SYSTEM Stabi ROAD®

Road - Building Technology

Business Group
Management & Development.

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ADDITIONAL QUERIES AND INFORMATION TO BE ADDRESSED TO:

Stabilizer

STABI Road

For strengthening and hardening road surfaces, in the construction of roads, streets and squares.

Issues presented herein, as well as conclusions, are of practical use to investors, designers and construction operators.

Chemical & hydraulic technology for soil stabilization

Alternative for aggregates

The technology used behind ECO Roads System is not only technically advantageous but also a highly economical solution, it guarantees greater road stability in comparison to all other traditional methods used.

EXPERTS ASSOCIATTION OF ECOLOGY

We have been in the market since 2004

European Union

AFRICA

Business Group
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DESIGN AND TECHNOLOGICAL GUIDELINES FOR THE APPLICATION OF THE STABI ROAD STABILIZER IN ROAD CONSTRUCTION

1. Properties of soil stabilized with STABI ROAD

Soil stabilization aims at the construction of a basis (surface) that, when hardened, will become a bearing part of a road surface, or will be that road surface in itself. Compacting and hardening of the soil is a result of a permanent change in the strength of bonds in the hydro particles of the soil – the capillary ducts get broken to a large extent. The depth of STABI ROAD penetration is limited only to the moment the solution encounters a perfectly dry layer, from which there are no ground water layers or capillary phenomena. The soil becomes impervious to the destructive activity of water and frost, at the same time demonstrating flexibility, thus preventing cracks and deformations from occurring, which could be dangerous for the surface structures (e.g. rut formation). The load bearing capacity of the surface is therefore raised considerably. In the case of soils where STABI ROAD can be applied, the load grows by E1 & 120 MPa and E2 & 200 MPa , and even E2 & 450 MPa. Apart from that, STABI ROAD also binds airborne particles and hazardous petro-chemicals (e.g. petrol, diesel, oil) with the soil, which decreases their density, resulting in the creation of a material similar to sedimentary rocks resistant to water, and effectively stops the washing out of hazardous substances to the neighboring ground waters or reservoirs.

2. Scope of application

The STABI ROAD preparation is designed to improve and/or stabilize the following native soils in road construction:

- anthropogenic soils (cinders, dusts)
- humus soils 2% < lom < 5%
- weathered rocks KW,KWg
- scree KR, KRg
- gravels 6, 6g
- all-in aggregates Po, POg
- sands Pr, Ps,Pd, P8, Pg
- dusts 9, 9 p
- clays Gp, G, G8

Additionally, the soil should meet the following conditions:

- content of grains falling through a 50 mm sieve should amount to 100%,
- content of grains smaller than 0,075 mm should be at least 20 %,
- organic particle content not higher than 5 %,
- flexibility indicator > 5 %,

3. Destination

Technology of stabilization with STABI ROAD can be applied to the construction of:

- bearing layers of road surfaces,
- auxiliary and basic foundations,
- permanent stabilization of dubious and heaving soils
- neutralization and consolidation of soils polluted with petro-chemicals, oils and petrol-based pollutants,

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- local and access roads,
- forest roads and cycling tracks,
- car parks and manoeuvring places
- strengthening construction sites and temporary roads,
- road shoulders, embankments and floodbanks.

4 Physical-chemical and chemical properties of STABI ROAD

The preparation, composed of a mixture of sulfone acids in a sulphuric acid solution, is sold in the form of a liquid concentrate of green-brown colour.

Other physical and chemical properties:

- Density: approx. 1.75g/cm3
- Smell: strong smell of sulphuric acid
- Toxicity: strongly caustic
- pH: 1.4
- boiling temperature: 147 °C
- ignition temperature: not applicable (non-flammable)
- solubility ion water: unlimited.

Due to the reactivity of STABI ROAD (concentrate) as a strongly caustic preparation, any contact with bases, metals, some salts, paper, wood, etc. should be avoided

– see attachment "Chart of Characteristics of a hazardous chemical substance".

