



TERRASYSTEM® - Soil stabilization

Climate and CO2-neutral - ecologically harmless, economically



STEP

BY

STEP

TERRASYSTEM® ROADS



TERRASYSTEM®

<http://www.terra-3000.com> , e-mail: terra.system@aon.at



The **TERRASYSTEM®** was specifically developed for soil stabilisation. Through the addition of **TERRA-3000®** catalyst, we can activate treated soils toward this process.

TERRA-3000® does not react as a binder or oxidant and is an catalysator, which breaks up the adhering water film and leads to an irreversible agglomeration of the fine particles, substantially reducing the capillary rise of water. It allows better compaction of the treated soil and increases the desired density during the time of construction and later under traffic.



Planning, Analysis, tests and Execution:

Prior to any roads construction with **TERRA-3000®** some basic information must be acquired through examination in soil laboratory conducted through experienced personnel.

This is essential in order to obtain soil index property or the current status of this soil.

This will enable to conduct the appropriate works to ensure adequate soil improvement.

What to consider are: Analysis

**Analysis of the particle sizes (sieve curve),
and unified soil classification (SUCS or AASHTO)
and hydrometer analyse for clay (<0,002mm) %-content**

Natural moisture content (NMC)

Optimum moisture content (OMC, Proctor-value)

Determine the organic content (%) by loss on ignition test - must be < 5% of the soil.

Determine the pH value of the soil

Determine the Load capacity (Evd)

Producing Presscore with **TERRA-3000® (water storage test)**

**Without these identification numbers, no successful use of
TERRA-3000® is possible!**

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1. Preparation of the road

1.1. To add necessary material to reach the ideal sieve Curve

The goal is to achieve a soil mixture with the ratio of 1/3 gravel (2mm – 30mm), 1/3 sand (0,063mm – 2mm) and 1/3 < 0.063mm grain size (loam) – minimum 15% clay (<0.002mm) must be in.

External material to improve the mechanical performance of the soil e.g. Starch / stability (ballast-supporting grain), must be mixed with the local soil, and need to be added before the treatment with TERRA-3000® begins.

In the 1/3 gravel grain (2mm to 30mm grain size) in the treated layer, should be the maximum size of **30mm not be exceeded** (stone size)!

1.2 Stable lower layer (base soil)

Before using **TERRA-3000®**, a proper preparation is required. Make sure that the lower layer is compacted properly to ensure optimal and easy construction of the substructure, which shall be treated with **TERRA-3000®**.
and ...

.... the embankment on the lower level layer must be completely stable and solid -- also during traffic load. Otherwise it is impossible to compact the road substructure properly.

If the lower layer still not stable and solid, so it is recommended to use sheepfoot roller until sufficient stability observed.

1.3 Drainage

Ensure that the entire surface water can be drained out of the slope. Therefore, the road slopes on both sides have to have drainage trenches, which are deep enough to ascertain water drain away even under heavy rain.

The diameter of these trenches must be chosen wide enough, to drain water away even when heavy rain does not impede to flood away.

The points 1.1 to 1.3 are mandatory prerequisites to the application of **TERRA-3000®**.



2. Roads Sub layer Construction preparation and Treatment

2.1. Preparation of the layers of the road foundation

Use the grader to create the top layer, which in loose soil is about 35% higher than compacted soil.

In order to enable optimal soil stabilization, foreign material may need to be added according to the laboratory results (coarse-grained materials such as gravel, sand, clay, loam) to ensure a good one prerequisites for the use of **TERRA-3000®**.

If the soil is too moist or the mixing device does not chop well, we recommend mixing in a small amount of quicklime up to 2-3%. That will help to dry out the soil and enable better shredding. However, mixing in quicklime does not harm the results of the **TERRA-3000®** treatment.

2.2 Treatment substructure with TERRA-3000®

2.2.1 Preparation

Prepare the required quantity of **TERRA-3000®** solution by adding **TERRA-3000®** as much water as required to get the soil near to the Optimum Moisture Content (OMC).

How much water for the dilution of **TERRA-3000®** is actually required can be calculated from the Natural Moisture Content (NMC) in the soil **AND** the Optimum Moisture Content. Both values have previously been evaluated in laboratory.

Example: N.M.C. is 9%
O.M.C. is 11%

You could add 2% water to get the desired 11% moisture content.

