
DOĞAL BETON

FOUNDATION

Enzymes as a Soil Stabilizer

The enzymes are absorbed by the clay lattice, and then released upon exchange with metals cations. They have an important effect on the clay lattice, initially causing them to expand and then to tighten. The enzymes can be absorbed also by colloids enabling them to be transported through the soil electrolyte media. The enzymes also help the soil bacteria to release hydrogen ions, resulting in pH gradients at the surfaces of the clay particles, which assist in breaking up the structure of the clay.

An enzyme is by definition an organic catalyst that speeds up a chemical reaction, that otherwise would happen at a slower rate, without becoming a part of the end product. The enzyme combines with the large organic molecules to form a reactant intermediary, which exchanges ions with the clay structure, breaking down the lattice and causing the cover-up effect, which prevents further absorption of water and the loss of density. The enzyme is regenerated by the reaction and goes to react again. Because the ions are large, little osmotic migration takes place, and a good mixing process is required.

Compaction of aggregates near the optimum moisture content by construction equipment produces the desired high densities characteristic of shale. The resulting surface has the properties of durable "shale" produced in a fraction of the time. (Millions of years required by nature). The idea of using enzyme stabilization for roads was developed from enzyme products used for treatment of soil to improve horticultural applications. A modification to the process produced a material, which was suitable for stabilization of poor ground for road traffic. When it is added to a soil, the enzymes increase the wetting and bonding capacity of the soil particles. The enzyme allows soil materials to become more easily wet and more densely compacted. Also, it improves the chemical bonding that helps to fuse the soil particles together, creating a more permanent structure that is more resistant to weathering, wear and water penetration.

According to a study report by the University of Minnesota

Natural Crete is one of the world's finest products for road stabilization.
Natural Crete is a unique, soil-stabilizing product with the potential to significantly reduce your overall costs for road construction. With Minimal Maintenance Natural Crete Roads are known to last 20+ years.

It is a non-toxic formulation of enzyme-rich materials that is manufactured through a natural fermentation process using only sugars and other 100% natural, organic compounds.

When mixed with water and applied during compaction, Natural Crete acts upon the soil's organic fines through a catalytic bonding process producing a strong cementation effect. The result is a durable and water-resistant mix that can be used in any climatic environment as a sub-base. Natural Crete continues to cure for 6-12 months after road installation, even though it cures sufficiently in as little at 72 hours to allow use by normal slow moving traffic (25 MPH – 40 kph), depending on the circumstances at the site, such as weather etc.

WHAT IS NATURAL CRETE?

Natural Crete is a complex non-bacterial, concentrated and organic multi-enzymatic formulation formulated for sub base stabilization, in road construction.

Natural Crete is produced through enzyme-induced fermentation of natural sugars and natural plants.

Natural Crete is 100% natural and environmentally safe.

Natural Crete was developed and has been proven through many years of field testing, Natural Crete is sold in a highly concentrated 5 gallon container for easy shipment.

Average dilution is 1 liter of Natural Crete to 2000 liters of water. The dilution is based on the environment and depends on humidity, temperatures and the makeup of the indigenous soil.

The Natural Crete cementation action increases the soil Load bearing characteristics by promoting a closer binding of soil particles.

Natural Crete increases the load-bearing capacity of the soil and reduces the plasticity and permeability.

Natural Crete continues to cure for 6-12 months after road installation, even though it cures sufficiently in as little as 72 hours for use of normal traffic, depending on the circumstances of site, such as weather, etc.

HOW DOES NATURAL CRETE WORK?

NATURAL CRETE is absorbed by the clay lattice, and then released upon exchange with metals cations. NATURAL CRETE has an important effect on the clay lattice, initially causing them to expand and then to tighten. NATURAL CRETE can be absorbed also by colloids enabling them to be transported through the soil electrolyte media. NATURAL CRETE also helps the soil bacteria to release hydrogen ions, resulting in pH gradients at the surfaces of the clay particles, which assist in breaking up the structure of the clay.

NATURAL CRETE is by definition an organic catalyst that speeds up a chemical reaction, that otherwise would happen at a slower rate, without becoming a part of the end product. NATURAL CRETE combines with the large organic molecules to form a reactant intermediary, which exchange ions with the clay structure, breaking down the lattice and causing the cover-up effect, which prevents further absorbtion of water and the loss of density. NATURAL CRETE is regenerated by the reaction and goes to react again. Because the ions are large, little osmosis migration takes place, and a good mixing process is required.

Compaction of aggregates near the optimum moisture content by construction equipment produces the desired high densities characteristic of shale. The resulting surface has the properties of durable “shale” produced in a fraction of the time. (Millions of years required by nature). The idea of using NATURAL CRETE stabilization for roads was developed from enzyme products used for treatment of soil to improve horticultural applications. A modification to the process produced a material, which was suitable for stabilization of poor ground for road traffic. When NATURAL CRETE is added to a soil, it increases the wetting and bonding capacity of the soil particles. NATURAL CRETE allows soil materials to become more easily wet and more densely compacted. Also, it improves the chemical bonding that helps to fuse the soil particles together, creating a more permanent structure that is more resistant to weathering, wear and water penetration.

NATURAL CRETE APPLICATIONS

In addition to creating a new and better way of building and maintaining roads, Natural Crete is being used successfully in many applications and various construction of :

Mine Leach Pads
Ponds
Securing Foundations
Landfill Liners
Runways
Manufacture of Bricks and Building Blocks
Lake Beds
Asphalt Reclamation

Wherever there is a need to increase the load-bearing capacity of the soil and to reduce its Plasticity and Permeability.

Natural Crete provides additional advantages to road builders, communities and the environment by being non-toxic, non-corrosive. It will not harm humans, animals, fish or vegetation and it is biodegradable.

ECONOMIC ADVANTAGES

Uses existing soil for road stabilization. All Soil types can be used for building roads as long as the soil has 15% to 20% cohesive fines passing a 200-mesh screen.

Provides an inexpensive way to increases the load bearing capacity.

10 gallons (37.85 Lt) of Natural Crete builds 1 KM per day, of sub base 6 inches (15.24 Millimeters) deep, 25 feet (7.62 meters) wide.

