



TERRASYSTEM®

TERRA-3000®

IMPLEMENTATION GUIDE

1. PREPARATION OF THE ROAD

1.1. Addition of Missing Fraction

Aspire a mixture of soil in the ratio of:

- 1/3 clay and silt (<0.063mm), (minimum 15% clay in the clay and silt)
- 1/3 sand (0.0063 – 2mm)
- 1/3 stones (2-50mm)

Borrowed material for the improvement of the mechanical strength/stability of the in-situ soil must be added in before treatment of TERRA-3000® can start.

1.2. Stable Sub-Base

Before the TERRA-3000® can be applied, some preparatory work needs to be carried on the road:

Take care that the sub-grade and sub-base is properly compacted to allow building up the treated base course without problems.

AND

The embankment at the sub-base level is fully stable – under traffic there must be no movement of the embankment otherwise it would be impossible to compact the treated base course properly.

IF the sub-base is moving, compact it with a sheep foot roller until it is stable.

If the sub-base is too wet for compaction, you have two choices:

1. Let the moisture dry out and assist the drying process by turning (mixing) the soil,
2. OR mix into the soil enough lime hydrate to obtain a compactable stage. Lime hydrate used in this layer will not cause any adverse effects.

1.3. Water Drainage

Take care that the whole embankment can drain off the surface water. For this purpose, the road embankment should have ditches on both sides deep enough to take the water from a heavy rain.

The diameter of these ditches should respect the quantity of water to be expected after heavy rains. Avoid steep slopes in the ditches wherever possible. A ratio 1:3 will in most cases be flat enough to avoid soil erosion, but bear this possibility in mind, because a too high speed of the running off water can cause under washing of the road. If necessary, lay pipes from the ditch to the other side of the road. The pipes must be deep enough that the mixer does not destroy it.

In flat areas, the road should lie at least 40-50 cm above the surrounding land level to allow the water in the embankment to drain out.

Make sure that the down side of the embankment is stable and cannot be eroded by water, otherwise a wall must stabilise it.

If these suppositions don't exist and you don't have to touch the sub-base or sub-grade, then you can begin with the application of the TERRA-3000® on the road.

2. TREATMENT OF THE BASE COURSE

2.1. Preparation of the Base Course Layer

Prepare with the grader the proper level of the base course, which is with loose soil approx. 35% higher than with compacted soil.

Frequently the base course cannot be built with the in-situ soil only; and we should add borrowed material (coarse material, gravel sand or crushed stones) in the base course layer to flatten the sieve curve of gap-sized material.

- Here we start by ripping off the base course layer of in-situ soil or bring it back from the side, if we had it to put aside for previous compaction of the sub-base.
- Pulverise the material to the required depth of approx. 250mm. Lumpy soil cannot be treated.
- If the soil is too moist or if the mixing equipment does not allow good pulverisation, it is advisable to add 2 to 3% lime hydrate to dry out the soil and allow better pulverisation of the soil.
- Add lime hydrate into the base course only if otherwise you cannot get workable conditions

Prior laboratory tests have shown that in despite the possibility to control the shrinkage property of the in-situ soil in a high extent, addition of lime may reduce the water resistance of the treated soil. However, if there is no other possibility, this drawback is outweighed by the advantages of the treatment with TERRA-3000®.

The soil is now ready and prepared for the treatment with TERRA-3000®.

2.2. Treatment of the Base Course with TERRA-3000®

2.2.1. Preparation

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

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

Example: NMC is 12%

OMC is 14%

You could add 2% water to get the desired 14% moisture content.

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

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

If the soil to be treated is > or < at OMC then use only 4 litres of water for the dilution of the 0.05 litres of TERRA-3000® per m² to avoid over moistening. 4 litres of solution per m² increases the moisture content in the soil approx. 1%.

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

2.2.2. Calculation of Water

Calculate the proper quantity of solution needed by multiplying m² x litre solution, respecting the size of your tank car.

2.2.3. Mixing Soil

Start mixing immediately after the start of sprinkling TERRA-3000® solution to avoid the surface soil becoming over moist. It is much better using a modern mixing mill with integrated injection.

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, 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, observe that the shape of the road is already at the right level to avoid 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 100mm too.

4. COMPACTION

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

When the sheep foot roller 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.

At this stage, the levelling blade of the grader is turned backwards to “shave” the surface for fine-tuning of the surface.

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



5. FINAL WORK ON THE ROAD

A high-quality base course has now been built, which should be protected with a wearing course against abbreviation of the traffic.

5.1. Wearing Course

There are different wearing courses possible.

5.1.1. Single Stone Layer

It is possible to put a single stone layer of crushed rock (20 to 30mm) on top before final compaction and roll 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.

5.1.2. Bitumen Layer with Chips

A surface coating with bitumen emulsion, covered with 4 to 12mm 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.

5.1.3. Asphalt Concrete Layer

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

5.2. 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, 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 need 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. A fact is that a very thin layer of asphalt can act as a wearing course, in most cases the savings achieved pays off the costs for TERRA-3000® with IN-SITU soil.

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