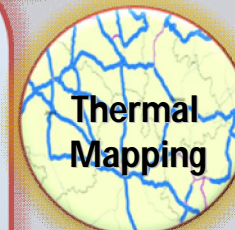
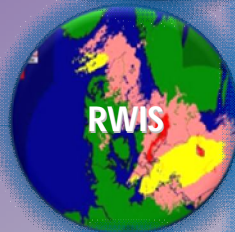
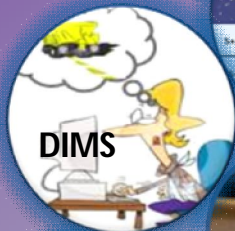
≈ 225 salt spreaders

≈ 550 plough

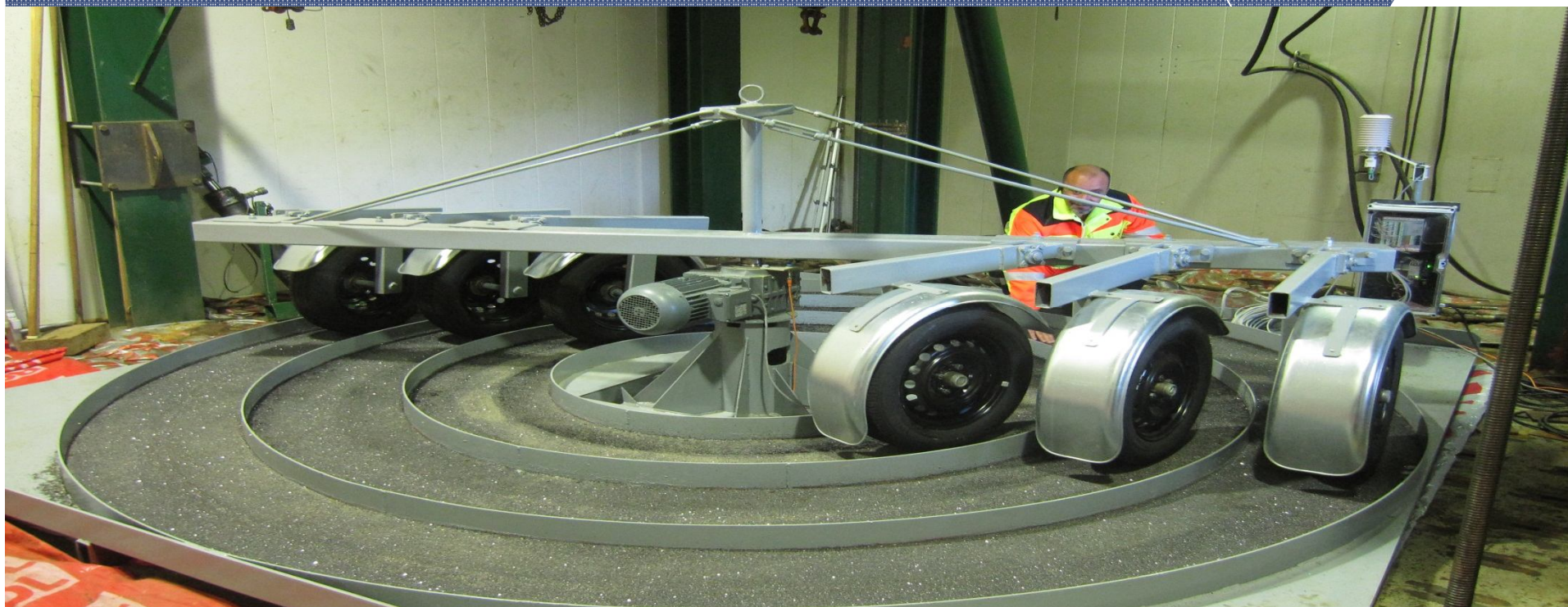


Vinter routes (Lorry + driver)