Less cost of labor uses fewer workers (Total 5 on a Team). 1 “Excavator Operator”, 1”Grader Operator”, 1 “Water Tank Operator”, 2 Compactor Operators (1 “3 Rubber Tire”, 1 “Steel Drum”). Multiple teams used on projects for additional savings.

Requires standard, readily available equipment. Excavator, Grader, Water Tanker and Compactors

In most cases (90%), Natural Crete works with the indigenous soil - no need to pay for material, and no cost to transport materials.

Easy build, 1 crew can build 1 KM, 25 feet (7.62 meters) wide of sub base within 72 hours. Natural Crete continues to cure for 6-12 months after road installation, even though it cures sufficiently in as little as 72 hours for use by slow moving traffic, depending on the conditions at the site, such as weather, etc.

With minimal Maintenance – 20 plus years of life span

NATURAL CRETE IS VERSATILE!

NATURAL CRETE ™ is used to reclaim and reuse asphalt.

NATURAL CRETE ™ is used to stabilize roads inside the deepest mines to the highest mountains.

NATURAL CRETE ™ is used to seal ponds for everything from pure spring water to toxic waste.

NATURAL CRETE ™ is used to stabilize river and stream embankments.

NATURAL CRETE ™ is used to stabilize hillsides to prevent slides.

NATURAL CRETE ™ is used to build secondary runways.

NATURAL CRETE ™ is used to make bricks and blocks for building construction.

NATURAL CRETE ™ is used to line lake beds.

NATURAL CRETE ™ is used to line leach pads.

NATURAL CRETE ™ is used to secure foundations.

NATURAL CRETE ™ is used as a base under cobblestone roads and sidewalks

NATURAL CRETE ™ is used to build dams.

NATURAL CRETE ™ is used from the frozen north to the hot south with wet or dry climate.

NATURAL CRETE ™ is used wherever there is a need to increase the load-bearing capacity of the soil and to reduce its plasticity and permeability.

PROPERTIES OF NATURAL CRETE

NATURAL CRETE is a complex non-bacterial concentrated and organic multi-enzymatic formulation for road stabilization and multiple other Applications. It is produced through enzyme-induced fermentation of natural sugars and natural plants.

Most soil types can be used for building roads as long as the soil has 15% to 20% cohesive fines passing a 200-mesh screen.

Increases Load Bearing capacity of nearly all cohesive soil materials (value of CBR).

Uses existing soil for road stabilization and provides savings in transportation costs.

NATURAL CRETE is safe for the environment. It will not harm humans, animals, fish or vegetation and it is biodegradable.

Saves time, easy application and decreases the cost of building, and increases the road's life.

Decrease road repair.

The soil used should have at least 10% - 20% cohesive clays passing through a 200- mesh screen.

Prevents the passage of surface water from the bottom and sides of the road and cracks and prevents corruption.

The shelf life is 2 years, stored in temperature below 130 F (45C).

OPTIMUM CONDITIONS FOR ROAD BUILDING WITH NATURAL CRETE CONSIDERS THE FOLLOWING:

Use materials that are structurally sound. Road base material using NATURAL CRETE should have gradation mix (size distribution) that will result in good load bearing values and contain approx. 18% to 30% non-granular fines (-200 mesh and cohesive in nature). Many roads have used material outside design standards, however prior to construction field testing was necessary for determining suitability, and upon completion, excellent results were obtained. Some clays and fines are silty in nature and are not useful for road construction. Excessive fines can cause problems as a result of high plasticity and low load bearing value.

Proper moisture must be maintained during compaction. NATURAL CRETE works best between 2%-3% below optimum moisture. Do not compact above optimum moisture. After applying NATURAL CRETE to the road material additional water can be applied to bring the moisture content closer to the amount needed for proper compaction.

Generally, roads should not be compacted in lift greater than 3 inches (7.62 Centimeters). Lift thickness is determined by the size and type of compaction equipment plus the type of material being compacted. Less compactive effort will be required using NATURAL CRETE.

OPTIMUM CONDITIONS FOR ROAD BUILDING WITH NATURAL CRETE CONSIDERS THE FOLLOWING:

The road should be allowed to cure prior to use if possible. However the road can be used sooner if necessary. Drying of the base material will create less plasticity, decreased permeability and greater strength.

STEP 1:
Blade or rip the existing road to a minimum depth of six inches(15,24 CM) and then windrow the loose material. If the road requires greater depth, work the material in lifts. If additional aggregate is needed, use less expensive material. Check the overall gradation of the material to insure it is within the designing limits .Overall depth to be treated depends upon designed axle load required.

STEP 2:
For each 165 cubic yards (126,15 Cubic Meters) of road base material add 1 Gallon (2.785 Liters) of NATURAL CRETE to the amount of water to obtain optimum moisture. Spray both bladed surface and the windrow to obtain optimum moisture. Blend the NATURAL CRETE treated material using a grader blade, working the soil & aggregate back and forth to blend in the NATURAL CRETE and water. If the material is too wet, blade dry. If too dry, add water without NATURAL CRETE to bring the material up to optimum moisture. After mixing, spread material to grade. The road material can be left in a windrow over night to allow complete moisture absorption. This will result in better compaction with less effort.

STEP 3:
Extend and crown the road surface with a blade. If your material dries out on a hot day, spray again with a diluted NATURAL CRETE MIX . Compact with a compactor such as a sheepsfoot or pneumatic roller. Vibratory rollers may be used fort the first and second passes, however further compaction should be done without vibrator action to avoid cracking. Compaction in 2-3 inch (7.62 cm) lifts (layers) should be done to insure maximum compaction.

