German research results and practical experiences in automatically salt spreading and contactless measurement of road surface conditions

Helsinki 11\textsuperscript{th} March 2015

Horst Badelt

Federal Highway Research Institute
Traffic Management and Road Maintenance
Content

- Basics of the automatically salt spreading
- First application of a model
- Experiences with contactless measurements of road conditions
  - Stationary sensors
  - Mobile sensors
- Further steps
What is the right spreading dosage?

Important road surface conditions:
- Road surface temperature
- Water or ice thickness
- Amount of salt on the road
Relation between temperature, water film thickness and salt dosage

Theoretical demand of sodium chloride for the melting of ice or for prevention of ice for different water film thickness [mm]

- 0.10 mm
- 0.15 mm
- 0.20 mm
- 0.25 mm
- 0.30 mm

Temperature [°C] vs. Spreading dosage g/m²
Input information for automatically salt spreading

actual data measured by the machine
- Road surface temperature
- Water film thickness
- Salt amount on the road surface
- Dew point temperature

Organisation
- next spreading tour
- Loading capacity/spreading route

Calculation in the spreading machine

Server in maintenance depot

De-icing agent
- Freezing curve
- Melting power
- Exposure time

Right spreading dosage

GPS

Short time forecast
- Road surface temperature
- Precipitation (kind/intensity)
- Dew point temperature (for the route)
First mathematical model for a calculation the spreading dosage

- GPS data of the service vehicle
- Forecast trend of the carriageway temperature $T_c = T_1 \rightarrow T_2$
- Road temperature $T_r$
- Correction factor $F_x$
- Period of forecast $F_Z$
- Residual quantity of salt $S_{WZ}$
- Calculation temperature $T_{ka}$
- Spreading density $A$: $SD_A = (T_{ka} \times WFD) / 0.0637$
- Spreading density $B$: $SD_B = SD_A \times F_x$
- Thickness of water film $WFD$
- Spreading density $C$: $SD_C = SD_B - S_{WZ}$

Source: Ingenieurbüro KOMMZEPT
First technical realisation in a spreading machine

Road sensors
Road weather station
Forecast for points of the weather station
GPS

PC on board
algorithm for calculating the Density

Control panel

Spreading dosage

Road surface temperature by infrarot thermometer

Server Fraunhofer IVI

visuel observations

analysis KOMMZEPT

source: Ingenieurbüro KOMMZEPT
The model calculated for the preventive spreading a fewer dosage than the driver
During a snowfall

- **Graph:**
  - **Y-axis:** Spreading dosage [g/m²]
  - **X-axis:** Time
  - **Legend:**
    - Blue line: Model
    - Red line: Driver

- **Graph Characteristics:**
  - Shows fluctuations in spreading dosage over time.
  - The model and driver lines are compared.

Page Nr. 9
Test field at the motorway A4 near Cologne for stationary sensors
Sensors on the testfield from 4 companies
Trend of the Road surface temperature in week 38/2013

difference above 3 °C
Reference measurement for the surface temperature with a pyrometer
test for estimation of the influence of sky radiation
Different water film thickness in the same situation

WFD H2: 0,35mm
WFD H3: 0,33mm
WFD H4: 0,11mm
Frage der Schwelle des Fahrbahnzustandes

WFD H2: 0,082mm
WFD H4: 0,01mm
Tovel test for the estimation the water film thickness
Tests of mobile sensors
Next steps:

- Definite the requirements for the parameters
- Development of the test methods
- Test of sensors
- Further development of the calculation model
Thank you for the attention

Contact mail: badelt@bast.de