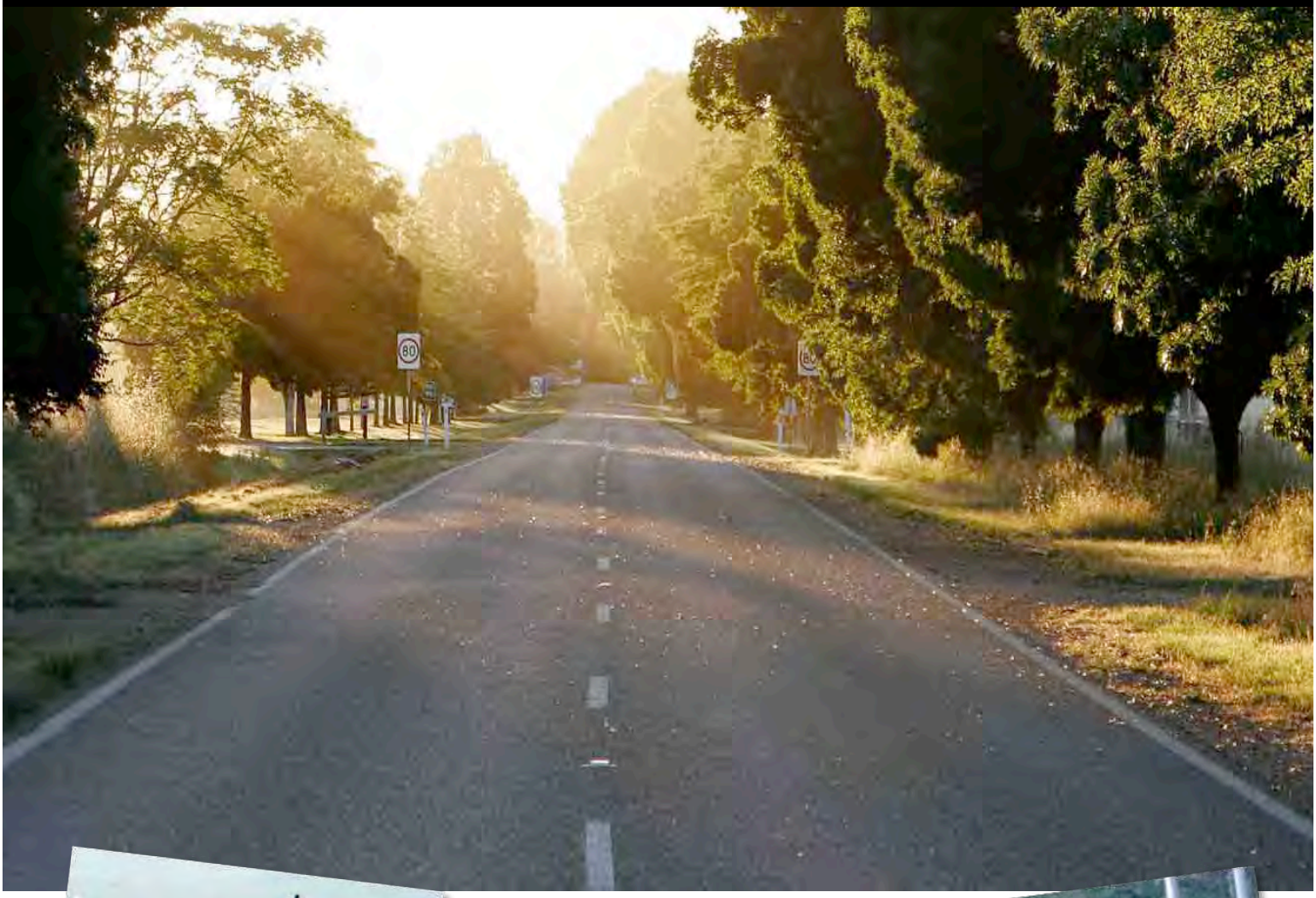
POLYMER PAVEMENTS

Kaveri®

SoilTech Mk. III. - Polymer Road Stabilizer



Environmentally friendly

COMPANY OVERVIEW

Kaveri Ultra Polymers P Limited is in the field of Manufacturing Bulk Material Handling Equipments for the Infrastructure Industry catering to Cement Plants, Power Plants, Steel Plants, Mines, Mineral Beneficiation Plants, Ferrous & Non-Ferrous Plants, Chemical & Fertilizers Plants, Foundry, Ports, Railways, etc. for more than 35 years.

Started primarily as a UHMW-PE Liner manufacturer, we have grown as a company that offers total solution from Design & Manufacture to Execution with an enviable range of products to include Rubber and Polyurethane Linings and Screens, Pneumatic Air Blasters, Conveyor Care Products like Belt Scrappers, Impact Pads, Skirt Board Sealing and Belt Tracking Systems.