AFTER ALLOWING THE ROAD SURFACE TO DRY (CURE), IT IS READY TO BE USED

ROAD DESIGN

Construction of new & existing roads must consider **design elements,** some of which are listed below:

1. *Traffic Loads (wheel weight & frequency of use)*
2. *Available road building materials*
3. *Topography & sub-base soil conditions (soft or firm)*
4. *Moisture (rain, snow & ground water)*
5. *Long term use and maintenance requirements*

Base conditions require greater thickness - in some cases as high as 48 inches (120 cm) where there are trucks with heavy loads such as in mines. If the base (ground) is firm, a minimum thickness of 6 inches (15.24 cm) of a Natural Crete Sub-Base can be used for normal traffic loads. Roads with truck traffic require greater thickness to support the high wheel loads of 20 to 30,000 lbs (9,000 to 13,600 kg) Analysis of the sub-base conditions and testing for load bearing capacity may be required to achieve proper design specifications.

Traffic loads and speed also affect the life of a road. In many instances a hard "wearing" surface cover is necessary. High-speed traffic increases the mechanical forces applied to the road surface. *To prevent surface wear, a protective cover such as asphalt, concrete or a chip seal coat may be necessary.*

ROAD DESIGN - Cont.

Surface and sub-surface moisture conditions also enter the equation for good road design. It is important that the road have **adequate drainage** and that the sub-base and road base be kept as dry as possible to prevent structural failure. **Side drainage channels are important as well as crowning of the road surface** to allow water to flow away from the road surface. Where ground water is near the surface it may be necessary to place a rock sub-base or other engineered treatment. It is up to the engineer to evaluate these conditions.

Road building materials also affect the design of a road. The type and properties of the material greatly affect the performance of a road. Well-graded gravel and soil give maximum performance. Cohesive fines enhance the performance of a road (less rutting and pot holes).

There are other factors, which must be considered. Civil Engineers qualified in road construction should be consulted for specific site conditions.

SOIL COMPACTION

COMPACTION is the process densifying or packing the soil...resulting in an increase in weight per unit volume. It is generally accepted that the strength of a soil can be increased by densification. Three important factors affect compaction:

Material gradation
Moisture content
Compactive effort

ROAD DESIGN - Cont.

MATERIAL GRADATION - Refers to the distribution (% by weight) of the different sizes of particles within a given soil sample. A sample is described as well graded if it contains a good, even distribution of particle sizes. If a soil sample is composed of predominantly one size particle, it is said to be poorly graded. In terms of compaction, a well-graded soil will compact more easily than one that is poorly graded. In well-graded material, the smaller particles tend to fill the empty spaces between the larger particles, leaving fewer voids after compaction. This is further supplemented by using **NATURAL CRETE** in the water during compaction.

Grade Specifications

Sieve Size	Gradation % Passing	Gradation Upper	Limits Lower
1”	100%		
½	85%	89%	81%
No. 4	62%	66%	58%
No. 16	48%	52%	44%
No. 200	24%	30%	18%

ROAD DESIGN - Cont.

MOISTURE CONTENT - or the amount of water present in a soil, is very important to compaction. Water lubricates soil particles thus helping them slide into the densest position. The wetting action of **NATURAL CRETE** further enhances this action during compaction. Water and **NATURAL CRETE** enzymes also assists clay particle bonding, giving cohesive materials their "sticky" qualities. Proper compaction cannot be achieved in materials that are too wet or too dry. Engineers have determined that in almost all soil there is an amount of water, called optimum moisture content, at which it is possible to obtain maximum density with a given amount of compactive effort. If tested the graph would show this relationship between Soil Dry Density and Moisture Content. This is called a Compaction Curve, Moisture-Density or Proctor Curve. The proctor curve shows this relationship between soil dry density and moisture content.

COMPACTIVE EFFORT - refers to the methods a compactor imparts energy into the soil to achieve compaction. Compactors use one or more types of compactive effort:

Static weight (pressure) such as a drum roller
Kneading action (or manipulation) Sheep foot roller
Impact (or sharp blow)
Vibration (or shaking) vibrating roller

ROAD DESIGN - Cont.

Natural Crete Water Application Guidelines Metric

It is important to determine the optimum moisture for the soil through a proctor test and also the moisture currently present in the soil in order to determine the amount of Natural Crete/water needed to be added, see example below.

For Example: Field Calculations estimated for 8 cm Lift

Volume 8cm X 8 Meters X 1000 meters	=	640.00 cubic meters
Material weight 640 cubic meters X 1,600 kg/cubic meters	=	1,024,000 kg or Lift
Additional Water to achieve optimum moisture (8% moisture X 1,024,000 liters)		81920 Liters
Safety Factor (avoids excess water) 70% X 81,920	=	57,344 Liters
Natural Crete- (1 Liter treats 33 cubic meters of soil) - Liters required		19 Liters

640 cubic meters road sub base divided by 33 cubic meters

Natural Crete dilution rate this example only in Dry Conditions.

