Climate and environmental protection with Alphasoil®-06

Co² balance and greenhouse gas footprint

In construction sector climate related and environmental aspects such as reduction of Co2 emissions and saving of natural and monetary resources are of growing importance!

Everyone professionally engaged in road construction knows about the immense quantities of building materials processed such as gravel, cement, concrete, additives, geo-textiles etc.

The consumption of these materials together with the required energy and related CO2 emissions are playing a huge role in destroying climate and environment.

Alphasoil®-06 construction process conserves natural resources by using existing soil which is for conventional construction declared as "waste product" or as "useless“. Doing so Alphasoil®-06 also reduces the output of emissions.

Cohesive materials such as loam and clay that are not applicable for conventional road construction because of its swelling and shrinking behavior can be refined to an extremely stable and sustainable building material by Alphasoil®- 06.

Some examples:
Preface on Co² emissions of the cement industry:
A problem that is becoming more acute as the greenhouse effect increases is the high emission of carbon dioxide by the cement industry. The cement industry is one of the main emitters of greenhouse gases that cause global warming. Worldwide, 4.1 billion tones of cement are produced annually, containing an average of about 60 % CaO (calcium oxide). Calcium oxide is traded under the name "quicklime" or "burnt lime" in impure form. It converts with water under strong heat development to calcium hydroxide. Every time water is added to calcium oxide, lime water is formed which reacts alkaline. Thus, even with optimum process control, the release of the carbon dioxide bound in the lime results in an emission of at least three billion tones of Co² or about 6 to 8 % of the annual Co² emissions. ⁴
Cement
Cement is an inorganic and non-metallic building material as a binder. It hardens through the chemical reaction with water (hydration). To produce building materials such as lean concrete (in-situ soil and cement) for stabilisation, so-called added water is added to the cement.

The curing time to achieve the final compressive strength and load-bearing capacity takes up to 28 days for cement stabilization.

Cement is strongly alkaline. Worth mentioning is the high pH value, up to >12pH strong lye. Alkaline aqueous solutions with a pH value of more than 10 are more corrosive than many acids. It is not without reason that the manufacturer Cemex recommends wearing protective equipment consisting of safety glasses, mouth protection, protective gloves and safety shoes when processing cement.

Cement is therefore alkaline/basic and therefore this type of soil stabilisation cannot be considered environmentally conform. It gets into the environment and thus endangers the ground water. Alkaline as well as basic cement soil stabilization in water and nature protection areas should be avoided and is generally not environmentally compatible.  

| Labelling according to Regulation (EU) No 1272/2008 (Cement) |
|---------------------------|---------------------|
| **Danger pictograms**     | ![Danger pictograms] |
| **Signal word**           | **Danger**          |
| Hazard notes              | H315 causes skin irritation |
|                           | H318 causes severe eye damage |
|                           | H335 may irritate the respiratory system |
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**Alphasoil®-06**

Alphasoil®-06 catalyst concentrate is a chemical product of monomeric and polymeric amines and is produced by synthesis and reaction, resulting in a very low and hardly measurable Co² emission during production. Due to these small quantities (concentrates) the Co² emission is negligible and hardly worth to be considered.

The process of soil stabilization is purely physical. This means that the ion exchange effect caused by the catalyst, the loosening of the adhesive water film of the soil particles (colloids) and the setting of the optimum moisture content according to Proctor (OMC, Optimal Moisture Content) as well as the use of an optimum compaction device (only static, not dynamic) guarantee a higher compaction and thus the expulsion of the colloid pore water and the closing of the capillary is possible. As a result, no more water penetrates into the stabilized layer, swelling in wet conditions or shrinking in dry and frosty conditions in the stabilized layer is not possible.

The final stability and load-bearing capacity of the substructure is achieved after the final compaction process, depending on the weather conditions, from 3 days ventilation time of the soil material. Thus the layer is waterproof and sustainably stable.

Alphasoil®-06 is a chemical product, which is surface-active and allows an irreversible agglomeration of the fines- and fine-particles of the treated soil.
Climate and environmental protection with Alphasoil®-06
Co² balance and greenhouse gas footprint

**Alphasoil®-06**
The environmental friendliness of Alphasoil®-06 is confirmed by certified test methods, i.a. according to the guideline OECD Guidelines for Testing of Chemicals "Inherent Biodegradability", proven by accredited institutes in Germany. In addition, analysis results from accredited institutes in Germany have shown that the product Alphasoil®-06 in the added admixture to the soil does not change the assignment values/criteria of the investigated LAGA eluate parameters.