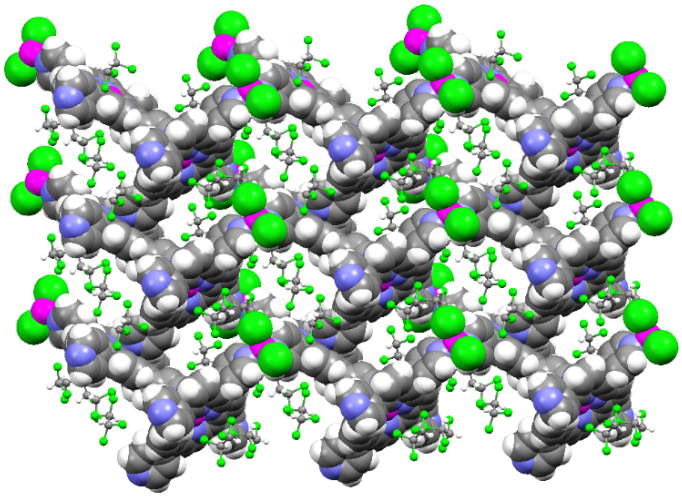
We also have a division undertaking Environmental and Pollution Control Projects like Dust Suppression System. Our endevour is to provide our customers with a "***one-stop***" solution for their bulk material flow, belt cleaning and dust control problems.

Polymer Pavements, also known as Polyroads, has its head office in Johannesburg, South Africa and is represented in eighteen countries on four continents Polymer Pavements manufactures and develops environmentally friendly Smart Materials for road construction, low cost road seals, factory floors, dust control, barrier liners and spray-on geoliners for dams.
These Smart Materials includes in-situ material binders, soil modifiers, asphalt modifiers and elastomeric mortar admixtures.

During the past 70 years, a number of countries have been researching and developing various polymeric admixtures in modified concrete mortars. Today, the USA, Germany, Japan have Standard Specifications for polymer modified mortars and concretes. However, in general the construction industry has been pedestrian in adopting technology.
Smart Materials have been developed as a renaissance to the stoic road construction industry. Layered pavement designs have not changed for the last 100 years.

Kaveri Ultra Polymers P. Limited have entered into a Joint Venture partnership with **Polymers Pavement Pty Ltd**. for the last 10 years to focus on Research and Development to manufacture and develop an environment friendly and smart material industrial polymer based products for Infrastructure Development Industry viz. **SoilTech Mk. III**.

SOILTECH MK. III



SoilTech Mk. III is a third generation nano polymer binder used for stabilizing soils for improving the strength of the soil and thereby improving the stability. It is a stabilization agent and was specifically designed & developed for mine haul-road stabilization, where excessive loading occurs and where all-weather roads are required. This technology is now used in commercial road design.

SoilTech Mk. III stabilizing polymers are elastomers, which gain strength from mechanical compaction and do not become brittle when cured. The elastomers are flexible in nature and allows certain amount of flex under load and does not become brittle unlike cement stabilization, will not crack under excessive loading – one aspect in reducing layer work in design phases.

In most cases, the in-situ soils in the area can be used for stabilization. The in-situ materials which would normally be classified as unusable or waste materials, can be transformed into suitably modified aggregates for use in base and sub-base layer construction. The SoilTech Polymers are the forefront of binding marginal soils and turning these materials into useable road construction aggregate. SoilTech Mk. III has been extensively tested with in-situ materials in various parts of the world.

SoilTech Mk. III has been extensively utilized in base and sub-base stabilization using in-situ materials, throughout the developing world. SoilTech Mk. III stabilizer has been purposely designed to penetrate through the road's base layer, into the sub-base layer, via capillary action and bind otherwise loose particles to one another, providing strength and cohesion. The SoilTech polymers are 0.5µm in size. These nano polymers are far more effective in coating and binding aggregate that the previous available polymers. The SoilTech Mk. III polymer is mixed with water which acts as a means of transport and facilitates the polymer in coating the soil particles. Once the water disperses, the polymers interlock and form a bond which gains strength under mechanical compaction. The greater the compaction, the better the polymer binds. Stabilized roads are opened to traffic 24 hours after construction. The kneading effect of vehicle traffic further assists in accelerating the evaporation process of the surfactants and coalescing solutions surrounding the polymer chains. SoilTech polymers will start binding when exposed to air and the surfactant, aided by an alcohol mix, starts to evaporate

SoilTech Mk. III Polymer is used for stabilizing base and sub-base layers of sealed and unsealed roads; mine haul roads, railway embankments, hard stands, parking lots and airstrips.

SoilTech Mk. III Polymer offers solutions for

1. **Asphalt Roads –** Ideal for stabilizing the base and sub-base layers. In most cases, the in-situ soils in the area can be used for stabilization. The stabilized road can be opened to traffic within 24 hours after construction, as the additional traffic on the stabilized road actually assists in dissipating the water in the base and sub base layers thereby speeding up the polymer binding process and the structural strength of the road. These roads are normally sealed with a chip & spray or asphalt seal after 5-7 days of sun curing or drying.