5. Application conditions

Before the application of STABI ROAD, it is essential to check its effectiveness on a given type of soil as to the required properties in the technical design, technical and technological documentation. In order to do that, one should perform appropriate testing of the actual soil, and prepare a recipe for the stabilizing mixture. The recipe should define the optimum amounts of the respective ingredients necessary to reach the required durability properties. Next, the test results should be compared with the requirements from the documentation, appropriate standards and technical requirements.

6. Testing

Irrespective of the technical regulations for road construction, one should performed the following testing, in accordance with the requirements of the applicable standards:

a) evaluation of the conformance of STABI ROAD with the manufacturer's data:
- density in temp. 20°C – PN- 92/C - 04504
- appearance, colour, solubility – visual examination

b) testing the soil to be stabilized:
- graining
- flexibility factor
- organic particle content
- optimum humidity and maximum volume density in accordance with the standard PN-88/B – 04481

c) preparation of a recipe for the stabilizing mixture:
- compression resistance after 7 days in accordance with PN –S –96012

d) tests to be performed during work and after completion:
- natural soil humidity - PN-88/B – 04481
- density factor – PN – S - 02205:1998
- compression resistance after 7 and 28 days – PN –S –96012

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Required parameters of the layer of stabilized soil
In the case of improved foundation, or a basic subsurface, the stabilized soil should meet the following conditions (in accordance with the PN-S-96012:1997 standard)

No.	Type of surface construction	Compression resistance of water-saturated samples (MPa)		Freeze-resistance index R^{zo}_{28} / R_{28}
		After 7 days R_7	After 28 days R_{28}	
1	2	3	4	5
1	Basic foundation for KR1 or auxiliary foundation for KR1 to KR3	In accordance with the requirements in the technical design, taking into account requirements in paragraphs 2 and 3		
2	Upper part of the improved soil layer at least 10 cm for KR1 to KR 3, or upper part of the improvement for the weak foundation of dubious and heaving soils	from 1.0 to 1.6	from 1.5 to 2.5	0.6
3	Lower part of the improved soil layer in the case of the surface structure being placed on a foundation of dubious and heaving soils	-	from 0.5 to 1,5	0.6

Individual construction layers made from soil improved with STABI ROAD should have the deformation module E2 compliant with respective standards.

7. Technological recommendations

7.1 Weather conditions
Soil stabilization can be commenced in favorable weather conditions, namely in the temperature above +5 °C, with minimum temperatures in the last 24 hours higher than +1 °C. Surface layers must not be processed during rainfalls. Should rain commence while the work is in progress, it should be discontinued, and then resumed in dry weather, with the soil being mixed for optimum humidity before compacting. If, directly after the completion of work, there is frost at night, on the next day, at temp. over 5 °C, the stabilized soil should be stirred and compacted again. In the case of summer heats (dry or windy weather), the soil humidity should be checked, as it may turn out that it is necessary to add a little water to compensate for the evaporation losses.

7.2 Structural cross-section of the road construction
In order to improve the load bearing capacity of soil through stabilization with STABI ROAD, the individual layers should be appropriately laid and have proper thickness. The layer stabilized with cement with an addition of STABI ROAD has higher durability and flexibility compared to the standard cement stabilization. In order to avoid possible cracking propagation in this layer, as well as to ensure optimum bond with the bitumen payer, it is recommended to lay a linking layer. Additionally, it will penetrate and seal any micro-fissures, as well as increase the impermeability of the lower layer.