Alphasoil®-06 is completely environmentally friendly and ecologically harmless. During the development, the utmost care was taken to ensure that the used chemicals are environmentally friendly and that no contamination of soil, water or air can occur. The product is not flammable and does not release toxic fumes. It can therefore be stored, used and processed everywhere with the usual care as a technical chemical.

Through synthesis and reaction for production, this results in a very low Co²-print. There is no negative Co²-balance due to reaction of the catalyst during processing and application.

Alphasoil®-06 can generally be characterized and regarded as relatively Co²-neutral.
Climate and environmental protection with Alphasoil®-06
Co² balance and greenhouse gas footprint

Co² to Cement:
The production and reaction of 1 ton of cement as a hydraulic binder currently releases between 0.65 and 0.95 tons of CO₂, depending on the efficiency of the production process, the fuel used and the type of cement. In total, this results in an average greenhouse gas potential of 587 kg CO₂ equivalents per ton of cement in Germany, according to the German Cement Works Association (Verein Deutscher Zementwerke).

Since in some various worldwide studies values of up to 1 ton of CO₂ per ton of cement are given, we have assumed an average value of 0.8 tons of CO₂ per ton of cement for our calculations.
Climate and environmental protection with Alphasoil®-06

Co² balance and greenhouse gas footprint

Co² to Alphasoil®-06:
The production of liquid Alphasoil®-06-concentrate by synthesis and reactions as catalyst and auxiliary agent releases an inconsiderable amount of CO²; here with 100 kg CO² per 1000 liters Alphasoil®-06-concentrate assumed and indicated.

There is no CO² emission through reaction during processing and catalysis.
Climate and environmental protection with Alphasoil®-06

Co² balance and greenhouse gas footprint

Assumed calculation for cement stabilisation compared to Alphasoil®-06 stabilisation:

For the cement stabilisation of a road substructure of 1000m x 6m, ≈20kg/m² to ≈60kg/m² cement is required, depending on the soil composition and soil type. Assuming an average value of 30 kg/m² cement, this results in 180 tonnes of cement for 6000m² of road subgrade that is to be stabilized.

Co² imprint cement:
The production and reaction of 180 tons of cement x 0.8 tons of CO2 thus represents a GHG footprint of 144 tons of CO2 greenhouse gas emissions.
Climate and environmental protection with Alphasoil®-06

Co² balance and greenhouse gas footprint

For the liquid Alphasoil®-06 stabilisation of a road substructure of 1000m x 6m, 0.036ml/m² to 0.05ml/m² Alphasoil®-06 catalyst concentrate is required.

With an assumed average value of 0.04ml (or 40g), 240 liters (or 240kg) of Alphasoil®-06 concentrate for 6000m² of a to be stabilized road substructure, by a soil composition with at least 15% to ≈30% pure clay (<0.002mm grain diameter).

Co²-imprint of Alphasoil®-06 concentrate:
The production of 240 liters of Alphasoil®-06 concentrate x ≈24kg CO2-emissions, therefore, represents no or a very low CO2- greenhouse gas emissions and is relatively CO2 neutral. Therefore Alphasoil®-06 offers worldwide an environmentally friendly possibility for infrastructure design.
Climate and environmental protection with Alphasoil®-06

Fine dust emission comparison Cement & Alphasoil®-06 during processing in practice

In practice, cement-based soil stabilization involves the problem of dust and fine dust emissions due to its powder form and the way it is processed with mixed milling machines on construction sites. It is true that more or less dust-reducing equipment can be used now. As a rule, this problem already exists due to the mechanical application and mechanical incorporation. Dust and fine dust emissions are therefore generally unavoidable with cement.
Cement is strongly alkaline. Worth mentioning is the high pH value, up to $>12$ pH strong lye. Alkaline aqueous solutions with a pH value of more than 10 are more corrosive than many acids. Reaches the environment during processing and thus endangers the groundwater. It is not without reason that the manufacturer Cemex recommends wearing protective equipment consisting of safety glasses, mouth protection, protective gloves and safety shoes when processing cement.  

What is the pH-value?

