The Municipality of Lindās rehabilitates roads with “wood glue”.

In 2015, the Kleivdalsroad in the municipality of Lindās was reinforced with full depth reclamation mixed with the wood based binder, Lignin, before the road was paved in 2016. The load-bearing capacity of the road was measured before and immediately after the reinforcements, without showing any particular evidence of improved capacity. Recent observations, however, shows great results on the damage development of the asphalt road.

Text: Rune Kilen (from Lindās Municipality)

In 2015, Lindās municipality's road department started a trial project with reinforcement of roads with poor load-bearing capacity. The Kleivdalsroad clearly distinguished itself as a relevant candidate in this project, as there was a great negative focus on this road through the media and the political environment because of the very poor condition of the road.

The Kleivdalsroad is about 5 km long and is located close to the Sjausettvannet, one of Lindās’ most important drinking water sources. So, one of the challenges was to find methods that gave the least possible risk of contamination of the water if there was any run off. We got to know of similar trial projects initiated by the Norwegian Public Roads Authorities, where Lignin was used as a binding agent for deep stabilization of roads and decided to use this technique on the Kleivdalsroad.

The load-bearing capacity of the road was measured before and immediately after the reinforcements to see if there had been any improved results to compare between the different sub-sections of the road. There is some uncertainty in the comparison of the pre / post measurements, as the respective measurements were performed with different operators. In addition, the pre-measurements had far less measuring points.

Measurements on the sub-sections:

<table>
<thead>
<tr>
<th>Section of the road</th>
<th>Measurement</th>
<th>Pre-load-bearing capacity (Mt)</th>
<th>Post-load-bearing capacity (Mt)</th>
<th>Diff %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-862 meter</td>
<td>Only asphalt</td>
<td>10,7</td>
<td>13,4</td>
<td>2,7</td>
</tr>
<tr>
<td>862-2080 meter</td>
<td>Full depth reclamation and asphalt</td>
<td>7,9</td>
<td>8,8</td>
<td>0,9</td>
</tr>
<tr>
<td>2080-2350 meter</td>
<td>Crushed rock replacement, Nonwoven geotextiles and triaxal geogrid, full depth reclamation and asphalt</td>
<td>8,8</td>
<td>8,7</td>
<td>-0,1</td>
</tr>
<tr>
<td>2350-3293 meter</td>
<td>Full depth reclamation and pavement</td>
<td>8,1</td>
<td>9,3</td>
<td>1,3</td>
</tr>
<tr>
<td>3293-4857 meter</td>
<td>Crushed rock replacement, improved with ca 30 cm new gravel and asphalt</td>
<td>13,4</td>
<td>11,1</td>
<td>-2,3</td>
</tr>
</tbody>
</table>
Because the whole road has been paved with the same asphalt type, but sub-sections utilized different base materials, it gives us a chance to evaluate the effects of these measures.

Road grinding:

One of Crusher international's grinding machines was used to mill 25 cm of the top layer of the road. It was old asphalt and a good deal of stone in the upper part of the road. This was very well handled by the equipment. The machine crushed both the asphalt and stones up to about 20 cm in diameter! One could feel and hear the stones being crushed by the spikes on the machine as it passed. Impressive! The method has clear environmental advantages as it enables the use of local crushed material and does not have to transport new material to the site.

Picture: Sharp teeth that chew both asphalt and stone. Photo: Rune Kilen (Lindås Municipality).

Crusher International is, moreover, one of the exhibitors at the Environment and Technology Fair, which is held at the Norwegian Trade Fair in Lillestrøm 5 - 7 March 2019. The theme for this fair is "Digitization in the green shift" – so the sustainable measures that have been done here will fit well into this theme. There will generally be more focus on the road professional for this fair compared to previous years, so we encourage the road people to keep up with what the fair has to offer and sign up early.

Does the load-bearing capacity measurements give a good picture of the product effects?
The load-bearing capacity measurements were carried out both before reinforcement and 1 year after paving the road, though uncertainty lies in the interpretation of these two sets of data (see above). However, it can be seen that when only a new asphalt cover was laid on top of the old pavement, the largest increase in the load-bearing capacity was 2.7 Mt. The rest of the sub-sections provided only marginal gain. However, the experience with the use of Lignin is that the cure time is much longer than, for example, the use of bitumen, as there is a lot of water in the Lignin mixture which needs to dry out of the road before the lignin produces a strengthening effect.

Observations April 2018

The road was visibly checked the last time by the Lindås’ road department in April 2018, so roughly 2 years after the reinforcement measures. The observations give some interesting results; on the stretch where only new top paving was laid, and where we achieved the highest theoretical load-bearing capacity, is also where we have received the greatest damage development on the road surface. This is mainly in the form of longitudinal telescopic cracks in the middle of the road. (see picture below) Photo: This shows teleprints on the sub-line that were only newly paved. Deep stabilization started at marked red dots. Photo: Rune Kilen (Lindås municipality)

For the remaining road, where the road was stabilized with Lignin, there is almost no damage, and certainly no damage as a result of frost heaving.

Photo: Department manager Rune Kilen and road engineer Ketil Mikkelsen inspect the undamaged road surface after the reinforcement measure. The place from which the picture was taken was one of the weakest sections of the road in terms of the results of the bearing measurements. Photo: Rune Kilen Lindås (Lindås municipality)
Sustainable resource

Traditional reinforcement methods largely utilize non-renewable resources in the form of bituminous binders. Bitumen is the residual product of the refining of petroleum and may be phased out in the long-term due to environmental considerations. I believe that the municipalities have a responsibility to search for sustainable measures that do not expose nature to environmental impacts. Lignin is a pure natural product and, definitely, a good renewable resource that is in abundance in the Nordic region.
Lignin

Lignin is the wood binder that gives the tree its mechanical strength. Lignin is extracted through the production of cellulose, as this substance has a negative impact on the quality of the paper, including that it causes a yellow color of the paper.

“Lignin products are used, among other things, as dispersants (provide flow and stabilization) in concrete, textile dyes, pesticides, batteries and ceramic products or as a binder in animal feed and briquettes. In concrete, the products improve the use properties and increase the strength of the concrete” Source: Borregaard LingoTech

Evaluating of the project

- Good environmental project as it uses the crushed material in the road and uses a pure natural product as a stabilizer.
- Very fast execution - short closing time on the road.
- Costs are similar to installing a new, good layer of asphalt and far less expensive than traditional stabilization with bituminous masses. We have the savings in the extended service life of the road surface.

- The lignin is mixed with water before applied in the deep stabilization and the road is very soft during the period after application.
- The road needs a long time to harden as a lot of water will need to exit the road before good reinforcement is achieved. (Lindås waited 8-9 months before the road was paved.)

Reinforcements of gravel roads in 2017

Some gravel roads that expected to transport timber were reinforced in 2017 with a similar method. A couple of these roads are paved now in 2018 while the rest are currently lying as reinforced gravel roads. We believe that this is a favorable method before paving the gravel roads. Lindås municipality has switched to using Lignin as a dust binding agent on the gravel roads. This has been shown to last longer than traditional dust binders.

Crusher international deep-stabilizes gravel roads in 2017. Photo: Rune Kilen (Lindås municipality)