Volume of soil : $1\text{m}^3 = x0,3\ 0,3\text{m}^3 \times 2\ \% = 0,006\text{m}^3$
= 6 liters / m² 30 cm thick

You take 6 liter water/m², add the required 0.05 litres **TERRA-3000®** and apply this quantity per m².



2.2.2 Calculation of Water

Calculate the proper quantity of solution needed by multiplying $m^2 \times$ litre solution, respecting the size of your tank car.

If the soil to be treated is more or less at OMC then use only 4 litres water for the dilution of the 0.05 litres **TERRA-3000®** pro m^2 to avoid overmoistening.

Do not use **TERRA-3000®** without deluding with minimum 1:20 until 1:40 with water, because it is too difficult to bring each soil particle in contact with **TERRA-3000®**.

2.2.3 Mixing Soil

START MIXING immediately after the start on sprinkling **TERRA-3000®**-solution in order to avoid that the surface soil is overmoistened.

Much better is the use of a modern special mixing mill with integrated Injection - "TERRA – TRAC" picture below



Proper mixing is of the utmost importance
no lumps - material must be all fine and homogeneous as possible

2.3 Addition of Coarse Material

Depending upon the kind of in-situ soil, latest before applying the **TERRA-3000®** solution, the addition of any borrowed material for the improvement of the mechanical strength/stability of the in-situ soil is carried out.

3. LEVELLING

Carried out with the grader, it has to be observed that the shape of the road is already at the time of construction more or less at right level in order to avoid the cutting into low level treated material in the final stage of construction.

The final level should have a gradient of 3-5% towards the sites of the road and shoulder, which should be treated in the top 100 mm too.



4. COMPACTION

Compaction starts immediately after the mixing in of the additive with a pneumatic or sheep-foot roller and should be continued during levelling with the grader.

If the rubber wheels or sheep-feet come out of the material – a sign of good compaction – the rolling is interrupted for the final levelling with the grader and continued with a flat roller.

Now the treatment of the base course layer of the road is terminated and should have a very smooth surface on the road as well as on the treated shoulder.



Sheep -foot roller



Pneumatic roller

5. Check soil compaction with the Dynamic Load Plate



Dynamic load plate test:
 rely on a high-performance dynamic load plate, which impresses with practical features and innovative technology across the board. In compliance with the user instructions of **TERRASYSTEM**, as well as a good compaction with the recommended equipment is a load capacity value from

Evd = 50 MN / m² (7250psi) to
Evd = 150MN / m² (21,756psi)

– long-term value by load through use, possible.



6. FINAL WORK ON THE ROAD

You have built now a high quality base course, which should be protected with a wearing course against abbreviation of the traffic.

6.1 Wearing Course

6.1.1 Single Stone Layer

It is possible to put a single stone layer of crushed rock (20 to 30 mm) on top before final compaction and roll it into the base course at the end of compaction. Such a layer will protect the base course to a high extent against damages when properly made, and will be an excellent basis.

6.1.2 Bitumen Layer with Chips

A surface coating with bitumen emulsion, covered with 4 to 12 mm chips (crushed little stones) after the treated soil has dried back once. Such a surface coating can also be applied directly on the dried back and dust free base course layer, if desired.

6.1.3 Asphalt concrete layer

The best wearing course is an asphalt layer. The asphalt layer should be 40 to max 60 mm thick. The treated soil must dry back once and must be dust-free. We recommend to use a primer before applying the asphalt layer.

6.2 Main Reasons for a Wearing Course

A base course should never be used as a wearing course, because it is designed to carry the load and not the abrasive effects of the traffic, therefore only a wearing course can prevent the abrasion of the base course. Otherwise, sooner or later the necessity of rebuilding the base course would arise.

Another very important reason for applying a wearing course is given if you have to deal with any clayey soil. Since clayey fines are no longer washed away, a treated layer becomes slippery when wet or dusty when dry. A wearing course can satisfactorily avoid this drawback and secure a long durability of the road. Due to the fact that already a very thin layer of asphalt can act as wearing course, in most cases the savings achieved pays off the costs for **TERRA-3000®** with "IN-SITU" soil.

7.1. General Information

The technical advice on the uses of our materials is given without obligation. The buyer is responsible for the application and processing of our products and the buyer is also liable for observing any third party rights. Technical data concerning our products are typical values.

TERRA-SYSTEM Bdstb. BetriebsgesmbH. does not provide any services (installation or supervising), so no legal claims of any kind or liability can be derived.