Mixed cement is an aqueous solution that is strongly alkaline because it has a high pH value. But what does this value actually mean? The general definition is: The pH value indicates the concentration of H$^{3+}$ ions in the water. If the solution contains many of these positively charged ions, then it is an acid. If, on the other hand, negatively charged hydroxide ions (OH$^{-}$) predominate, then it is an alkaline solution - i.e. a caustic solution.
Climate and environmental protection with Alphasoil®-06

Alphasoil®-06 soil stabilization is based on liquid soil stabilization or soil consolidation. The liquid Alphasoil®-06-catalyst is also applied and worked in by mechanical spraying equipment or integrated injection in mixing and crushing machines. As a rule, the liquid Alphasoil®-06 working solution does not emit any dust and fine dust during practical processing, because the dust is bound by the liquid and cannot escape into the air. This also has an environmentally friendly aspect.
Climate and environmental protection with Alphasoil®-06

Co² balance and greenhouse gas footprint

Depending on soil analysis the locally available cohesive soil material can be used by Alphasoil®-06-System in addition with sand or feeding of loam/clay according to the results of analysis.

This eliminates the drain and bringing transports and the excavation for the exchange of soil material with crushed grain as it is necessary within conventional road construction according to the “Mc Adams” process.

The reduction of truck transportation and associated fuel and time savings, lead to an enormous reduction of CO2 emissions.
Climate and environmental protection with Alphasoil®-06
Co² balance and greenhouse gas footprint

Supposing a road width of 10 m, an excavation of 70 cm depth and a road distance of 10 km you will have to dredge and carry away about 70,000 m³ of ground.

Presuming the specific weight of the dredged ground is 1.8 (lower limit) this will result in about 126,000 tons of material!

A four-axle dump truck with 38 tones of payload and a consumption of 40 liters Diesel/100 km required for the removal of excavation 3316 cartloads.

The distance of 20 kilometers per load, resulting 66,320 km and a Diesel consumption of 26,528 liters!

For the delivery of gravel that are 3,316 cartloads again!
Using Alphasoil®-06-system and working with local soil we are able to eliminate this gigantic complexity.
A huge saving in cost, time and emissions.

The rocks in the local existing soil themselves can be smashed into the required amount of gravel by stone-crusher equipment which is necessary for soil stabilization with Alphasoil®-06.

This protects another natural resource, or makes locally existing resources available!
Climate and environmental protection with Alphasoil®-06 contaminated soils

Another aspect in many projects is that contaminated toxic local soils must be deposed in special landfills. To assure pollutants will not be washed out into ground water. This appears to be very expensive!

By treating the soil with Alphasoil®-06-System the soil layer becomes agglomerated (made into one piece, mono-block). This assures that pollutants are not washed out and remain in the layer without detriment to the environment, fixed and immobile!
Another possibility is to manufacture building materials from so-called "sieve scrap"-waste materials from quarries and clay pits which contain cohesive material (loam/clay) and gravel.

In most cases, these materials are deposited on huge mining waste heaps and are assumed largely worthless for the construction industry.

Alphasoil®-06 is able to produce a high-quality building material from this sieve-scrap. This may contribute to the resources, time, emissions and money-savings and therefore enabling us to protect our environment!

Example for road construction in the central mixing processes with Alphasoil®-06:
Where the locally available earth & soil material is composed unfavorably for the Alphasoil®-06-System a central mixing processes may be used. At first glance this process seems very complicated. But it holds some very serious advantages in terms!

Existing overburden material or soil materials, that only in certain zones appears, can thus optimally and easily to a consistent quality building materials are mixed together.

The thus-produced building material will be coated by a paver on the stable mature soil and can be directly highly compressed.

Through the resulting subgrade, the water can derived from the later finished road.

This is a very important aspect which should be in principle used at every road-construction!

Furthermore, this method saves time, because the breaking of the gravel, the application of Alphasoil®-06 and the mixing process at the local site is completely eliminated.

A continuous, rapid construction and a high-quality effect is the result.
Climate and environmental protection with Alphasoil®-06
Generate Building Materials

Alphasoil®-06- central mixing processes with mobile mixing unit:

Gravel, loam / clay and sand will be delivered separately.

Subgrade, routing & drains were previously completed.

Fractions are mixed in the composition of optimal cooperation with Alphasoil®-06 to a mountable construction material.

After the coating of the building material, start to compact continuously with a 15 tons sheep-foot-roller.

The fully finished Alphasoil®-06-material will applied by an paver to the subgrade or by truck on a dyke / dam.

The finished Alphasoil®-06 - building material is delivered.
Climate and environmental protection with Alphasoil®-06
Landfills, Dykes & Dams

A central-mixing-process is an advantage for the dyke- and dam buildings and the edge sealing's of landfills, where the local soil material is not optimally composed for soil stabilization with Alphasoil®-06. Most of the soil fractions which are close to the coast, can be very salty and those are hygroscopic.