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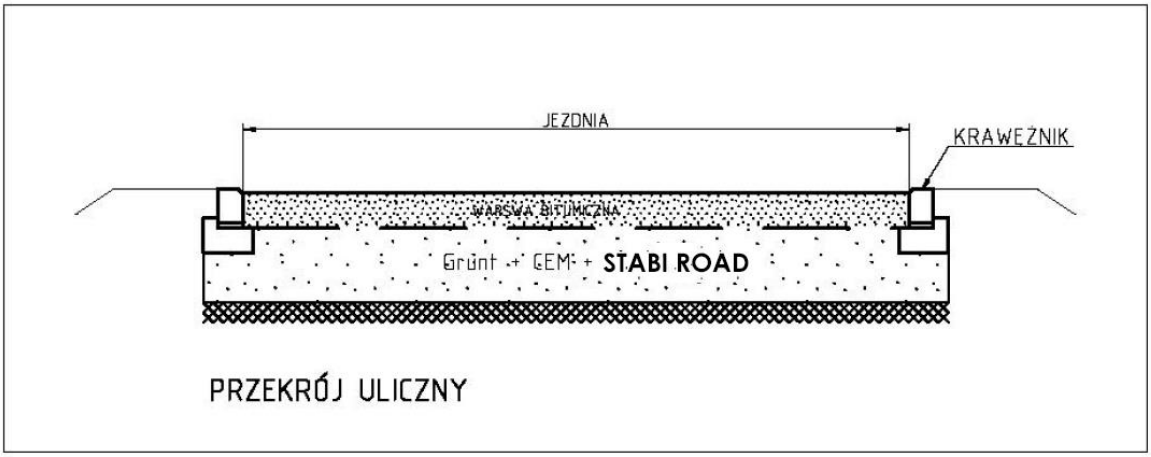
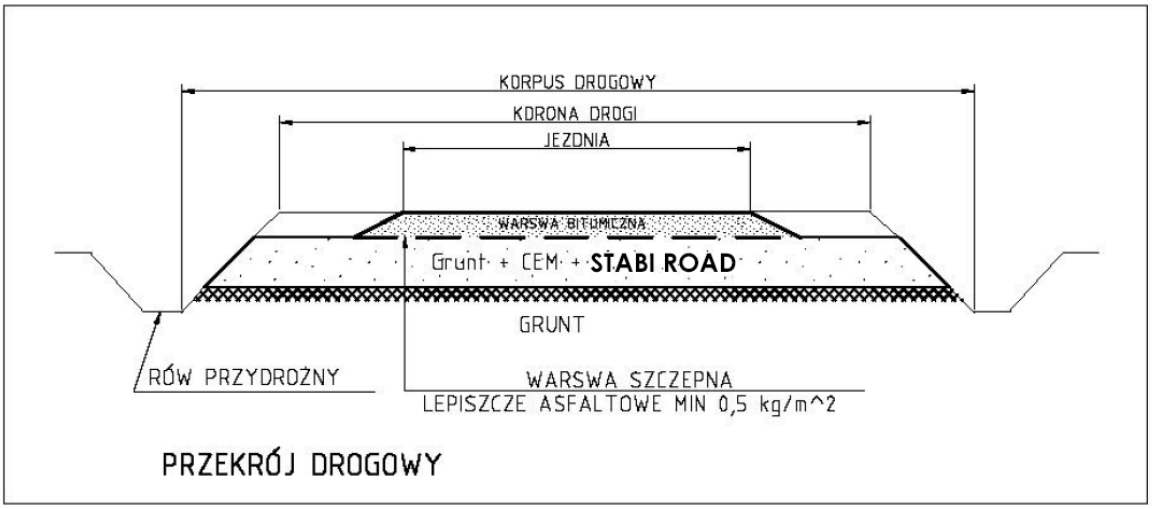
Following are diagrams of cross-sections for the compacting of the surface and load-bearing layers.





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7.3 Preparation of the STABI ROAD solution
The volume of the soil to be stabilized during one day should be calculated. Next, the amount of STABI ROAD concentrate necessary to process the given volume of soil has to be established, assuming the consumption of 50 ml/m2 (125 ml/m3) Proper solution is prepared by diluting with water at the ratio of 1 : 200. The tank should be filled with an appropriate amount of water (decreased by the reserve for washing the emptied concentrate containers), and an appropriate amount of the concentrate should be added by pouring it carefully through the intake hole of the tank.

Always remember to add the concentrate to water.
Next, move the tank a few times back and forward, making sure the concentrate mixes with water properly. Emptied concentrate container should be partially filled with water, and the water added to the tank containing the solution.

Before the commencement of work with the concentrate, one should get acquainted with the chart of characteristics of a hazardous preparation STABI ROAD (concentrate) – strongly caustic substance.