2. **Rural & Feeder Roads (Sealed or Unsealed) –**

SoilTech Mk. III is ideal for providing a tough base layer. Sand slurries or cost effective chip seals can be applied as a wearing course.

In some cases, due to economic reasons, the feeder roads may be left unsealed – with no wearing course. In such case, a light clear polymer binder (diluted SoilTech Mk. III Polymer) can be sprayed over the existing stabilized road as a cost effective interim measure. It may be necessary to apply a diluted polymer spray over the stabilized area over every 6 months.

3. **Mine Haul Roads –** SoilTech Mk. III was specifically designed & developed for mine haul-road stabilization. The SoilTech Mk. III Polymer stabilized road provides the structural load bearing capacity required for haul vehicles.

4. **Container Depots & Parking Lots –** due to the flexible nature of the polymers in SoilTech Mk. III, the stabilized base/ Sub base layer allows certain amount of flex on the road and does not become brittle. It provides an excellent platform or hardstand for storage depots, taxi stands and parking lots.

Advantages of SoilTech Mk. III Polymer

Reduce the consumption of quarry aggregate in road construction and thereby minimize the significant environmental impacts.

Aggregate is mined from the earth, either dug out of pits or blasted out of quarries. This process has many significant environmental impacts. Creating the pits or quarries requires the removal of virtually all natural vegetation, top soil and subsoil to reach the aggregate underneath. Not only does this lead to a loss of existing animal wildlife, it also leads to a huge loss of biodiversity as plants and aquatic habitats are destroyed. Moreover, adjacent eco-systems are affected by noise, dust, pollution and contaminated water. Pits and quarries disrupt the existing movement of surface water and groundwater; they interrupt natural water recharge and can lead to reduced quantity and quality of drinking water for residents and wildlife near or downstream from a quarry site.

In-situ materials can be used

In many instances in-situ materials on site which would normally be classified as unusable or waste materials, can be transformed into suitably modified aggregates, for use in base and sub-base layer construction. SoilTech Mk. III has been extensively tested with in-situ materials in various parts of the world.

Reduced Road Crust speeds up the construction time

With SoilTech Mk. III Polymer stabilization the amount of layered work normally associated with convectional flexible pavement/cement stabilized roads can be reduced. The thickness of granular sub base layer can be reduced and granular base layers eliminated.

BITUMINOUS CONCRETE 40MM
DENSE GRADE BITUMINOUS MACADAM 100MM
WET MIX MACADAM 125MM
WET MIX MACADAM 125MM
GRANULAR SUB BASE 300MM
SUB GRADE TOP 150MM
SUB GRADE-II 150MM
SUB GRADE-I 200MM
EMBANKMENT-AS PER PROFILE

BITUMINOUS CONCRETE 40MM
DENSE GRADE BITUMINOUS MACADAM 50MM
SOIL STABILIZED BASE 150 MM
GRANULAR SUB BASE 200MM
SUB GRADE TOP 150MM
SUB GRADE-II 150MM
SUB GRADE-I 200MM
EMBANKMENT-AS PER PROFILE

Reduction in crust layer reduces the total construction time when compared to conventional road construction. The reduction in construction time reduces the amount CO_2 emission from construction activities.

Reduce construction costs.

Reduced crust layers and thickness results in reduced construction cost and makes it cost effective

Reduced maintenance

As long as the asphalt wearing course layer is maintained, the structural integrity of the road will be preserved, with the road pavement remaining rut-free and eliminating the need for base or sub-base maintenance.

Increases the strength and stability of base & sub-base layer

Stabilized Base offers resistance to consolidation and movement due to repeated wheel loading and prevents rutting due to deformation in sub-base & sub-grade layers.

Structural strength achieved with SoilTech polymer stabilization, exceeds international single axle loading (80kN) standards by several hundred percent. A further major design benefit of SoilTech polymer is that apart from the fact that a very impressive load bearing strengths are achieved, the elastomeric properties of SoilTech also provides unsurpassed tensile performance, for road stabilizing products.

Engineers are now able to reduce the number of supporting layers, traditionally used to support in conventional rigid or flexible pavement designs. SoilTech is normally mixed into the base layer, assuming that the sub-grade offers reasonable support. In some instances, the sub-base may also be stabilized with a lower dosage of SoilTech in order to provide further strength to in-situ materials.

FACTORS INFLUENCING SOILTECH POLYMER STABILIZATION

Factor	Remarks
Material or Aggregate	It stands to reason that the better quality of aggregate used, the better results will be. Having said that, SoilTech has been designed to work with marginal materials. **Ideal Materials**: i. Plasticity index of 10 (will work with P.I of between (0 – 16) ii. Decent grading modulus (will also work with mixed grading of <2mm) **Materials to be avoided:** i. Material with very poor grading modulus– single sized particles that are non-plastic.
Percentage of SoilTech Mk. III polymer applied	Normally SoilTech would be applied at 0.5% per MOD of the material: i. Where materials are poor, a higher dosage of SoilTech stabilizer is recommended. Perhaps 0.75% - 1.5% per MDD ii. Modify SoilTech with higher dosage of cross-linking polymers
Compaction	Compaction is critical. SoilTech polymer binders do not form chemical crystallization bonds such as concrete when curing. SoilTech needs mechanical compaction. One needs above average heavy compaction at OMC level, using a 12 tonne vibrating roller or heavier.