Natural Crete Dilution Table - Water to be Added

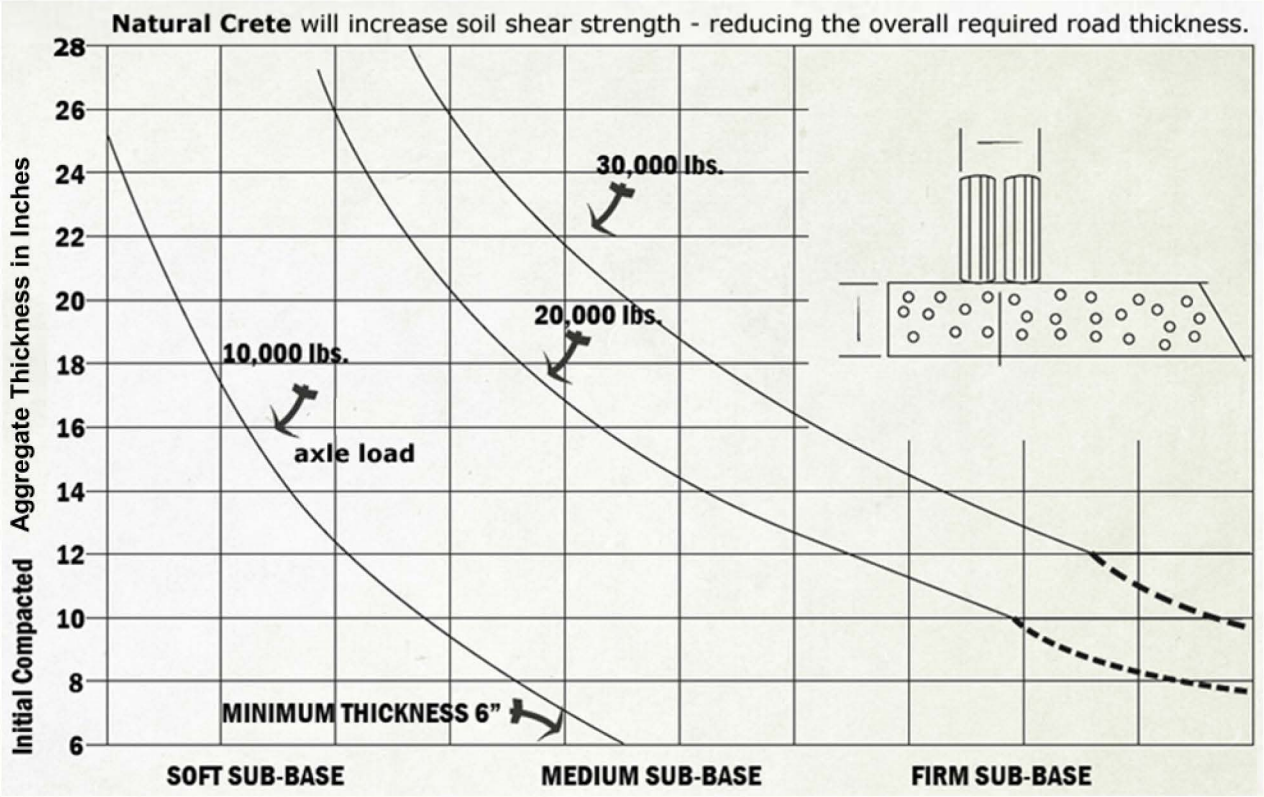
Water required to reach optimal Moisture for Compaction

Water%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	
Water/Liter Natural Crete	528	1056	1584	2112	2640	3168	3696	4224	4752	5280	Liters
Using 70% Safety	370	739	1109	1478	1848	2218	2587	2957	3326	3696	Liters

STRENGTH

The load, which the wheel of the vehicle exerts on a gravel surface, spreads out as it passes down through the road base. The angle of force, increasing in width as it penetrates deeper into the road material is referred to as the internal angle of friction *O*. It varies depending upon the type of material present. The objective in road design is to have sufficient road base thickness to support anticipated wheel loads.

NATURAL CRETE treated material has increased compressive strength, which resists deformation and excessive flexing due to wheel loading. This stabilization results in an overall stronger base. It also means less maintenance.



Frequently Asked Questions about using NATURAL CRETE

Is there any effect when* NATURAL CRETE *is mixed with any other organic material e.g. CaO or CaCO3?

NATURAL CRETE works well with all organic soils. It will increase the bonding of the fines (-200 mesh) and allow greater moisture penetration to facilitate compaction.
NATURAL CRETE has been used successfully in roads containing Limestone (CaO) and Calcite (CaCO3), a fine grain limestone. The use of clays in road building should usually be less than 30% - 200 mesh.

As time goes on will* NATURAL CRETE *reduce or increase its bonding strength? Will the road come out with cracks or become fragile?

NATURAL CRETE treated soils (for roads or ponds) achieve their greatest strength at the time of compaction and subsequent to 72 hours of curing (72 hours drying). Bonding of the soil particles takes place in the presence of moisture and compactive force. This condition will last as long as the material resists external forces. Heavy wheel loads, water, freeze-thaw cycles ultimately have an effect on all roads. **NATURAL CRETE** treated soil resists these forces due to the bonded, high density of the road material. The road will resist the detrimental effects of erosion and mechanical forces. **NATURAL CRETE** continues to cure for 6-12 months after road installation, even though it cures sufficiently in as little as 72 hours, for use by normal traffic, depending on the circumstances at the site, such as weather, etc.

Cracking occurs as a result of two factors: (1) If the road material contains a high percent of expansive clays - having a high shrink-swell factor. When the road is completed and dries out some cracking will appear. This reduces the effectiveness of the roads stability, however we have seen roads showing this condition that have performed very well - but with reduced life. (2) The Soft sub-base may not support the treated base under wheel loads, i.e. expansive clays. The bearing capability of the road is insufficient. This is corrected by increasing the thickness of the road base.

Frequently Asked Questions about using NATURAL CRETE – Cont.

When the clay fines (-200 mesh) exceed 25% or are highly expansive some surface cracking will occur. Generally the cracks are superficial, often filling in with road particles during normal traffic use. Generally this condition is referred to as "Alligator Cracking" and does not significantly affect the stability of the road base.

Prior to placement of any surface material, the **NATURAL CRETE** treated soil should be lightly sprayed with a diluted solution of water & **NATURAL CRETE** to assist in the bonding of the new surface material (i.e. Asphalt) to the road base. Moisture will close many of the cracks.

Proper drainage will reduce ground moisture and keep cracking to a minimum.

After compaction, what is the ratio of expansion? Will extreme weather affect the road (hot or cold)?

After compaction, the expansion-contraction ratio will be dependent upon the soil type (percentage of expansive clays) as well as the gradation range (distribution of particle sizes.) Well-graded soils (ranging from -200 mesh to 1 inch) are ideal for road building. The -200 mesh fines should be approximately 20%. If the frost level extends below the level of the road some heaving may occur, however in the spring the road should settle back to its original elevation without damage. Proper road construction including shoulder drainage will minimize the effects of frost. Good engineering practices should be observed. Hot weather does not affect a road, other than dry dirt surfaces tend to be dusty under high wheel loading. **NATURAL CRETE** treated surfaces will reduce the amount of dust.

Frequently Asked Questions about using NATURAL CRETE - Cont.

When the road contains more than 20-30% clay, will the road surface become too slippery and lose traction?

Road constructed with material containing a high clay content will exhibit slippery surfaces when wet. It may be necessary to use some aggregate to increase traction in wet conditions.

