

Flood Embankments Dykes and Dams Constructions with TERRA-3000®



Seasonal floods are belonging to natural chains of events upon rivers.

Heavy rainfall events or snow melts can constitute flood waves.



**For being a flood catastrophe, it is only
after human values are concerned.**



**In the course of the ongoing land use,
were always larger flood hazards areas
are populated.**



Thus, the threat of flooding is escalate!

Flood dams or dikes are usually made of a sand core, what is covered of a one to two meter thick layer of cohesive materials such as clay / loam.



Grass plants prevent erosion and increase the stability of the constructions.

**Flood dams and dikes
serve to avert temporary hazards
such as flood or storm flooding.**



The dyke/dam height depends on the particular landscape and the flood risk.



The land side of the dam should have a Dyke-Defense-Way. On this one you can carry, by an crevasse, sandbags and defense arrangements.

A crevasse is a failure of a dam or a dyke.



A dam break is unfolding by hydrostatic pressure and the softening of the soil material.

The shear stress pushes the softened material away horizontally.

Characteristic of a dam break is that a small leak increased rapidly.



More and more water flows over the dam, destroy it further and there is a chain reaction .

Threatening a dam break, it will attempt to strengthen him with stones, textile materials and sandbags



or poured earth material for weight on it.

Animals can endanger dams, by relatively simple digging into the earth material to build their burrows and thus undermine the dam



The resulting increase in attack surface of the water macerate the dam and make the soil unstable.

The resulting insights of the dam-related problems are therefore geotechnical.

The Geotechnical Engineering recognizes several methods by which the physical properties of soils can be positively influenced.

One of these methods, which has been proven, especially in road construction and earth work, is the soil stabilization with



TERRA-3000®

The soil stabilization with TERRA-3000® improves the fitting ability and compressibility of cohesive (cohesive) clay loam soils.



This sustain a long-term sustainability, durability, volume stability as well water resistance and frost resistance achieved!

The ground stabilization with TERRA-3000®
based on an electro-physical process:

Adhesive film of water in the soil material is dissolved and thus prepared for ion exchange

Mutual repulsion effect of the soil material is eliminated by changing the electrical charge, which the atoms can move closer together

With adequate compaction, the material is agglomerated and the capillary action adjourned

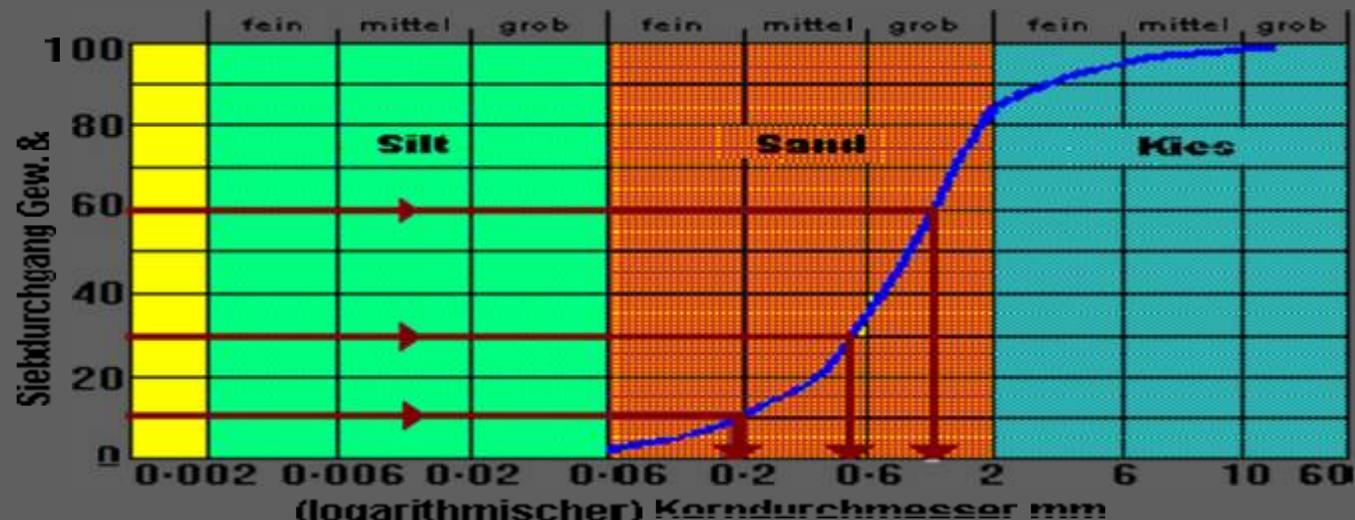
**Result: firm and solid, freeze proof, broad waterproof,
In this state irreversible soil material.**