The are of stabilization performed depends on the thickness of the soil layer, and with the use of a 1000 litre tank, it is as follows:

STABI ROAD water solution	Layer thickness, cm					Volume of stabilised soil. m^3	Amount of **STABI ROAD** in litres
	20	25	30	35	40		
	Area, m^2						
1:200	200	160	133	114	100	40	5.00

7.4 Stabilization implementation
Depending on technical possibilities and the object of stabilization, the STABI ROAD stabilizer solution can be used in two different manners:

- penetration
- mixing.

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Penetration method
The road bed is to be dug through to an appropriate depth, with the use of mixing miller or soil miller. The depth of milling depends on the road design and the expected pressure of vehicle axes (usually from 25 to 30 cm). Approx. 60% of the STABI ROAD stabilizer solution should be applied directly onto the soil, with the tank passing over the area at least twice. The solution should be applied from one edge of the road, and then returning to the other edge. The process should be continued until the tank is emptied of the solution. When more than one tank is used, the procedure should be similar. Next, after 1-2 days, the soil should be scarified again, and the remaining 40% of the solution should be applied. The STABI ROAD solution naturally penetrates the soil, initiating the process of soil bonding. Numerous passages with the tank favorably influence the even distribution of the solution, taking into account all the fissures and cracks that appear during spraying (calibration of the strength of the stream from the tank is not necessary).

Mixing method
The layer to be stabilized should be scarified with the use of mixing miller or soil miller, at the same time dosing the STABI ROAD stabilizer, in the amount of 50% of the solution prepared for the purpose. Next, the procedure should be repeated, with the soil being mixed with the remaining solution. If it is possible, mixing machines equipped with liquid dispensers

If a grading machine is used in the mixing, after the first application of the solution, the upper layer of the soil should be moved to one side of the road, forming an embankment. The remaining solution should be applied to the lower layer of the soil. When all the stabilizer has been used up, the lower layer of the soil should be moved onto the already existing embankment, formerly formed with the upper layer. Next, with the use of the grader, the embankment should be spread alongside the road. Such procedure will ensure proper mixing of the STABI ROAD solution with the soil.

Stabilization of soil with addition of cement and STABI ROAD

The soil should be scarified to the depth of 25 – 30 cm. Next, the cement should be evenly spread, with a slight time and distance advance in order to perform stabilization work on the same day, or before weather conditions deteriorate. The next stage is adding the STABI ROAD stabilizer with the application of one of the above-mentioned methods. Soil stabilization must be performed with the observance of the optimum humidity, with ± 2% tolerance.

7.5 Finishing work
In order to compact the stabilized layer, traditional construction methods should be applied. A vibrating roll should be used, followed by a steel or rubber-covered roll, applying pressure of over 10 tones, depending on the ambient temperature, after 0.5 ± 2 hours since mixing the solution. The speed of moving rolls should not exceed 3 km/h. While performing the compacting, one should remember of maintaining appropriate humidity, and – depending on needs – either sprinkle the soil, or mix it additionally.

After the completion of construction, the surface has to be sprinkled with water, which will make it smooth. If cement, lime or fly-ash is used, and the road is not to be covered with asphalt-concrete, cobble stone or concrete, in order for those additives to work properly, the standard procedure of sprinkling with water for the next 3 days has to be applied. Otherwise, surface cracking may occur, dust and lower durability.

If a vibration roll is applied, one should also remember to switch off the vibrations for the last two rounds, so that surface cracking is avoided.

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On the other hand, when preparing foundation for a more refined surface, or constructing an independent surface, one should bear in mind that the traffic on the first days will bring about further compacting of the road. Therefore, it is recommended to develop the road crown so that it final shape complies with the design. The wearing course can be developed through pressing gravel or grits 12/25 mm into the stabilized layer, laying the surface layer with double or triple bitumen on 16/25 mm grits, laying concrete slabs on sand or cement and sand under-layer, with the joints filled with sand and cement at the ratio of 1:3, or laying a surface of broken aggregate stabilized mechanically.