INTEGRATED WINTER PROJECTS



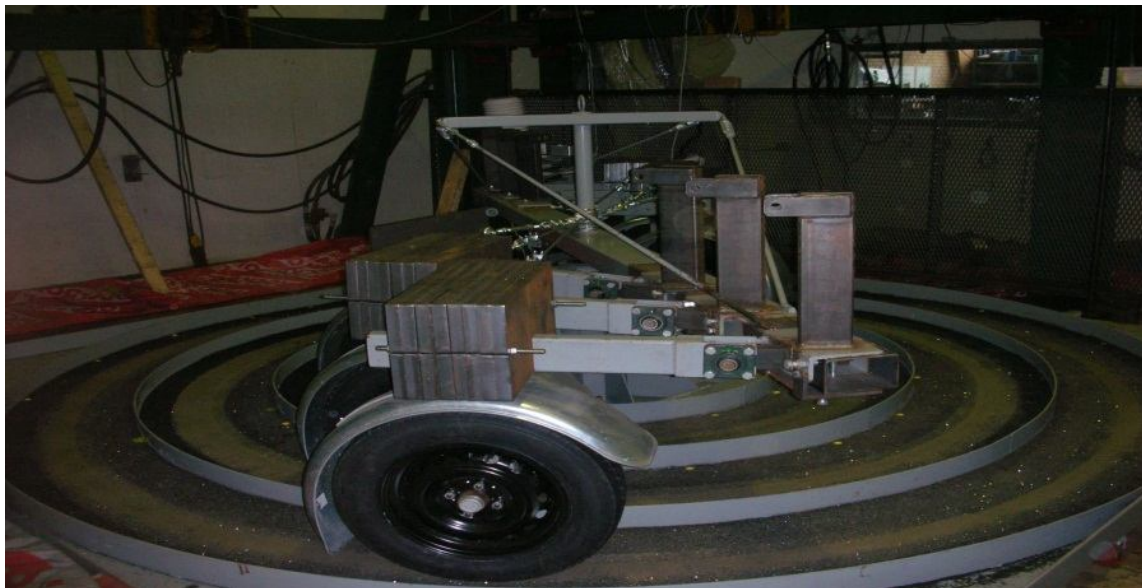
TRAFFIC IMPACT ON THE ICE MELTING



ICE-CAROUSEL

OBJECTIVES

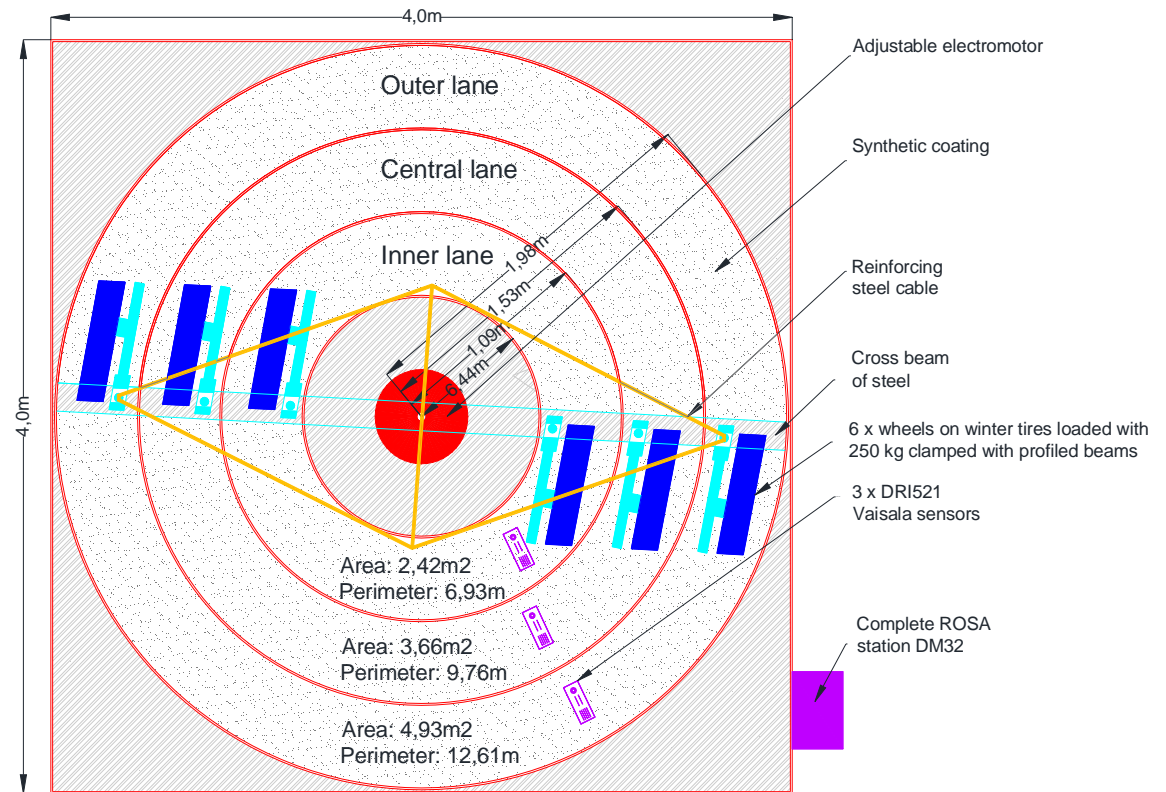
- **Determination of traffic-accelerating effect on the thawing of ice.**
- Determine the friction energy created by the rolling resistance between tires and the road surface.



