Innovation in road renovation and construction

----intelligent road construction technology----
Poligate Ltd. is a company of the adinotec Group, based in Griesheim, Germany. Poligate Ltd. is specialized in developing and marketing innovative products for the industrial and construction sector.

One of the innovative products we offer is a method for soil stabilization, using our polymer nanoSTAB® by which roadbeds and other traffic routes can be reinforced without having to excavate or exchange the soil layers of the roadbed. This method is as well suited to construct new roads as for road rehabilitation.

This service goes beyond delivering additives for soil stabilization and includes planning and performing precisely coordinated construction measures.

Our method allows us to deliver high quality road rehabilitation and constructions projects faster and more cost effective than conventional methods. It is also a major step forward in the global goal of reducing environmental impacts from CO₂ emissions.
Construction companies, as well as contractors can gain considerable competitive advantages implementing this technology. We deliver our polymer, the necessary expertise, equipment and of course, the project-accompanying quality assurance, from the planning stages through after care.

Efficiency and quality is improved by on site training of the local staff. Unlike for example Chinese companies, Poligate offers a detailed know – how and technology transfer.

Due to shorter construction times, personnel and equipment cost savings can be achieved. At the same time traffic jams resulting from construction works are reduced considerably, a fact which is highly appreciated by everybody.
Building a high quality long-lasting roadbed depends upon detailed data gathered in preliminary surveys. The more precise information is gathered at this stage, the more optimized the final construction plan can be defined and implemented.

For this reason we partner exclusively with qualified institutes to perform the necessary soil analysis using the latest measuring technologies and methods.

Using the findings on existing geological and soil mechanical conditions in the individual layers, we then develop an optimized mixture ratio of binding agent and our polymer \textit{nanoSTAB}® leading to the most long-term economical result.
Stabilization

Depending on the exact situation, a typical construction project could be as follows:

The existing surface is milled through, using specially developed machinery to break down the milled material and crush it into very small pieces. Different milling machines are used depending on the specific soil type and milling depth.

The nanoSTAB® mixture and the binding agent are mixed into the milled material. For this process, the binder is applied by a spreading vehicle and the polymer is added through adjustable nozzle bars in front of the milling machine.

After the roadbed has been worked in this manner, it is levelled off by a grader and then thoroughly compacted. The surface can be opened to traffic or cleared for further works after a very short time.
In civil engineering, quality must be of the highest level.

To achieve and guarantee our objective of producing lasting, low-maintenance roads, we depend upon our internal quality management and also employ highly experienced and independent institutes for external quality assurance from the outset.

That way, even unexpected problems or the slightest deviations from the construction plan can be responded to immediately. Project-related test reports from our own internal quality management or from the independent laboratories combination with the daily reports are integral parts of our site monitoring and documentation.
In the characterized process our product \textit{nanostab$^\text{®}$} is added.

\textit{nanostab$^\text{®}$} is a non-toxic, environmentally friendly and water-soluble polymer additive that is milled together with hydraulic binders into the roadbed to be stabilized or renovated.

\textit{nanostab$^\text{®}$} provides a high water-impermeability and therefore significantly contributes towards reducing frost damage in the roadbed or road surface. Given its rapid reactivity combined with the hydraulic binder, roadbeds constructed in this way reach a high early hardness, which means these surfaces can be opened to traffic or cleared for application of the road surface after a very short time. The compressive strength values exceed are much stronger than the German standards. Due to the flexural tensile strengths and the flexibility of the stabilized base course achieved with \textit{nanostab$^\text{®}$}, the tendency to form cracks is minimized, ensuring higher stability and durability.

Due to its ability to immobilize contaminants present in the soil, \textit{nanostab$^\text{®}$} is especially well suited to use in environmentally sensitive areas.
Example for a standard road
Depending on the existing or expected volume of traffic

The **nanoSTAB®** method drastically reduces the thickness of the required roadbed construction, and its higher quality allows for a reduced asphalt pavement profile.
Advantages during the planning phase

Low investment costs given a significantly smaller vehicle fleet. The fleet of heavy vehicles normally required for transporting soil material from and to the construction site is not necessary any more.

Additional cost saving due to a reduction of the asphalt pavement.

Work is performed up to 5 times faster by in situ stabilization of the roadbed, allowing the road surface to be applied sooner and the road to be reopened to traffic earlier.
Advantages during the construction phase

- Nearly unlimited applicability, since the milling machines can even work in confined areas.

- Considerable cost savings since there is no need for existing roadbed material to be removed and no need to transport new material to the site. This reduces the necessary machinery and personnel and reduces costs for fuel and maintenance.

- Fewer and shorter weather-related construction stoppages, because the nanoSTAB® method can be applied up to temperatures of -2 to -3 degrees Celsius. Traditional methods in comparison cannot be applied below temperatures of +5 to +6 degrees Celsius.

- Reduction or prevention of frost damage given the low water permeability of the prepared roadbed.

- Minimized or reduced maintenance costs given high compressive strength and flexural tensile strength of the roadbed.

