Optical Road Salt Sensor

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0. OUTLINE

- The problem in Spain
- Vehicle-based sensor technology: Discussion and example of integration
- New technology for residual salt monitoring
- Next steps and conclusions
A-2 Highway
Connects Barcelona and Madrid, the largest cities in Spain.

Traffic data:
33,000 vehicles per day (average)
32% heavy vehicles
Relevant sector L-4 climatologically values, referred to Lleida City, are the following:

- Average annual temperature: 58.5°F. (January: 41.5°F, August: 76.5°F)
- Average annual precipitation: 15 in
- Wettest month: May; less rainy month: July.
- Annual average number of snow days: 1 (January)
- Annual average number of foggy days: 53
- Average annual number of days of glazed frost: 37
Last season required treatments:

- Anti-ice preventive actions: 61 nights (22 in January)
- Applied to a total of 3.140 miles. According to GPS maintenance trucks traveled 21.513 miles.
- A total of 666 US t of NaCl and 343.640 gal of NaCl brine were used.
- Additionally curative treatments in three short snow storm.
1. The problem…

• Roads declared as National Service level 1 apply zero ice policy

• Private applicators up against fear of being sued

• Preventive actions defined by predictions based on sparse road data

• Possible amounts of residual salt are not into account in the operational plans, when establishing the criteria to apply new anti-icing treatments
Decision Support Systems advance with vehicle-based sensor technologies

- RWIS network
- On-board optical sensors
- Information management & decision system based on observation / prediction
- Other sensors (air T and RH)
- GPS
- Sensor fusion: Salt dosing control
2. Pavement sensors

Pavement temperature sensor

Road condition sensor

Portable salinity sensor

Freezing temperature sensor
MDSS with information of infrared temperature sensors mounted on vigilance vehicles
3. Optical technology for road sensors

Incident beam  Specular reflection  
Air  
Material  
Diffuse reflection due to absorption and scattering

Diffuse reflectance spectroscopy

Luminescence
Sensors prototypes
Preliminary specifications of remote residual salt sensor

- LED Technology (eye safe)
- Measure residual salt on dry pavement
- 10% uncertainty (including dependence with temperature) for a full scale value of 20 g/m² (4.2 lbs. per 1000 sq. ft.)
- Compact design for on-board installation: salt dosing control
4. Next…

✓ Research - new models for predicting residual salt
✓ Performance measurements
✓ Dose control depending on residual salt
5 Conclusions

• Cutting-edge vehicle-based technologies can make maintaining winter roadways more efficient, safer and less costly.

• Laser and optical technologies provide cost effective solution for remote mobile sensors.