[Click here](#)

DRAWINGS OF ICE-CAROUSEL

Ice-carousel is constructed from a large steel plate which is divided into three annular lanes each got synthetic coating as a replacement for conventional paving. Traditional asphalt could not be used because the asphalt's properties together with steel would not be successful when the temperature drops to minus degrees.



METHOD OF TESTING

- Determine traffic accelerating effect on the thawing of ice. In this experiment, various de-icing agents and dosages are applied.
 - De-icers approved by the De-icers Group and the dosage is determined by the de-icer properties and capabilities under different temperatures
 - The following de-icers are temporarily approved:
 - **Road salt**
 - **Magnesium chloride**
 - Calcium chloride
 - Safecote
 - Calcium magnesium acetate **CMA 25** & 30 %
 - **Potassium formate**

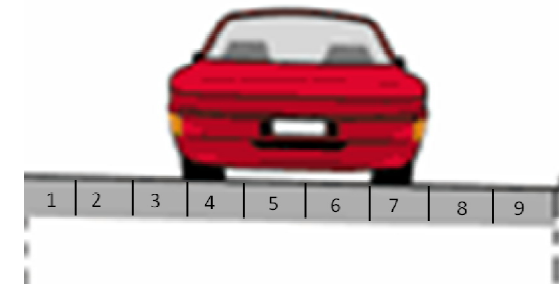
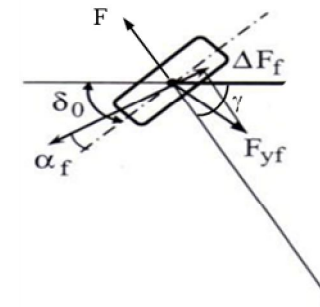
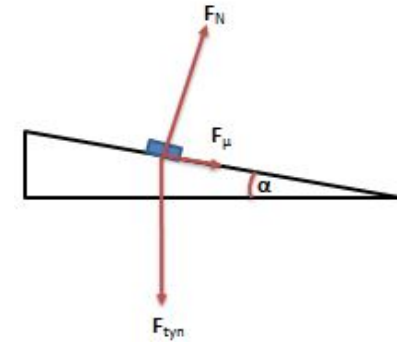


Products marked in **red** are reported until 1 June 2014

FROM AN EXPERIMENTAL SETUP TO REAL TRAFFIC CONDITIONS

- The tires are not affected by the sliding force. The force is offset by the cross bar which holds on the wheels.
- The extra rolling resistance for a turning wheel is incorporate into analysis
- The probability of vehicles position on roadway are calculated, and incorporated into the model

The Sliding Force



EQUIVALENCE OF TRAFFIC INTENSITY

- Both the rotating speed and rotational frequency has a major impact on the traffic intensity represented for such roads.
- De-icers group subsequently recommended two traffic intensities which are the basis of traffic flow respectively on municipal roads and state roads. The following tests are conducted in accordance with De-icers group's recommendation.