Development & Installation - TERRA-3000®

Soil analysis by sieve analysis of the to be treated soil.

It requires at least a clay content ($<0,002\text{mm}$) of 15%!

Optimal is 30% loam ($<0,063\text{mm}$), 35% sand ($0.063\text{-}2\text{mm}$)
and 35% gravel ($> 2\text{mm}$)



The addition of TERRA-3000® additive to achieves a optimum compression for high densities.

The moisture of the soil material, before compaction, should be near the OMC (optimum moisture content) value.

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Bring soil material mix (loam, sand, stone) with more than 15 % clay (<0,002mm) .

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**Crush soil material and rocks
to produce support grain
(gravel) by Crasher.**



**Bring the TERRA-3000
working solution.**

Development & Installation - TERRA-3000®



Mixing TERRA-3000® and soil material even by mill or crusher.



Produce fine level by grader.

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High compacting the soil material consistently , with minimum 10 Tons on the roller, by Sheep foot roller without vibration!

The heavier the rolling elements the better the stabilization and solidification of the soil material by TERRA-3000® ! Allow to dry 3 days & the under floor is completed!

Development & Installation - TERRA-3000®



At a special composition of the fill material of the dam top, according to the TERRA-3000®, heavy traffic is possible !

A track construction of any kind, is possible through the ground stabilization with TERRA-3000® and the correct soil composition!

What makes the soil stabilization after the TERRA-3000® so interesting for dyke- & dam construction, is the relatively simple, time-saving and cost-effective design and after all the very stable & efficient result!



A softening of the dam body or the stabilized upper layer of the dam during flood, is by the interruption of the capillary & by arriving of a k_f - value of 10(-10) largely eliminated

Construction Methods

Basically two methods for dam constructions after the TERRA-3000 offering themselves.

For smaller dams, the dam can be built up to a dam body, made up of several 30 cm soil-TERRA-3000®-layers, piece by piece.

The base of the fill should be based on natural ground without Humus! The respective layer, treated with TERRA-3000®, is applied to the dam-layer soles and should be compacting with 10 tons minimum on the roller after every layer. Compact constantly! The higher the compression, the higher the CBR values can be achieved!

The use of a Sheep foot roller, about the kneading of the clay material, is an advantage.

The first layer, the dam-layer sole, should be lay 30cm minimum under the at the dyke reaching stratum. With this, a possible undercutting of the dam body is prevented.

Should the dam be exposed to higher loads by heavy traffic, so we construct the dam-top-layer from 30% loam-contingent : 35% sand-contingent : 35% gravel contingent.

In normal traffic, this is not necessary!

Construction Methods

For larger dams with relatively high bulk cubature, the complete dam can be covered with one or, depending on the requirements, two layers of each 30cm Soil-TERRA-3000®-Mixture. The dam core may consist of untreated cohesive embankment fill material, which should be well compacted. In every case, the dyke-base should consist of a TERRA-3000®-Soil-Layer and are applied as described above!

If this is not possible, the dam-tongue should be constructed much deeper as the adjacent upper soil-layer which reaches the dam. With that a possible undercutting of the dam will prevent.