Before placing any bitumen layers directly on the stabilized soil, one should remove all the loose particles with a steel brush, and sprinkle the stabilized foundation with an asphalt binder, in the amount of no less than 0.5 kg/m2. The bitumen layer of the road surface can be made on a stabilized layer after reaching the required compression resistance after 7 days, or checked load bearing resistance with the VSS board, but no earlier than after 7 days.

Meeting the following two conditions (irrespective of traffic category) is a criterion of sufficient compacting of the soil:

condition 1
E1 / E 2 Q 2,2
E1 – deformation module at 1 deformation in the given scope in MPa
E2 – deformation module at 2 deformation in the given scope in MPa

condition 2
E1 & 100 MPa for the improved soil foundation
E2 & 120 MPa for the auxiliary foundation.
The above rules of conduct are just additional information for the use of the STABI ROAD stabilizer in road
construction, irrespective of the current technical and technological requirements for this industry.

8. Hygiene and Safety at Work
Principles of safe behavior when working with the STABI ROAD concentrate.

While working with the preparation, care should be taken, especially when it is handled in its concentrated form (strongly caustic properties – avoid contact with strong alkali, metals and their alloys).
One should remember to put on rubber boots, gloves and acid-proof glasses when handling the concentrate. Under no circumstances should one allow the concentrate to touch the skin or clothes. Direct contact with the skin causes burns and damage to the clothes.

Containers with the concentrate should always be opened in well-ventilated, well-aired rooms, preferably in the open air. Respiratory ducts should be protected by applying a respirator on the face. In the case of the concentrate spillage, the spot has to be washed with a large amount of water. The products should be stored in a dry and cool place, in sealed original containers.

All the necessary information concerning Hygiene and Safety at Work when handling STABI ROAD is to be found in: "Chart of Characteristics of a hazardous chemical substance STABI ROAD", which should be read prior to using the preparation.

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First aid

Skin - take off the clothes immediately and the skin should be rinsed profusely with a 3-5% solution of baking soda (sodium bi-carbonate) or 2-5% ammonia, and then with a large amount of cold water for approx. 10 minutes. The burned skin can also be sprinkled with magnesia MgO, or powdered chalk.

If the irritation or pain persist, a doctor has to be consulted. Stained clothes have to be washed prior to further use.

Eyes – wash the eyes with a large amount of water – keep washing for approx. 15 minutes. Consult an ophthalmologist.

Respiratory system - carry the victim to the open air, lay them down with outstretched legs, loosed the collar and belt, cover with a blanket. If a large amount of vapors has been absorbed, a short inhalation of ammonia vapor can be applied. If breathing problems persist, a doctor has to be called immediately.

Alimentary system - if the swallowing did not induce vomiting, clear water should be applied to rinse the mouth. Also, a 3% solution of baking soda, magnesia or egg whites can be used.

When vomiting is finally induced, more liquid should be provided and a doctor should be called immediately. Until medical help arrives, the victim should be kept in warm and quiet. Absolutely nothing should be given to the mouth of a person who lost consciousness.

Handling splashes and spills
Package punctured – seal the puncture with the use of an appropriate sealing material,
Securing a leak – first, the spill has to be secured from spreading to a larger area (apply absorbing agent in the form of absorbing socks)

Liquidation of spills – if a large amount of the liquid sills, it is recommended to neutralize it with one of the following: water solution of baking soda, slaked lime, powdered chalk, powdered dolomite or ammonia water,
after which absorbing mats should be applied.

Cleaning the spill area – after neutralization and collecting the liquid, the spot has to be washed with a large amount of water.

9. Appendices and related document

Standards:

- PN- 92/C – 04504 - Chemical analysis – Determining the density of liquid, solid and powdered chemical products
- PN - 89/C-04963 - Chemical analysis – Determining pH of water solutions of chemical products
- PN-88/B – 04481 - Construction soils. Testing soil samples
- PN – S - 02205:1998 - Car roads. Earthwork. Requirements and testing
- PN –S –96012:1997 - Car roads. Foundation and improved under-layer of cement-stabilized soil

"Chart of Characteristics of a hazardous chemical substance STABI ROAD"

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