All soils that have a salt content of about 4% are not suitable for soil stabilization. Let's stick to the topic of dyke construction and its aspects in environmental technology:

Example of a dam sealant after Alphasoil®-06
Climate and environmental protection with Alphasoil®-06
Dykes & Dams

Global warming leads worldwide to more and more low-pressure systems and the numbers of storms will escalate in the future!

A race between man and the weather has begun. A change of views about coastal protection, flood embankments as well as the dykes is needed urgently!

A dam break is unfolding by hydrostatic pressure and the softening of the soil material. The shear stress pushes the softened material away horizontally.

Alphasoil®-06 prevents the erosion of the dam body and so makes it fairly stable and insensitive to water!

Most floodings remain only a certain time before they flow back again.

If we increase the stability of a dam to hold just about double the existing flooding time the environment is spared a catastrophe!
Moreover Alphasoil®-06 is able to prevent from cracking of the dam face material in severe drought which is the most common traditional problem of enormous impact.

Through a higher stability of dams treated with Alphasoil®-06 damage to the dam body is prevented and therefore persist over a longer period.

The soil stabilization with Alphasoil®-06-System for the dyke and dam construction is interesting because of the relatively simple, time-saving, cost-efficient and reliable results!

A softening of the dam body during flooding is largely eliminated by the disruption of the capillary action and a reached Kf value of $10^{-1}$!
Climate and environmental protection with Alphasoil®-06
Dykes & Dams

Conclusion:
Dams and dykes which are attached or built with Alphasoil®-06-System resisting floods better!

Treatment with ALPHASOIL®-06 and the high compaction ensures a higher relative impermeability of the earthworks.

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!
Climate and environmental protection with Alphasoil®-06

Disposal Sites

The same advantages as previously described for ground stabilization with Alphasoil®-06 also arises in the design and construction of landfills or disposal sites. That for the edge-seal of a landfill necessary cohesive soil material will be made into a material that is enormously stable, impermeable to fluids and largely crack-resistant.

This leads to the following advantages for landfill:

Through the injection of Alphasoil®-06 and gravel to edge-sealing-material, a much higher bearing capacity on the later finished edge-seal can be reached! This prevents leakage occurring in a sedimentary setting under the edge seal. The static pressure can be intercepted!

Due to the relative elasticity of material treated with Alphasoil®-06 sediment subsidence's can be bridged.

Cracking is substantially eliminated!

The pollutants in the landfill therefore can not reach the ground water and are controlled by the landfill operator. Environmental damage will be avoided!
Climate and environmental protection with Alphasoil®-06

About our Product

The innovative, modern ground stabilization with Alphasoil®-06, combined with cohesive soil materials is an environmental friendly and highly efficient procedure and may also be used as complementary action together with traditional construction methods.

Alphasoil®-06 is completely environmentally compliant!

Alphasoil®-06 is in use completely safe on the environment.

Alphasoil®-06 is a natural and environmentally compatible product for soil stabilization.

Each soil has the natural property to turn back to stone. It needs a very long time for this process and high pressure. With the addition of Alphasoil®-06, this process can be accelerate.

The soil is in its behavior in terms of capacity and density permanently improved.
Climate and environmental protection with Alphasoil®-06

About Our Product

Alphasoil®-06 affects the pore and micro pore area of the soil surface. It breaks the adhesive water film around the fine and ultrafine particles and acts on the ground electro-physical ion exchange.

This leads to an irreversible agglomeration of the fine- and extremely fine particles of the treated soil. The decrease in permeability by closing the capillary, leads to a strongly increased resistance to water of the so treated soil, which in turn is the source for shrinkage effect. Due to the greatly reduced water absorption capacity of the so treated soil, a softening of the sub grade is prevented. Because of this decreased capillarity and also frost resistance is increased.
Climate and environmental protection with Alphasoil®-06

For Our Partners

**Partners**

The successful introduction of an innovative and pioneering technology to a large extent depends on the serious attitude of all involved partners.

If all parties involved bring in commitment to the technology as well as enthusiasm and a professional behavior, this besides the most common aim to make it an profitable business will guarantee an overall success.

Regarding the practical application of Alphasoil®-06 we are always interested to receive serious suggestions so we will be able to assure ongoing improvement and reliable proposals!

Source of supply listing:
1 - https://rpoth.at/pastwork/zement_klimaschutz.shtml Oktober 2009
2 - VDZ / IBU (2017): Umwelt-Produktdeklaration (EPD) Durchschnittlicher Zement Deutschland
3 - https://www.chemietechnik.de/klimabilanz-der-zementindustrie/ Chemietechnik, Fachinformation für Entscheider