ALTERNATE DESIGN PROCESS

Material Sampling and Test Parameters for Alternate Design

Before proceeding with alternate design, adequate material sampling and in-situ soil testing is required to exceed the AASHTO load bearing capacities and obtain the desired results. The various test parameters required for alternate design using SoilTech Mk. III Polymer:

- Atterberg's Limits
- Grain Size Analysis
- Water Content
- Free Swell Index
- Water Content-Dry Density Relation (Proctor Compaction Test)
- California Bearing Ratio Test
- Unconfined Compressive Strength

Design Parameters

Various parameters to be considered for alternate design are:

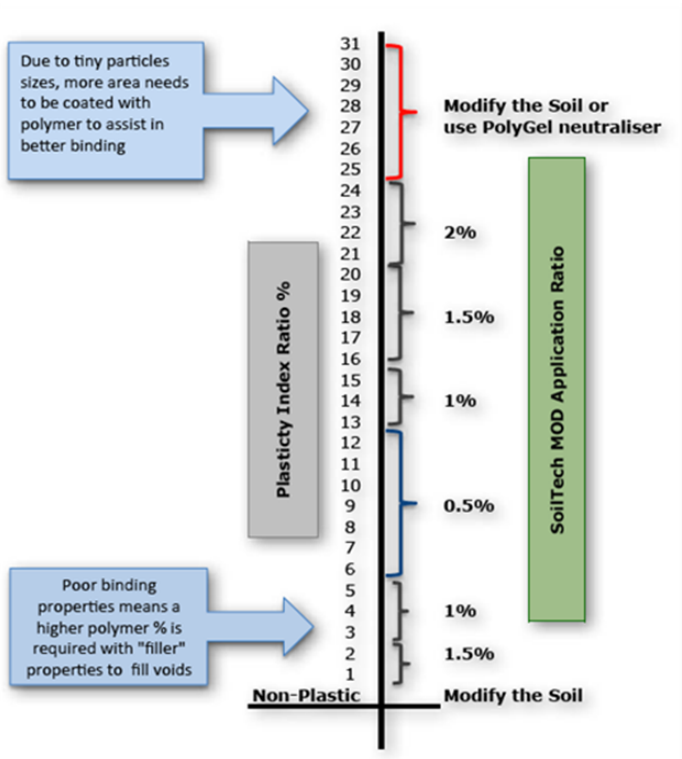
- Type of Construction: Sealed/unsealed road, Mine Haul road, Hard Stands, Parking Lot, Railway Embankments, Airstrips.
- Type & nature of Traffic
- Current Traffic use
- Design Life span of the Road
- Cumulative Increase in Traffic during life span of the road
- Type of material to be stabilized
- Environmental condition
- Material Sampling & test results
- Stress Strain Analysis of the alternate designed pavement for reduction in crust layers and thickness.

Percentage of SoilTech polymer shall normally be applied at 0.5% per MOD of the material. However, a higher dosage may be applied based on the material sampling and test results.

Pre-Construction Quality Control Test on the material or soil

Test parameters to be established before construction at site:

- Plasticity Index (PI) of the material or soil to be stabilized. Clay or aggregates can be used to modify the material in case the desired PI is not obtained.



- Optimum Moisture Content (OMC) & California Bearing Ratio (CBR) of the material/soil.
- Maximum Dry Density (MDD) for optimum compaction.

Materials that work best with SoilTech requires plasticity range of between 5 and 15. The finer the materials, the more polymers will be required to coat the material particles.

Various cross-linking polymers and activators may be added to poor materials in order to achieve the desired performance results. However, one needs to distinguish the economic feasibility between adding various polymers or activators to poor materials or whether it is more practical to merely import a better aggregate before stabilizing.

Construction Process:

- Check the alignment of the road and fix the centerline.
- Prepare the bed to receive the Polymer treated stabilized layer
- If required, modification of the material /soil shall be done. The site shall be prepared by scarifying & pulverizing the material/soil
- Prepare the liquid polymer stabilizing agent by adding and mixing SoilTech Mk. III Polymer to the water in the Bowser.
- The liquid stabilizing agent shall be evenly distributed by spraying into the pulverized material/soil and mixed to obtain and uniform mix.
- The prepared material/soil is graded and leveled to desired profile.
- Rolling and compaction is done to obtain the desired Maximum Dry Density (MDD). The result can be checked in-situ by performing Field Density Test (FDD).
- The surface can be opened to Traffic after 3 days of sun curing/drying.
- For Sealed Surface, wearing surface course can be laid after 5-7 days.