- Immense reduction of CO₂ emissions.
In a model calculation for renovation of a 17 km long, approximately 30 m wide road section of a 2x4 lane motorway, the following comparative values were calculated between conventional renovation and renovation using our nanoSTAB® method:

### Conventional Renovation

- 510,000 m²/~2,000 m² per day amounts to approx. 255 working days.
- Vehicle fleet required:
  - Removal of existing material: 510,000 x 0.6 m³ amounts to approx. 20,400 truck runs
  - Delivery of new material: 510,000 x 0.6 m³ amounts to approx. 20,400 truck runs
- Total: approx. 40,800 truck runs

### Application of the nanoSTAB® Method

- 510,000 m²/~8,000 m² per day amounts to approx. 64 working days.
- Vehicle fleet required:
  - Removal of existing material: not applicable amounts to zero truck runs
  - Delivery of cement and polymer approx. 1.780 truck runs
- Total: approx. 1,780 truck runs

With an estimated transportation distance of approximately 20 km and an average fuel consumption of approximately 40 l per 100 km, the nanoSTAB® method would also reduce fuel consumption by approximately 312,160 litres.
Aside from immobilizing contaminants present in the soil, the amount of heavy vehicle transportation to and from the construction site, and thus the CO₂ emissions into the atmosphere, are reduced to a minimum.

For example, in the model calculation described above, with a fuel saving of approximately 312,160 litres, the reduction of CO₂ emissions can be calculated at 312,160 l x 2.647 kg/l, or namely 826,287 kg CO₂.

Alternately blocking each of the 4-lane sides of the road during renovation work, with a traffic incidence of approximately 130,000 cars per day, results in additional CO₂ emissions of approximately 79,000 kg CO₂ per day from vehicles caught in a jam.

By employing the nanoSTAB® method, and thus reducing the construction time by 191 working days, CO₂ emissions are reduced by an additional 15,089,000 kg.
comparison of the *nanoSTAB*® method with the traditional method for road renovation
Comparison

<table>
<thead>
<tr>
<th>Construction Time</th>
<th>Construction with the nanoSTAB® method is approximately 5 times faster than with the conventional construction method. For example: construction time for 1 km road (10 m width) with nanoSTAB® method needs 2 days</th>
<th>Construction time for 1 km road (10m width) with conventional method is 10 days (base course and binder course)</th>
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</thead>
<tbody>
<tr>
<td>Material</td>
<td>Existing soils can be stabilized in situ. By repairing existing roads the asphalt pavement can also be milled and used for the stabilization of the roadbed.</td>
<td>Existing soil and/or asphalt layers must be excavated and removed. New material has to be delivered</td>
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<tr>
<td>Load Bearing Capacity</td>
<td>It is not necessary to remove the existing soil. With the specific modification of the nanoSTAB® polymer with the binding agent every required load bearing capacity can be obtained with the existing soil</td>
<td>Load bearing capacity is limited in accordance with existing material. If higher load bearing capacity is needed, the existing soil has to be exchanged for new material.</td>
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<tr>
<td>Processing or workmanship</td>
<td>Through the high hydration heat, resulting from the reaction of nanoSTAB® and the binding agent, the nanoSTAB® method can also be employed at temperatures up to -2 or -3 degrees Celsius. (Air temperatures about minus 6 degrees)</td>
<td>Using traditional construction methods the building activities must be stopped when temperatures fall below 5 or 6 degrees Celsius.</td>
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</table>
## Comparison

<table>
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<tr>
<th></th>
<th>nanoSTAB®</th>
<th>conventional</th>
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<tbody>
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<td><strong>durability</strong></td>
<td>Due to the addition of nanoSTAB® the resistance of the roadbed against frost damage and dynamic stress as well as the water impermeability rises significantly. Due to the elasticity of the single particles movement in the road bed is reduced and thereby the abrasion between the single particles.</td>
<td>By the traditional method the single particles can move more or less freely in the soil. Thereby the abrasion rises. Due to the water permeability entering water can flush out fine aggregates of the roadbed and thereby produce new voids or magnify existing voids. By this way settlements in the road bed are generated and with that damages in the asphalt pavement.</td>
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<td><strong>impact of soil</strong></td>
<td>Existing contaminants are immobilized, and there is rarely a need to dispose the existing material.</td>
<td>Contaminated soils must be disposed on dumping grounds.</td>
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<td><strong>environment impact</strong></td>
<td>Due to the shorter construction duration and reduced equipment needs, the nanoSTAB® method reduces CO2 emissions and thereby the pollution of the environment. For example: For 17km of highway repair work the CO2 output would amount to 37,693 kg.</td>
<td>Due to the longer construction duration and the greater need for equipment, CO2 emissions for the same work with conventional methods would amount up to 863,980 kg.</td>
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</table>
Patent

The nanoSTAB® technology has been filed for international patent application, patent is pending.

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Certification

The nanoSTAB® technology has been certified in different countries:

- Romania
- Russia 3 x
- Turkmenistan
- Turkey
- Abu Dhabi
- Libya
- Ghana
Poligate Malta

Polymer manufacturing facility. Capacity 250,000 Liter per day, per 8 hour shift
Maschine park
Libya
In action
Quality

Static load plate test according to DIN 18 134
Sample Core

28.03.2014
Polymer distribution tank with ground injection system
Night shift

Abu Dhabi
Early morning

Tripoli Libya
Cement
Polymer
Mixing

Poligate Ltd.
HHF001
Industrial Estate
Hal Far
B' Bugia
Malta

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28.03.2014
Endproduct
Before and after