In many applications surface treatment is applied as part of the overall design. This provides a wearing surface for traction, moisture protection, and greater overall strength. Cost and availability of materials are the primary factors affecting the type of surface building material.

In road building it is desirable to minimize excessive clay content. Under moist conditions the surface will not have proper surface friction and excessive plasticity may be present.

How long will the road last when used with NATURAL CRETE?

NATURAL CRETE treated roads have been in use for over 20 years. The longevity of a road is a function of several factors:

a. Climatic conditions such as temperature ranges and rainfall.
b. Type of soils used in construction.
c. Road design - crowning, drainage & other engineered parameters.
d. Type of vehicular traffic, speed and degree of usage.
e. Wearing surface applied (if any.) Example: Chip Seal, Chip Coat, or Asphalt.
f. General maintenance - frequency and quality.

Frequently Asked Questions about using NATURAL CRETE – Cont.

We have seen **NATURAL CRETE** treated roads retain their integrity over longer periods than previously experienced by road departments. For example a road in the USA has been in continual use for over eighteen years, with very little maintenance. Other geographic areas have reported substantial reduction in road maintenance by over 50%. **NATURAL CRETE** treated road bases last longer.

Can temporary roads be constructed using less NATURAL CRETE?

NATURAL CRETE is always used at the rate of 1 gallon per 165 cubic yards or 1 liter per 33 cubic meters of soil material. Temporary roads might be constructed with reduced thickness, providing the wheel loads would not immediately destroy the road.

Is compaction required when using NATURAL CRETE?

NATURAL CRETE is used when moisture is applied to soil for compaction. Stability or stabilization occurs when soil particles are in close contact. Even when used in pond applications, the downward force of the water assists in compaction.

Spraying **NATURAL CRETE** on soil without any compaction will not affect a change in erosion. The soils ability to resist erosion is a function of the mineral makeup of the soil and compaction (or density.)

Will NATURAL CRETE affect plant life if there is contact?

NATURAL CRETE is not harmful to plant life in its full range of various applications i.e. road building, pond construction, etc.

STAGES OF APPLICATION

(INSTALLATION OF ROAD IN MUĞLA, TURKEY 2012)

STEP 1:
Blade or rip the existing road to a minimum depth of six inches (15.24 cm) and then windrow the loose material. If the road requires greater depth, work the material in lifts. If additional aggregate is needed, use less expensive material. Check the overall gradation of the material to insure it is within the design limits. Overall depth to be treated depends upon designing axle load required.

STAGES OF APPLICATION – Cont.

EXCAVATED ROAD

STAGES OF APPLICATION – Cont.

MOVING 6 INCHES (15.24 cm) OF SURFACE SOIL INTO A WINDROW

STAGES OF APPLICATION – Cont.

STEP 2: APPLICATION OF NATURAL CRETE DILUTED IN WATER

For each 165 cubic (.15088 KM) yards of road base material add one gallon (3.78 L) of NATURAL CRETE to the amount of water to obtain optimum moisture. Refer to the worksheet. Spray both bladed surface and the windrow to obtain optimum moisture. Blend the NATURAL CRETE treated material using a grader blade, working the soil & aggregate back and forth to blend in the NATURAL CRETE and water. If the material is too wet, blade dry. If too dry, add water without NATURAL CRETE to bring the material up to optimum moisture. After mixing, spread material to grade. The road material can be left in a windrow over night to allow complete moisture absorption. This will result in better compaction with less effort.

STAGES OF APPLICATION – Cont.

MIXING TREATED SOIL

RE-LAY TREATED SOIL 2-3 (5.08-7.62 cm) INCHES AT A TIME AND COMPACT

STAGES OF APPLICATION – Cont.

Step 3 - Extend and crown the road surface with a blade. If your material dries out on a hot day, spray again with a diluted NATURAL CRETE mix. Compact with a compactor such as a sheepsfoot or pneumatic roller. Vibratory rollers may be used for the first and second passes, however further compaction should be done without vibrator action to avoid cracking. Compaction in 2-3 inch lifts (layers) to insure maximum compaction.

STAGES OF APPLICATION – Cont.

Step 4 - General Guidelines- Speak with your Qualified Local Asphalt Rep

Either Emulsion (CSR) or (MC) asphalt can be used. The Emulsion means it is cut back or diluted with water and is shot at a temperature around 106F (71C). The MC is cut back with diesel fuel or other petroleum product and shot at a temperature of 225F (107C). The advantage of one over the other is debatable. Generally speaking the MC will penetrate dirty gravel better then emulsion, but may have a tendency to bleed off more if the balance of oil to gravel is not correct. When using MC, the first coat is thinner, usually MC-800 and the second coat is heavier MC-3000.

When using Emulsion, use the same weight CRS-2 for both layers. There is also available variations of CRS-2, some quick dry, some rubberized, some hard. Check with your Local supplier to see what is available and competitively priced. Also when using Emulsion, you need approximately 29% more material to obtain the same amount of asphalt thickness, due to drying where water evaporation reduces the overall weight.

The Natural Crete road surface should be prepared at least 3 or more days prior to applying asphalt. The surface should be smooth, dry and hard. Dress any imperfections prior to applying the asphalt, as they will extend through the finished surface. (A smooth base is essential) Prior to applying or shooting the first layer of oil, dampen the surface with a mist of Natural Crete treated water, diluted 1 Gallon of Natural Crete to 10,000 Gallons of Water. The Natural Crete Mist will help oil bind to the road. After the mist dries and looses its sheen you are ready to apply the oil. Usually, approximately .4 to .5 gallons of oil is applied per square yd of surface. Then immediately apply 3/4 inch of gravel 3/4" minus gravel and compact with a compactor. After the first layer of oil and gravel is rolled down, you can pull a (non rotating) drag broom over the surface to smooth out any roughness caused by the chip spreader, truck or roller. This will insure a smooth surface for the second layer. Now the second layer (Final) layer of .35 to .40 gallon per square yd of oil and 1/2 inch of 1/2" or 3.8" chips can be laid down and compacted. The gravel chips must be fractured rock to stay in place. Pea gravel cannot be used. If you have the proper amount of oil and, gravel and chips, the oil should penetrate both layers and bond together. If too much oil is used, bleeding will occur.

