Use of lignin solution in the road structure to increase the bearing capacity of forest truck roads

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Building of forest truck roads, acc. km

Roads build with local materials

Larger timber trucks

Transport through the whole year

Climatic changes

- 42,000 km
- 32,000 km older than 25 years
- 10,000 km

Rebuilding cost:
- 270 NOK/m (30 €)
- 8.64 bil. NOK (1 bil. €)
The Norwegian Forest Road Standard increased the minimum road width from 3.5 meters to 4.0 meters in 1997.
Reinforce without widening?
Add bearing capacity reinforcing materials or solutions?

The common use of lignin (or lignosulfonate) solution is on the road surface as a dust suppressant and road stabilizer; it binds soil particles to provide a solid, hardwearing surface. Long term experiences from the Norwegian Public Road Administration indicated that the treatment also resulted in an increased bearing capacity.

This study is aimed at measuring the effect on bearing capacity of applying lignin (Norwegian trademark Dustex) to the top/base layer (upper 20 cm) on existing forest roads and if this is an economically viable alternative to traditional methods.

Dustex is biodegradable and has no environmental restrictions.
What have we done?

1. Measure bearing capacity 1, before treatment, - June 2013
2. Crushing and Dustex-treatment, - June 2013
3. Measure bearing capacity 2, after 1 year, - July 2014
4. Measure bearing capacity 3, autumn rain, - October 2014
5. Measure bearing capacity 4, after 2 years, - June 2015
Built-in FWD, Pri 2509, from SWECO (was Grontmij)
Bearing capacity was registered for every 50 meter on the right road side. On the retour the starting point was moved 25 meters, so that the measurements from the left road side was placed between the ones on the right side.

The roads are mapped with measurements for every 25 meters, but on alternating road side.

General impression:
Large variations between neighboring points, road side (cut/fill) and road sections.
Should not be a surprice for an old forest road built with local moraine materials, but....
Road 1, Summer 2013, Before treatment
Spraying about 8 l/m2
ROAD 1

- Før_1306
- Som1_1407
- Høst_1410
- Som2_1506
ROAD 2

- Før_1306
- Som1_1407
- Høst_1410
- Som2_1506

Untreated vs. Dustex treated
The Norwegian Forest Road Standard requirement is 10 tons axle load
Reinforce and widen

25 cm top layer of crushed rock reduce the road width about 30 cm on each side
35 cm top layer of gravel reduce the width 2x50 cm

25 cm top layer, 4 m width is $1\,m^3$ or 1,5 tonn materiale per meter road
⇒ 1,5 t a 100 NOK = 150 NOK/m road
⇒ + transport + widening
⇒ = ca 250-300 NOK/m road  (28-33 €)

Dustex-treatment:
⇒ ca 160-200 NOK/m road  (18-22 €)
Conclusion

• Clear positive effekt of the Dustex-treatment for the bearing capacity in wet/rainy periods, - in short term

• Whether this treatment is an economically viable alternative to traditional methods in the long term or not, still remains an unanswered question. The lignin is compostable and the duration of the measured increase in bearing capacity under wet conditions is uncertain.

• The Norwegian Institute of Bioeconomy Research (NIBIO) aims to follow up these test roads in the future (2018? After 5 years?)
Thank you!