Road type	Capacity	AADT
Municipal roads	300 cars/hour/direction	≅ 7200 daily traffic/direction
State roads	1000 cars/hour/direction	≅ 24000 daily traffic/direction

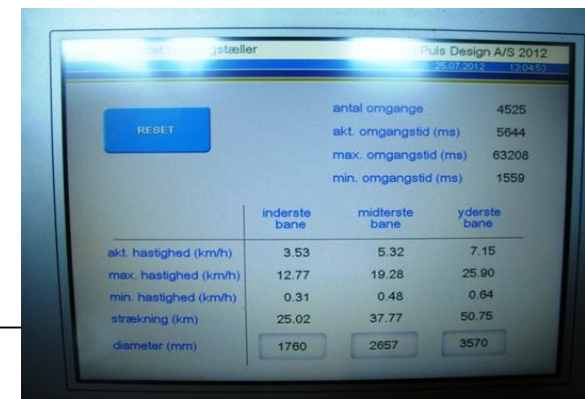
- Taken the above-mentioned recommendation into consideration, the traffic intensity for each lane is determined on the basis of either rotation frequency or speed with the following spreadsheet:

Selection of speed

Track	diameter mm	Speed km/t	lap time msec	traffic intensity cars/hour
Inner	1682	1.59	12000	300
Middle	2592	2.44	12000	300
Outer	3498	3.30	12000	300

Selection of rotation frequency

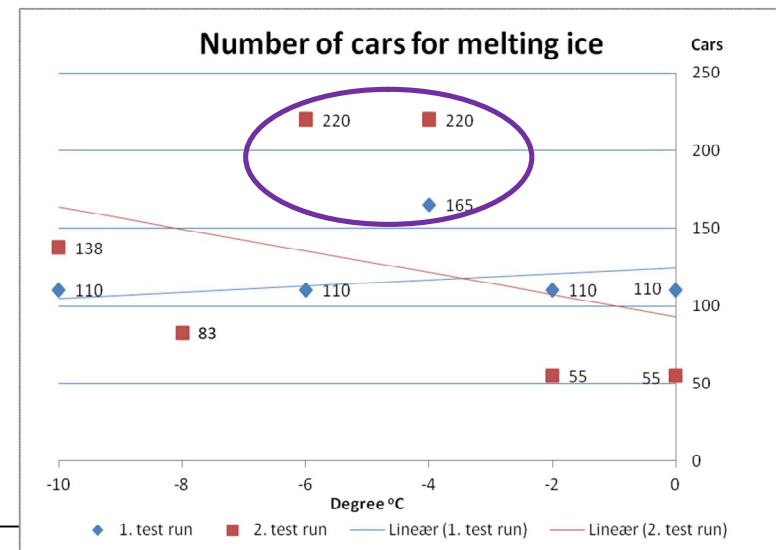
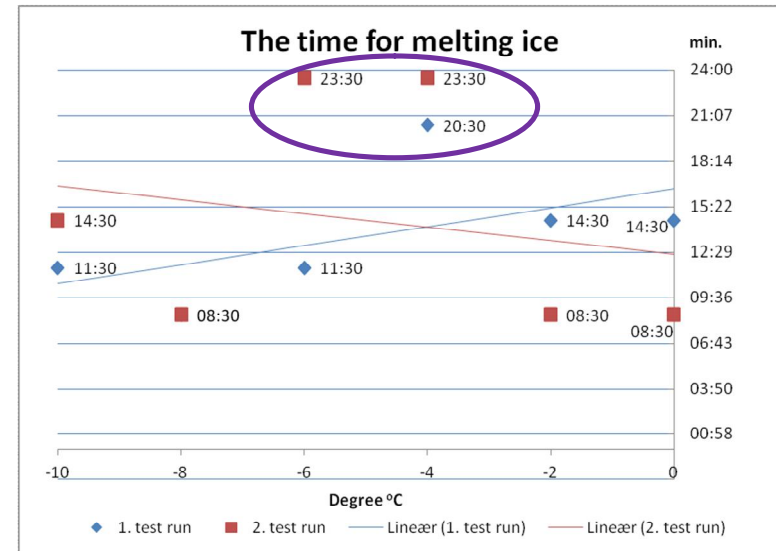
Track	diameter mm	Speed km/t	lap time Msec	traffic intensity cars/hour
Inner	1682	5.28	3600	1000
Middle	2592	8.14	3600	1000
Outer	3498	10.99	3600	1000