STAGES OF APPLICATION – Cont.

AFTER ALLOWING THE ROAD SURFACE TO DRY (CURE), IT IS READY CHIP SEAL, ASPHALT OR CEMENT

STAGES OF APPLICATION – Cont.

Finished Road in Mugla, Turkey after adding asphalt.

ASPHALT RECLAMATION

The Reclamation and Re-Use Process

This new method for asphalt reclamation is the most exciting thing to happen in the road maintenance and repair field for as long as We can remember. We believe the process Natural Crete has developed will revolutionize road repairs. A valuable benefit of this process over the years will be the prevention of asphalt material leaching into the earth due to the permanent bonding process of Natural Crete.

As the oil currently used for asphalt becomes more and more scarce, it also becomes more expensive. This fact alone will require everyone in the road business to make some serious decisions about budget allocations. Cutting back on work needing to be done can only generate more deteriorated roads so we need to rethink the way we currently do business.

Most Transportation Departments have been stockpiling asphalt grindings for years, never having a cost effective method for reusing them.

Natural Crete has developed a program that provides a method of utilizing those mountains of asphalt grindings. In addition, we are currently training people to recycle the asphalt “in place”. These methods are rapidly sweeping across the World. You will find that this is the most efficient, cost effective and permanent solution to those badly needed road repairs.

ASPHALT RECLAMATION – Cont.

Here is how it all works:

When a base or sub base is the root of the problem, full depth reclamation is the solution. This is accomplished by using a grinding machine, such as the Asphalt Zipper for small repairs, or a Wertgen type grinder to grind through and pulverize the asphalt with base materials while simultaneously injecting Natural Crete. Once this material is thoroughly compacted in place, the failure will not reappear. Natural Crete is a permanent and inexpensive solution to every base failure. There is no need to haul out material unless another overlay will go on top, then cut off just enough material so the overlay can be leveled with the adjoining road- way.

The method for repairing failed asphalt is exactly the same, called asphalt reclamation. We have always known that Natural Crete works well when asphalt grindings were mixed into the soil being treated. However, recently we discovered Natural Crete works equally as well with asphalt grindings alone. We are now providing a method that will allow agencies to make repairs, in place, to failed asphalt. The old days of “mill and fill” are a thing of the past. When asphalt grindings are injected with Natural Crete they bond back together resulting in a product that is even denser and harder than the original. Simply grade the treated asphalt grindings back in place, wet with additional Natural Crete and compact.

Imagine being able to repair rutted or alligatored asphalt without hauling out old and bringing in new material. The cost of materials, time and effort saved by using these methods can be calculated easily. It means that the budget dollar will go many, many times farther.

The only special equipment needed to accomplish either method is a machine to do the grinding.

ASPHALT RECLAMATION – Cont.

What about the stockpiles of grindings?

Now that we know the effects of Natural Crete on asphalt grindings, we are seeing more and more ways of utilizing the old grindings. For example we can pre-inject Natural Crete into asphalt grindings at the maintenance yard to take to the site of a pot hole or road failure. The end result provides a permanent repair and is much cheaper to use than cold mix. It will also set up harder and is much more durable than cold mix. You can make these and similar repairs for a few cents per foot instead of a few dollars per foot.

Road Shoulders:
An area that continually causes everyone problems and is continually being overlooked is road shoulders. We are currently working with different agencies and teaching our method for reestablishing shoulders.
In many cases where shoulders have been neglected, we find there is a drop off of one to six inches. These areas are obvious traffic hazards and will eventually lead to road failure. This is a perfect area to utilize asphalt grindings. They can be incorporated into the road shoulder providing a safer roadway and preventing erosion. This is an inexpensive method of providing safety and reducing liabilities.

Gravel Roads:
Placing a thin lift of asphalt grindings (2”) over an existing gravel road and incorporating Natural Crete into the mix will provide a solid wearing surface that readily accepts a chip seal or class 3 slurry seal for a durable inexpensive road. Even if the budget prevents a final surfacing, the treated mix will remain a serviceable road for years until surfacing can be funded. An additional benefit is a noticeable reduction in dust or particulate matter. Erosion is also decreased with this process.

ASPHALT RECLAMATION – Cont.

Below is a perfect example of a Failed Asphalt Road.

ASPHALT RECLAMATION – Cont.

Asphalt being Reclaimed, mixed with Natural Crete and reinstalled ready for Compaction

Natural Crete is certified GREEN. It is safe to handle in all situations and requires no specialized equipment.

TESTING

TEST METHOD FOR PREPARING AND ANALYZING PAVEMENT SUB-GRADE, SUB-BASE AND BASE COURSE MATERIALS CONTAINING NATURAL CRETE IN A MATERIALS TESTING LABORATORY.

This test method protocol has been developed in response to request for proper laboratory procedure when testing road base materials treated with Natural Crete. It should be noted that no laboratory sample will simulate the actual strength characteristics exhibited in the field with full-scale Natural Crete treated base materials. Therefore, if one is to obtain a truly valid approximation of the relative strength of treated material, it is recommended to test Natural Crete treated road base by obtaining fully cured samples from the actual road beds. Test methods described below will reference the American Society for Testing and Materials (ASTM). Test methods may be found at the ASTM Internet site http://www.astm.org.

I. PREPARATION OF LABORATORY SAMPLE

Prior to any laboratory testing, a suitable sample must be prepared. It is recommended to prepare a minimum soil aggregate mix of five (5) gallons (18.9 Liters). All (100%) mineral aggregate must be crushed (e.g., cracked rock faces). That portion of aggregate passing the No. 4 sieve should be slightly plastic (0<PI<6) when tested in accordance with ASTM Method D4318-95a. Any humus material and or other organic material (i.e. roots, moss, leaves etc.) should be removed from the test material. The dry material soil aggregate should be uniformly graded with the gradations specified in Table 1, following ASTM Method C136-96a.

TESTING – Cont.