i. Pulverizing

ii. Spraying SoilTech Mk. III

iii. Mixing & grading

iv. Rolling & compaction

v. Laying Wearing Course

Construction Machinery/Equipment required for construction of Polymer Treated Base Course Layer using SoilTech Mk. III Polymer:

- Hydraulic Motor Grader with back-end ripper.
- Tractor with Rotovator
- Water Bowser with capacity of minimum 4000 litres
- Vibratory Soil Compactor of 11 ton capacity
- Survey Equipment Set
- Dynamic Cone Penetrometer Test (DCP) testing Equipment
- Moisture meter

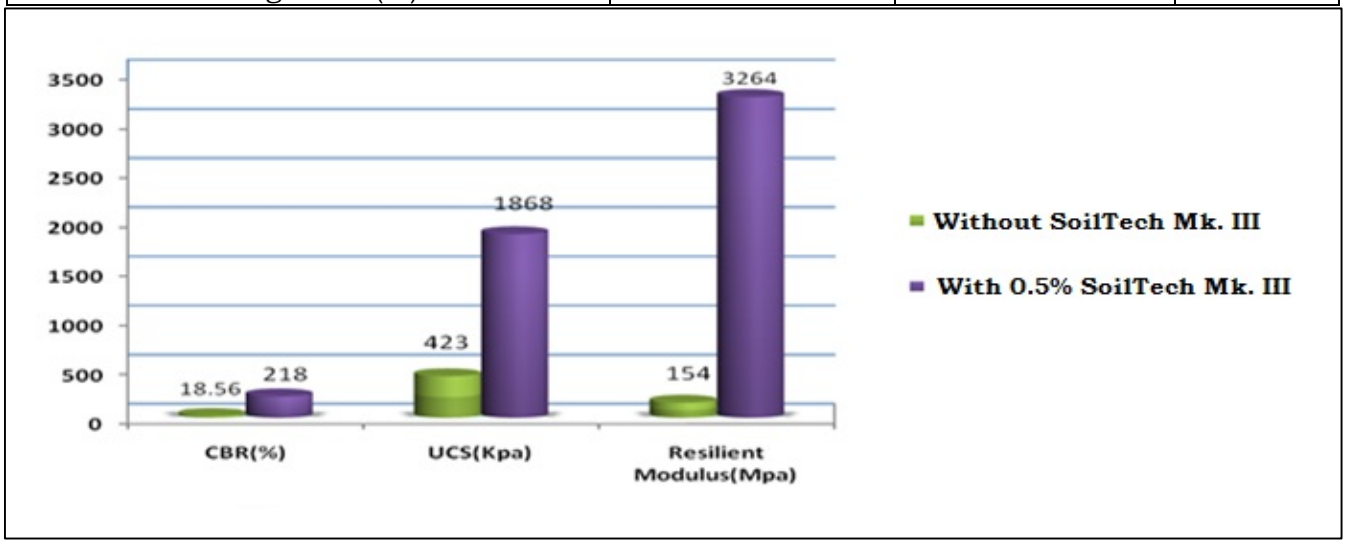
QUALITY & RESOURCE COMPARISON

CONVENTIONAL DESIGN (IRC-37) vs. ALTERNATE DESIGN (STABILIZED)