The development of the stabilizing layer or layers of this , is identical to the previously described procedure , except that the dam with the stabilized soil will be irreversibly coated and sealed !

For reasons of aesthetics and adaptation in the landscape, the embankment with a layer of topsoil must be covered with appropriate planting. In the case of using a Sheepsfoot-Roller, the resulted sheepfoot pattern in the stabilized layer, will used as an armature for the planting.

The TERRA-3000® for soil stabilization is Trendsetting!

The bearing capacity of the soils, which are treated after TERRA-3000® exhibit a higher stability and sustainability, as with lime-cement- treated soil mixture only.

A 25 to 30cm loam / clay-sand-gravel soil layer, after the TERRA-3000® reach a capacity of $\geq 100 \text{ MN} / \text{m}^2$.

The capillary action of the soil is extensive interrupted and show relatively weather-and waterproof .

A soaking and freezing is no longer possible .

The optimally and properly treated soil with TERRA-3000®, is agglomerated and remains irreversible in this state .

The like this treated soil got a water permeability of kf- value 10 (-10) and is water-impermeable.

Dams and dykes, which are armed with TERRA-3000®, are more resistant against floods!

By the treatment with TERRA-3000® and the high compacting of the earthworks, a relative impermeability is created.

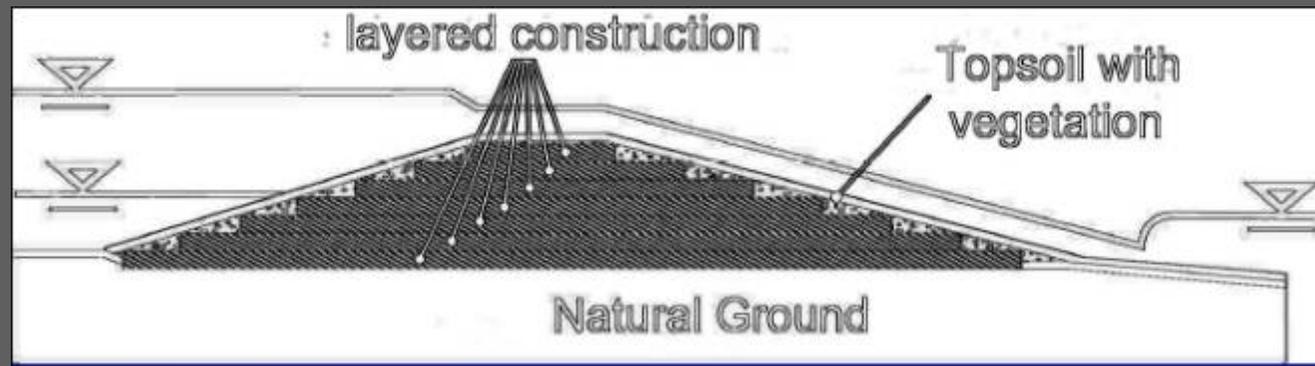
A rapid maceration is decelerated or even prevented .

Dams & Dykes are so much ruggedized against floods!



Conclusion:

Dams and dykes which are attached or built with TERRA-3000® resisting floods better! Treatment with TERRA-3000® and the high compaction ensures a higher relative impermeability of the earthworks.



Layered Construction with TERRA-3000®

A rapid softening is delayed or prevented.
The dams and dykes are stable and withstand the flood for longer period of time
An enormous environmental damage in local economy can be prevented!

TERRA-3000® is nonpolluting!



The determination of the biodegradability of the product Sample TERRA-3000® was named after the directive OECD Guidelines for Testing of Chemicals inherent Biodegradability: Zahn-Wellens/EMPA Test 302 B. Adopted 17th July 1992 and after German unification procedures for water, wastewater and sludge investigation, testing procedures with aquatic organisms (Group L), determination of the biodegradability, static test according to DIN EN 29888 (L25).



TERRASYSTEM®

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