PRELIMINARY TEST RESULTS

TRAFFIC FLOW RESPECTIVELY ON MUNICIPAL ROADS

- The time for melting the ice is calculated to be between 8.30 min to 14.30 min. This equivalent to 55 to 138 cars.
- The deviations that appears on the datasheet are most probably due the spreading technique which is used to spread the de-icing prior to the initiation of each test



UNCERTAINTIES

- All tests will be made in a cold room, therefore:
 - Wind effect which under normal circumstances would blow on pavement, will not be present.
 - Irradiance and radiance can not be achieved.
 - The significance of the synthetic coating vs. traditional pavement is so far unknown
 - The use of road sensors are subject to some uncertainties



IMPLEMENTATION

- If it turns out that the friction energy have enough effect on the heating of the road surface, the results will immediately be used in the dosing instructions, as currently used, inter alia, municipalities and the state.
 - It is expected that the results may contribute to the salt consumption during call-outs can also be traffic dependent, ie. in rush hours, consumption can be reduced, and at best, some salting entries completely avoided by creating sufficient heat.

Doseringsinstruks
Vintersæson 2011/2012



Spredertype		Fugtsalt		Fugtsalt		Egøke Combi		Egøke Combi		Slide Combi		Slide Combi		Klipper/Weiser		Klipper/Weiser		Faldsping Combi		Faldsping Combi		Vieske		
		Soredere 30% befugtning SW3500 SW3500	Soredere 30% befugtning SW3500 SW3500	Soredere 30% befugtning CS RMS opt heat Strate 1 & 2	(Tallerken) S4400	(Duser) S4402 S4502 Ester S4200 udbyret med etere komple	(Tallerken) Stratos 3	(Duser & Tallerken) Stratos 2	(Tallerken) IMS Combi	(Duser) IMS Combi	(Tallerken) CIC 546	(Duser) CIC 546	(Tallerken) CIC 546	(Duser) CIC 546	(Tallerken) CIC 546	(Duser) CIC 546	(Tallerken) CIC 546	(Duser) CIC 546	(Tallerken) CIC 546	(Duser) CIC 546	(Tallerken) CIC 546	(Duser) CIC 546	(Tallerken) CIC 546	(Duser) CIC 546
Præventiv saltning		Fugtsalt		Fugtsalt		Combi		Combi		Combi		Combi		Combi		Combi		Combi		Combi		Saltlage		
Doseringsvalg	Vejtstand	Vejtemperatur °C	g/m ²	g/m ²	g/m ²	Forsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	Fugtsalt + saltlage g/m ² + m/m ²	
1	Rim (tør, let fugtige eller fugtige veje)	over 3	7,5	10	7	*3+10	3+11	*3+11	*3+11	*3+11	3+11	*3+11	3+11	*3+11	3+11	20								
2	Rim (tør, let fugtige eller fugtige veje)	under 3	10	12,5	10	3+16	5+13	4+15	4+15	4+15	4+15	4+15	4+15	4+15	4+15	30								
3	Frysende våde veje	over 3	12,5	15	12	5+15	7,5+13	7+15	7+15	7+15	7+15	7+15	7+15	7+15	7+15	30								
4	Frysende våde veje	under 3	15	17,5	15	7,5+15	10+13	15	10+13	10+13	10+13	10+13	10+13	10+13	10+13	40								
5	Sne og islag	Alle	20	25	20	10+20	17,5+10	20	16+10	16+10	16+10	16+10	16+10	16+10	16+10									
Under snefald																								
6***	Saltning sker uden befugtning	Sne/ under snefald	Alle	5	5	7	5	5	5	5	5	5	5	5	5									
Saltning ved allerede indtrådt gletthed																								
7	Is / fastkørt sne	Alle	20	25	20	10+20	17,5+10	20	16+10	16+10	16+10	16+10	16+10	16+10	16+10									

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