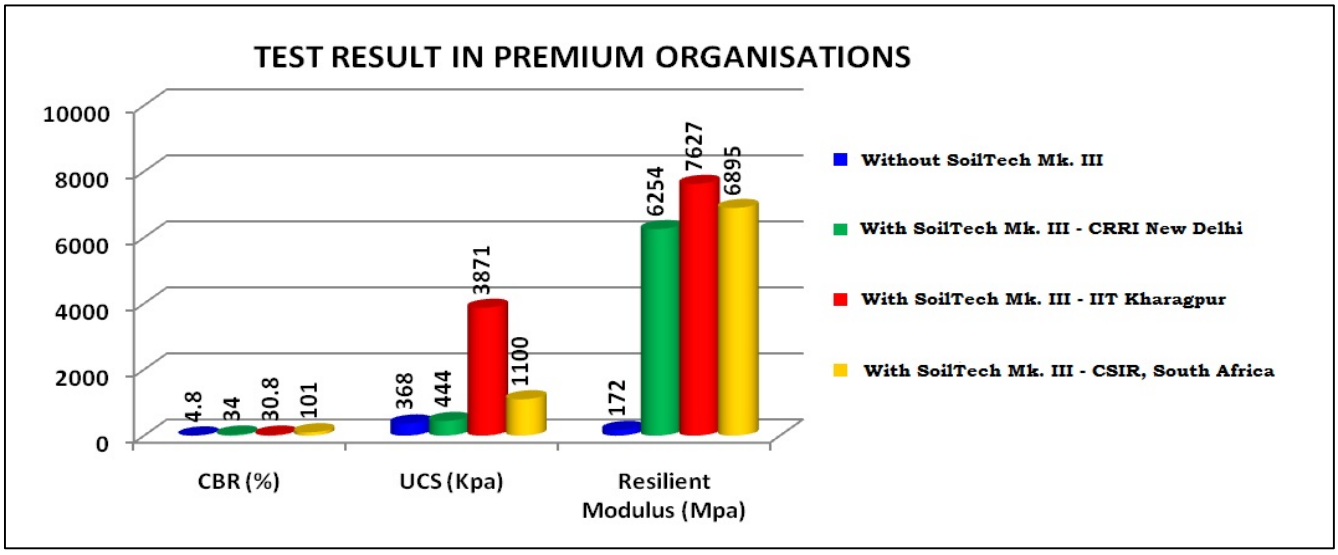
1. Durability and Strenghth

(i). Real Time Case History of NH-1, Panipat -Jhalandhar; Km 96.000 TO 387.000 in the State of Haryana & Punjab

Description	Test results of Borrow Soil without SoilTech Mk. III	Test results of Borrow Soil after blending with 0.5% SoilTech Mk. III	Remarks
Resilient Modulus (Mpa)	154	3264	
Unconfined Compressive Strength (Kpa)	423	1868	
California Bearing Ratio (%)	18.56	218	



(ii) Research and Test Reports from Premium Institute



2. Construction Time, Man, Materials & Machinery

Description	Requirement as per Conventional Crust for Per Km of 5.5 mtr Road	Requirement as per Alternate Design per Km of 5.5 mtr Road	Total Saving	
			Quantity	%
Construction Time (Day)	28	18	10	36
Man Power (Man Days)	784	468	316	40
Machinery (Hours)	224	139.5	84.5	38
Aggregate (Cum)	3317	1578	1739	52
Bitumen (MT)	58	29	29	50

ENVIRONMENTAL BENEFITS

- **Reduction in consumption of quarry aggregates**.
  Aggregate is a non-renewable resource obtained from borrow pits or quarries. Reducing the aggregate consumption reduces creation the pits or quarries requires and help preserve natural vegetation, animal wildlife, and biodiversity. It also reduces noise, dust, and pollution and contamination water caused by blasting operations done to obtain quarry aggregates.

- **Reduction of carbon footprint by reducing CO2 emissions**
  Reducing activities which leads to CO2 emissions can lead to reducing carbon footprint. SoilTech Mk. III stabilization technology reduces blasting operations required to create pit/quarries for aggregates, reduces use and movement of construction machinery by reducing the length of construction period which in turn reduces CO2 emissions.

OTHER SMART MATERIALS

Dust-Tech

Dust Palliative

Dust-Tech essentially is a liquid plastic. The polymer has been developed with a particle size of 10 µm (ten micron). The minute size of the particles allows greater penetration into the soil. The very sticky Dust-Tech liquid polymer is surrounded with stabilizing agents to keep the product from sticking together while in its packaging. Once the product is mixed with water and applied over the ground an evaporation process of the stabilizing agents takes place, leaving the Dust-Tech polymer to penetrate and bind with the soil particles.

Dust-Tech, being a liquid plastic will bind the top 5 to 10mm of the tailing material.

POLY SEAL

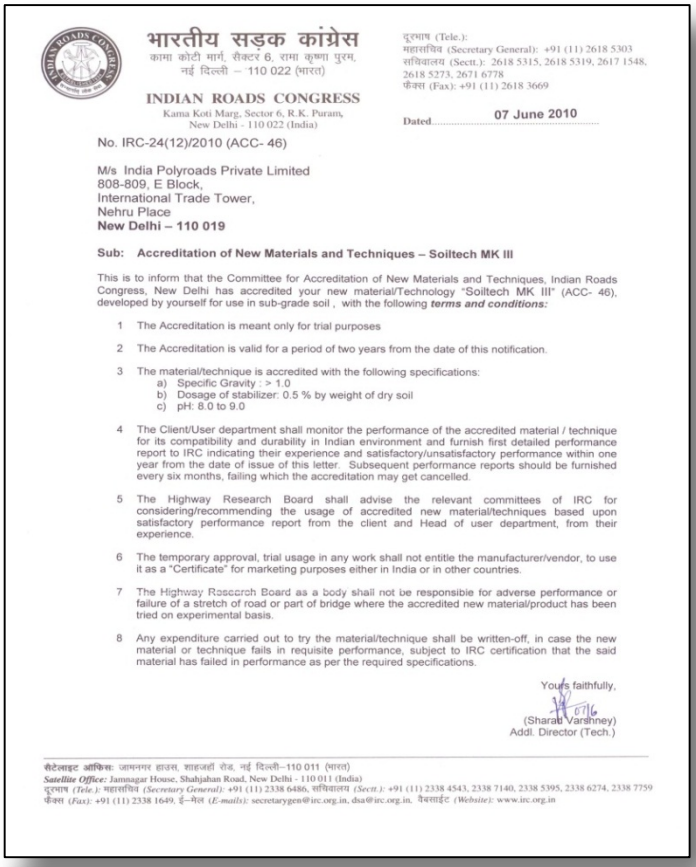
Dam & Barrier liners

PolySeal is a water-soluble polymer spray-on barrier liner. It is a composite consisting of PolySeal elastomeric cross-linking polymers, which is mixed as an admixture with cement and non-plastic aggregates.

