Evaluation of the Effect of Lime-Stabilized Subgrade on the Performance of an Experimental Road Pavement

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Abstract: When constructing a forest road, from environmental and economic aspect it is important to use local soils for the material of the pavement. In Hungary such use of cohesive soils is problematic, especially in the areas with higher rainfall. The lime-stabilization is a possible solution for this problem. Lime-stabilization is the process of mixing lime into the subgrade to provide for increased bearing capacity.

The road test for lime-stabilization was a series of experiments carried out by the Institute of Geomatics and Civil Engineering. The aim of the experimental road was to determine the bearing capacity of lime stabilized layers that can be taken into account in the design process of forest road pavements. The study of traffic resistance of pavements built on lime stabilized subgrade was also an important goal of the experimental road.

The 580m long experimental road section is located at the Forestry of Bánokszentgyörgy in Zala County, which belongs to the *Zalaerdő Forestry Company*. The different pavement versions were designed with about the same design bearing capacity. This equivalent thickness was 30ecm. The road sections with the same lime stabilization layer thicknesses were placed next to each other. The 15-25-35cm lime stabilization layer was built using local soil in the first 360m. Nine different pavements were built with asphalt and macadam surfaces in different thickness in 40m length each. A traditional pavement - without lime stabilization - was built in the last 220m as a control section, where sandy gravel course as sub-base course is located on the subgrade. To better understand the bearing capacity of the lime stabilization layer, the 5th pavement version was built with just 35cm lime stabilization layer and with 2cm of fine crushed stone.

After the calculations the modulus of the lime-stabilization layers resulted as E_{lime} = 500 MPa, which is almost the same as the modulus of a well-compressed continuous grain-distribution macadam layer.
The reactions of different pavement types to loads were studied by the application of 2072 ESAL artificial traffic. The experimental pavements got more or less deformed due to the artificial traffic. Benkelman beam measurements were conducted to determine the deterioration curve of pavements. The central deflection changing was linear compared to the traffic. As a result of one year resting the pavements of all variations regenerated. On pavements with 25 cm and 35 cm thick stabilized courses deflection values are similar, while higher deflection were measured on the ones with 15 cm stabilized courses.

This result makes the lime-treated soil layers possible to be counted as pavement layers, further on. Where the thickness of the lime-stabilization is 35cm, the load bearing capacity modulus of the improved subgrade equals the load bearing capacity of the control section's entire pavement. This load bearing capacity equality provides a huge economical advantage against the traditional pavements.

The conditions of the sections are as follows:

- the pavements with asphalt surfaces and thicker crushed stone courses resisted more to the harmful influence of the artificial traffic,
- the macadam pavements built on lime stabilization better followed the reduction of bearing capacity of subgrade,
- the section with 35cm lime stabilization, which has just 2cm fine crushed stone, also resisted the artificial traffic.

According to the experiences of the experimental road section the Department of Forest Opening Up planned the 2.5km long ‘Lónyai’ II. class forestry road of the ‘Nyírerdő’ Forestry Company, the bottom layer of which is the local cohesive soil (clay) made with lime-stabilization. Onto the excellent quality lime-stabilization layer a crushed stone pavement was built, the usability of which has been excellent

since then. Thanks to the favourable experiences here, more than 3km long second section of the ‘Lónyai’ forest road was also built.
The experimental road section and the well-built lime-stabilization pavements also point out, that in the case of cohesive subgrade it is essential to have a good water drainage system and to prevent the increase of the subgrade water content, to provide a constant load bearing capacity of the built lime-stabilization or macadam pavements.

Key words: forest opening up, lime-stabilization, road test, bearing capacity

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