TABLE A - INITIAL TARGET GRADATIONS

Sieve Size	Ideal Gradation (Percent Passing)	Ideal Gradation Tolerance
1"	100	0
1/2"	85	+ 4 - 4
No. 4	62	+ 4 - 4
No. 16	48	+ 4 - 4
No. 200	18	+ 4 - 4

II. DETERMINATION OF OPTIMUM MOISTURE

After properly preparing the laboratory sample as described in I above optimum moisture should be determined using the modified R. R. Procter test as described in ASTM Method D698-91, Procedure C. Please refer to the Caterpillar Compaction Method Manual, for information on obtaining optimum moisture for the laboratory sample mix.

TESTING – Cont.

III. PREPARATION OF SAMPLE FOR NATURAL CRETE ADDITION AND CURING

Once the optimum moisture is determined for the proper mix design, a 6 inch (152.4 mm) diameter mold should be prepared, as described in ASTM Method D698-91, Procedure C, prior to placing the mix in the mold, the 5 gallon (18.9 liters) bucket of mix should be brought to one percent below optimum moisture (Optimum Moisture - 1%) using water and Natural Crete. Natural Crete should be added at a rate of 0.004 fluid ounce per gallon aggregate mix, or 0.02 third ounces (0.6 millimeters) per 5 gallon (18.9 liters) bucket (see following comment note). The contents of the bucket should be thoroughly mixed and then rechecked for moisture content prior to compaction and curing. It is recommended to cover the bucket with a leak proof lid to avoid moisture loss during sample preparation.

NOTE:

Since it is so difficult to mix such a minor amount of Natural Crete for even a 5 gallon (18.9 liters) sample mix, it is recommended to pre-mix one (1) third ounce of Natural Crete in one (gallon) of water. Use this Natural Crete water solution to bring the 5 gallon sample up to the proper moisture content, as described above (e.g., optimum moisture - 1%).

With the prepared moisture adjusted Natural Crete aggregate mix, a 6 inch mold should be prepared in accordance with ASTM Method D698-91, Procedure C. It is suggested that each of the three specified layers to be compacted be an approximate one inch (25.4 mm) layer or lift. Once the mix has been properly compacted using Procedure C, the sample should be carefully removed from the mold and placed on a drying rack.

The Compacted sample should then be cured for a minimum of 7 Days (168 hours) at room temperature. Curing time should be increased to 28 days(672 hours) prior to any strength testing to allow for maximum bonding strength. If it is desired to use a curing oven, the oven temperature should not exceed 98 Degrees Fahrenheit (37 Degrees Celsius). 100% Curing time is approximately 6-8 months and is subject to weather conditions.

OTHER USES

OTHER USES / BRICK AND BLOCK BUILDING

Natural Crete was used for making Blocks and Bricks which were then used to Build a Home.

Bricks and blocks can be built to almost any size.

An entire development being built with Natural Crete blocks and bricks.

A private home built with Natural Crete bricks.

A school being built with Natural Crete bricks and blocks.

Project: E3 Technology 2010 Testing

Type of Block: Adobe Block (Untreated)

Test Date: 09/01/2010

COMPRESSIVE STRENGTH (HALF BLOCKS) ASTM C-67

Specimen No.	Size (In) Width	Length	Height	Gross Area (sq.in.)	Load (lbs.)	Strength (psi)	Specifications (psi)
1	5.990	7.680	4.040	46.00	23,000	500	
2	5.950	7.690	4.030	45.76	19,560	427	
					Average:	464	

Test Date: 09/01/2010

MODULUS OF RUPTURE (FLEXURAL STRENGTH)

Specimen No.	Distance Midspan to Failure	Net Width (Face to Face Minus Voids)	Depth (Bed Surface to Bed Surface)	Distance Between Supports	Load (lbs.)	Strength (psi)	Specifications (psi)
1	0.890	4.770	4.030	7.3	730	77	
2	0.000	6.500	4.040	7.250	675	69	
					Average:	73	

Note: Moisture Content = 0.8%
ASTM C-67 requires five specimens, client provided one.

Robert Romero, SET

Copies: Addressee (1)

Type of Block: Adobe Block (ECOBRIXX Treated)

Test Date: 09/01/2010

COMPRESSIVE STRENGTH (HALF BLOCKS) ASTM C-67

Specimen No.	Size (In) Width	Length	Height	Gross Area (sq.in.)	Load (lbs.)	Strength (psi)	Specifications (psi)
1	6.020	7.910	4.030	47.62	29,860	627	
2	5.910	7.910	4.030	46.75	29,280	626	
					Average:	627	

Test Date: 09/01/2010

MODULUS OF RUPTURE (FLEXURAL STRENGTH)

Specimen No.	Distance Midspan to Failure	Net Width (Face to Face Minus Voids)	Depth (Bed Surface to Bed Surface)	Distance Between Supports	Load (lbs.)	Strength (psi)	Specifications (psi)
1	0.350	4.200	4.020	7.3	625	90	
2	0.000	6.370	4.030	7.250	840	88	
					Average:	89	

Note: Moisture Content = 0.8%
ASTM C-67 requires five specimens, client provided one.

Robert Romero, SET

Copies: Addressee (1)

ACCREDITATION

Turkish Department of Transportation accreditation of Natural Crete for use as a Soil Stabilizer in Building Roads. The entire report is available upon request.