PolySeal Geoliner is high-tech, cost effective and easy to apply. The application of three coats of PolySeal emulsion will result in a highly elastic, non-toxic and flexible sealant for concrete or earthen dams or capping of waste stockpiles.

Advantages include relatively low cost, high stiffness, high compressive strength, non-flammability and ease of fabrication. However there are some serious limitations, such as low tensile strength and brittleness, which could affect the long-term durability.

CERTIFICATION



भारतीय सड़क कांग्रेस
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नई दिल्ली – 110 022 (भारत)

INDIAN ROADS CONGRESS
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Dated..... 07 June 2010

No. IRC-24(12)/2010 (ACC- 46)

M/s India Polyroads Private Limited
808-809, E Block,
International Trade Tower,
Nehru Place
New Delhi – 110 019

Sub: Accreditation of New Materials and Techniques – Soiltech MK III

This is to inform that the Committee for Accreditation of New Materials and Techniques, Indian Roads Congress, New Delhi has accredited your new material/Technology "Soiltech MK III" (ACC- 46), developed by yourself for use in sub-grade soil , with the following ***terms and conditions:***

1 The Accreditation is meant only for trial purposes

2 The Accreditation is valid for a period of two years from the date of this notification.

3 The material/technique is accredited with the following specifications:
a) Specific Gravity : > 1.0
b) Dosage of stabilizer: 0.5 % by weight of dry soil
c) pH: 8.0 to 9.0

4 The Client/User department shall monitor the performance of the accredited material / technique for its compatibility and durability in Indian environment and furnish first detailed performance report to IRC indicating their experience and satisfactory/unsatisfactory performance within one year from the date of issue of this letter. Subsequent performance reports should be furnished every six months, failing which the accreditation may get cancelled.

5 The Highway Research Board shall advise the relevant committees of IRC for considering/recommending the usage of accredited new material/techniques based upon satisfactory performance report from the client and Head of user department, from their experience.

6 The temporary approval, trial usage in any work shall not entitle the manufacturer/vendor, to use it as a "Certificate" for marketing purposes either in India or in other countries.

7 The Highway Research Board as a body shall not be responsible for adverse performance or failure of a stretch of road or part of bridge where the accredited new material/product has been tried on experimental basis.

8 Any expenditure carried out to try the material/technique shall be written-off, in case the new material or technique fails in requisite performance, subject to IRC certification that the said material has failed in performance as per the required specifications.

Yours faithfully,
(Sharad Varshney)
Addl. Director (Tech.)

सैटेलाइट ऑफिस: जामनगर हाउस, शाहजहाँ रोड, नई दिल्ली–110 011 (भारत)
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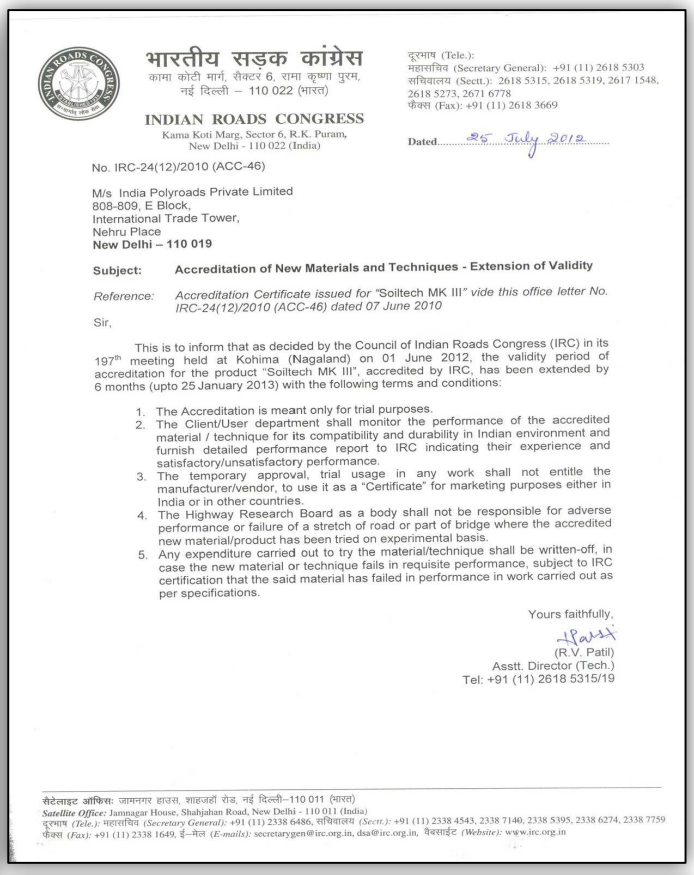

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Dated..... 25 July 2012

No. IRC-24(12)/2010 (ACC-46)