MATERIAL SAFETY DATA SHEET

UNITED STATES DEPARTMENT OF LABOR

Material Safety Data Sheet

Complied with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
Form Approved
OMB No. 1218-0072

IDENTITY as used on Label "Natural Crete"	Natural Crete LLC., 14 Monarch Bay Plaza, Ste 466 Dana Point, CA 92629. USA

Section I

Manufacturer's Name Natural Crete LLC.	Emergency Telephone Number 1(866)931-3954
Manufacturer's Address Natural Crete LLC.	Telephone Number for Information 1(866)931-3954
14 Monarch Bay Plaza, Ste 466	February 15, 2013
Dana Point, CA 92629. U.S.A.	Signature

Section II - Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	%(optional)
None	NON-Hazardous			

Section III - Physical/Chemical Characteristics

Boiling Point	212	Specific Gravity (H_2O = 1)	1.07
Vapor Pressure (mm Hg) 15.284	75	Melting Point	0
Vapor Density (AIR = 1)	Same as Water	Evaporation Rate (Butyl Acetate = 1)	See Water
Solubility in Water Infinity Soluble			
Appearance and Odor Amber Brown-Pleasant Odor			

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used) Non-Flammable	Flammable Limits N/A	LEL N/A	UEL N/A
Extinguishing Media None			
Special Fire Fighting Procedures None			
Unusual Fire and Explosion Hazards None			

Section V - Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable	X	Temperatures above 140 Degrees Can reduce Enzyme Activity. Not as Effective with Acids or Strong Bases
Incompatibility Acids or Strong Bases			
Hazardous Decomposition or Byproducts None			
Hazardous Polymerization	May Occur		Conditions to Avoid N/A
	Will Not Occur	X	N/A

Section VI - Health Hazard Data

Route(s) of Entry:	Inhalation? N/A	Skin? N/A	Ingestion? Light Diarrhea if Ingested
Health Hazards *(Acute and Chronic)* *None*			
Carcinogenicity: N/A	NTP? N/A	IARC Monographs? N/A	OSHA Regulated? N/A
Signs and Symptoms of Exposure Mild Irritation to Mucous Membrane and Eyes ph range is 4-5			
Medical Conditions Generally Aggravated by Exposure Mild Skin and Eye irritation if prolonged contact			
Emergency and First Aid Procedures Flush eyes with water and rinse other areas thoroughly with water			

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled Wash down with water
Waste Disposal Method Can be washed into Sewage System- Can be absorbed by the earth
Precautions to Be taken in Handling and Storing N/A
Other Precautions N/A

Section VIII - Control Measures

Respiratory Protection *None*		
Ventilation Normal	Local Exhaust Normal	Special Standard
N/A	Mechanical *(General)* *N/A*	Other N/A
Protective Gloves None	Eye Protection None	
Other Protective Clothing or Equipment None		
Work/Hygienic Practices Good Hygienic Practices		

PARTIAL LIST OF LOCATIONS WHERE NATURAL CRETE HAS BEEN USED RECENTLY

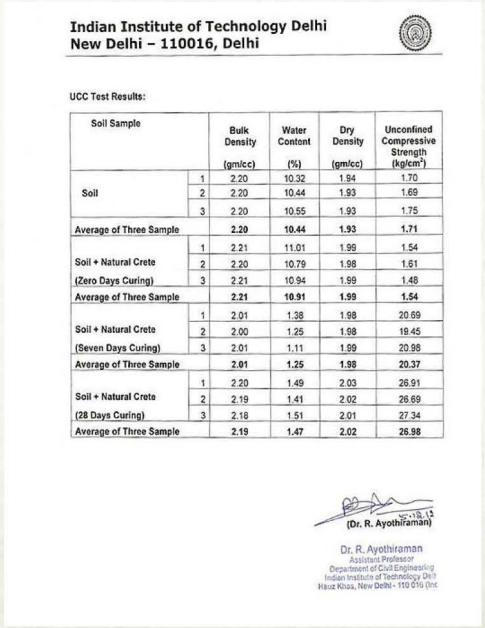
USA
Las Vegas – Nevada – Pond & Lake Project
Alaska Dept of Transportation – Road Const
Nevada Dept of Transportation – Road Const
California - Dept of Transportation Rural Road Const
Arizona Dept of Transportation Road Const
Washington Dept of Transportation Road Const
Utah Dept of Transportation Road Const
Colorado Dept of Transportation Road Const
New Jersey Dept of Transportation Road Const
Pennsylvania Dept of Transportation Road Const

INDIA
Patna & Bihar

TÜRKiYE
City Of Tuzla Dept of Transportation Road Const
Konya Dept of Transportation –City of Meram
Muğla City Dept of Transportation
Eregli/ Konya Turkey City Dept of Transportation
Ortaca/ Mugla Turkey City Dept of Transportation

Indian Institute of Technology Delhi
Department of Civil Engineering
UCC Test Results

Note increase of Unconfined Compressive Strength of over 1500% with Natural Crete



Indian Institute of Technology Delhi
New Delhi – 110016, Delhi

UCC Test Results:

Soil Sample		Bulk Density (gm/cc)	Water Content (%)	Dry Density (gm/cc)	Unconfined Compressive Strength (kg/cm²)
Soil	1	2.20	10.32	1.94	1.70
	2	2.20	10.44	1.93	1.69
	3	2.20	10.55	1.93	1.75
Average of Three Sample		**2.20**	**10.44**	**1.93**	**1.71**
Soil + Natural Crete (Zero Days Curing)	1	2.21	11.01	1.99	1.54
	2	2.20	10.79	1.98	1.61
	3	2.21	10.94	1.99	1.48
Average of Three Sample		**2.21**	**10.91**	**1.99**	**1.54**
Soil + Natural Crete (Seven Days Curing)	1	2.01	1.38	1.98	20.69
	2	2.00	1.25	1.98	19.45
	3	2.01	1.11	1.99	20.98
Average of Three Sample		**2.01**	**1.25**	**1.98**	**20.37**
Soil + Natural Crete (28 Days Curing)	1	2.20	1.49	2.03	26.91
	2	2.19	1.41	2.02	26.69
	3	2.18	1.51	2.01	27.34
Average of Three Sample		**2.19**	**1.47**	**2.02**	**26.98**

(Dr. R. Ayothiraman)

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Date: 5th December 2012

To
The Director
Natural Crete
7, Aaravali Office Complex
Alaknanda
New Delhi – 110019.

Kind Attn.: Mr. Harbhej Singh

Sub: Evaluation of index and engineering properties of soil mixed with Natural Crete
Ref.: IITD/IRD/CW12288 dated 25/09/2012

Dear Mr. Harbej:

You had entrusted IIT Delhi for the above work and submitted soil samples and Natural Crete for testing.

IIT Delhi conducted the tests as per your requirement and a report on results of testing is enclosed herewith.

With best regards,

(R. Ayothiraman)

Encl.: Report of Testing

DOĞAL BETON

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