M/s India Polyroads Private Limited
808-809, E Block,
International Trade Tower,
Nehru Place
New Delhi – 110 019

Subject: Accreditation of New Materials and Techniques - Extension of Validity

Reference: Accreditation Certificate issued for "Soiltech MK III" vide this office letter No. IRC-24(12)/2010 (ACC-46) dated 07 June 2010

Sir,

This is to inform that as decided by the Council of Indian Roads Congress (IRC) in its 197th meeting held at Kohima (Nagaland) on 01 June 2012, the validity period of accreditation for the product "Soiltech MK III", accredited by IRC, has been extended by 6 months (upto 25 January 2013) with the following terms and conditions:

1. The Accreditation is meant only for trial purposes.
2. The Client/User department shall monitor the performance of the accredited material / technique for its compatibility and durability in Indian environment and furnish detailed performance report to IRC indicating their experience and satisfactory/unsatisfactory performance.
3. The temporary approval, trial usage in any work shall not entitle the manufacturer/vendor, to use it as a "Certificate" for marketing purposes either in India or in other countries.
4. The Highway Research Board as a body shall not be responsible for adverse performance or failure of a stretch of road or part of bridge where the accredited new material/product has been tried on experimental basis.
5. Any expenditure carried out to try the material/technique shall be written-off, in case the new material or technique fails in requisite performance, subject to IRC certification that the said material has failed in performance in work carried out as per specifications.

Yours faithfully,
(R.V. Patil)
Asstt. Director (Tech.)
Tel: +91 (11) 2618 5315/19

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श्रमेण सर्वम् साध्यम
Border Roads Organisation

SADA VIJAYEE
SADA PRATHAM

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पिन–930031
द्वारा 56 सेना डाकघर
Headquarters
31 Border Roads Task Force
Pin - 930031
C/o 56 APO
29 DEC 2011

TO WHOM IT MAY CONCERN

Certified that "SoilTech MK-III", a nano polymer based soil stabiliser was used for soil stabilization below the Bituminous Concrete layer in Reasi – Pouni – Rajouri Road.

Stringent Technical evaluation and post real time field test performance revealed that, SoilTech MK-III have not only upgraded the CBR values by 600 times over the pre-treated soil; but also the UCS and R. Modulus values have increased significantly. The Product successfully featured to have also restrained rain water from engrossing surface below stabilized base.

The SoilTech MK-III; Nano-polymer application is implemented using very simple machines and manpower with in a very short time of their professional approach while execution.

We wish them more success in their future endeavor.

HQ 31 Border Roads Task Force (GREF)

(P Satyanarayan)
Col
Commander

Patel REALTY

A Patel Venture

Date: 8th April 2010

TO WHOMSOEVER IT MAY CONCERN

This is to inform you that we have used SOILTECH (Formerly called as SOILFIX) Polymer base Soil Stabilizer supplied by M/s. Kaveri India, Bangalore to build Roads in our Project called "NEO TOWN" in Electronic City Bangalore.

They built entire Roads using this New Technology in India and we hereby confirm that the roads were built Faster, Economical and Stronger than Conventional Method of building Roads. We also like to add here that the roads were built during monsoon season also.

We are considering to use this product for our various other Projects.

Thanking you

Yours faithfully
For, Patel Realty (India) Ltd.

Satwinder Singh.

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KAMACHI TMX
TMT BARS
THE SOUL OF STEEL

27th June 2014

TO WHOMSOEVER IT MAY CONCERN

This is to inform you that we have used "Soiltech" soil stabilization chemical which is manufactured by M/s. Polyroads, South Africa. Soiltech was used for soi stabilization to construct roads at our power plant in Gummidipoondi.

There was no aggregate used to stabilize the soil as the soil in Gummidipoondi area is o' a very high quality. The road was constructed in lesser time than the conventional roads. There was also a cost saving as compared to the conventional roads and Soiltech stabilized roads. We have been using the roads without a wearing course for the last 3(months and are very satisfied with the performance.

For Kamachi Sponge & Power Corporation Ltd.,

Vinod Kothari

Authorised Signatory

Kamachi Sponge & Power Corporation Ltd
Corporate Office
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DATE 17-12-08

TO WHOMSOEVER IT MAY CONCERN

This is to inform you that We have used "Soil fix" soil stabilizer manufactured by M/s Kaveri India in our Golfshire Project near new Airport in Bangalore.

We used "soil fix" for stabilizing 200 meter X 7 meter road m the month of April this year and the road stabilized by using soil fix is allowed to heavy traffic and the road is perfect in all respect till date.

On seeing their performance of the product, we ordered them to build entire 7.5 kms stretch at our project. They built the road using soil fix during monsoon and the same is built to our total satisfaction.

We estimated a time form of 6 months to build this road but the road was built in only 2 months during monsoon. The budgeted cost also came down by 25%o to build this road b} using soil fix.

Thanking you

Yours faithfully

(FOR PRESTIGE ESTATES PROJECTS PVT LTD)

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