

**MANIBHADRA
EARTHMOVERS**

**IT PAYS
TO GO
GREEN**

TerraZyme
OPTIMAL SOIL STABILIZER

**TerraZyme - A Cost Efficient alternate for GSB and WMM for roads.
Accredited By IRC**

ABOUT US

Manibhadra Earthmovers is a civil engineering firm established in 1996. We specialize in the field of road work, filling work, basement and all infra-related work. Our belief in strong work ethics of providing highest quality standards and our non-negotiable policy for the health & safety of our workers have majorly contributed to our firm's success. We are successful today, not only because our knowledge, expertise & experience but also because of our talent pool of qualified employees that work on-site and off-site to achieve goals without compromising on quality of work.

We have experience & expertise in following **types of work-**

- Bituminous, RCC and Paver Road
- Government road
- Eco friendly / All weather road
- Mass Excavation & Earth Filling
- Commercial, Industrial and Residential Projects
- Land Stabilization

A COST-EFFICIENT & ECO FRIENDLY ALTERNATE FOR GSB AND WMM ROADS

With changing pace and time, considering the climatic and environmental impact, we have been continuously innovating. This is our mission behind introducing and promoting **TerraZyme, an eco-friendly product**. We at **Manibhadra Earthmovers** in association with Avijeet Agencies (P) Ltd (distributors of TerraZyme in India for past 19 years) have taken up exclusive rights for Western India Region for TerraZyme. This product is manufactured by Nature Plus Inc, USA. The vast experience of 30 years in road work of **Manibhadra Earthmovers** and their expertise has lead has lead to this synergy of interests in promoting TerraZyme.

TerraZyme is an excellent replacement for GSB and WMM. The use of TerraZyme leads to a saving upto 10% to 30% - per Sq.mt in road construction. TerraZyme is a biodegradable product made from plant and vegetable extracts. It helps in the workability of soil by improving the engineering properties of the soil like CBR value, ITS, Density. It also helps in reducing OMC, plasticity index of soil and its permeability.

APPLICATION PROCEDURE



Scarifying
The Surface



Adding TerraZyme
To Water Tank



Spraying The
TerraZyme



Mixing The
TerraZyme



Templating And
Leveling



Compaction



Road Ready To Use

Design Comparison CBR 6, MSA 20, As per IRC 37

Conventional Design	thk in mm	TerraZyme Design	thk in mm
GSB	260	Subgrade improved with TZ	150
WMM	250	Existing Soil + TZA + Metal 20%	150
		Good Soil + TZA + Metal 30%	100
DBM	90	WMM	150
BC	40	DBM	50
		BC	25
TOTAL	640	TOTAL	625

CALCULATION

As per IRC 37 – 2011 (MSA 20 and CBR 6%)

Elastic modulus of subgrade, $E_{sg} = 17.6 \times (CBR_{sg}) 0.64 \text{ MPa}$

Elastic modulus of granular sub-base, $E_{gsb} = 0.2E_{sg} \times (h_{gsb}) 0.45 \text{ MPa}$

h_{gsb} is the thickness granular sub base.

Elastic modulus of granular base, $E_{gb} = 0.2 E_{sg} \times (h_{gsb} + h_{gb}) 0.45 \text{ MPa}$

h_{gb} is the thickness granular base.

For stabilized material, $E = 1000 \times \text{UCS Mpa}$

UCS for stabilized material = 1000kPa

KENPAVE ANALYSIS

Poisson's Ratio varied from 0.5 to 0.4

E value for each layer was taken from the above table.

Loading – single axle single tyre

Contact Radius of circular loaded areas, CR – 17cm

Contact Pressure on circular loaded areas, CP – 560kPa

One Radial Coordinate was considered, at the loading point (RC at 0cm)

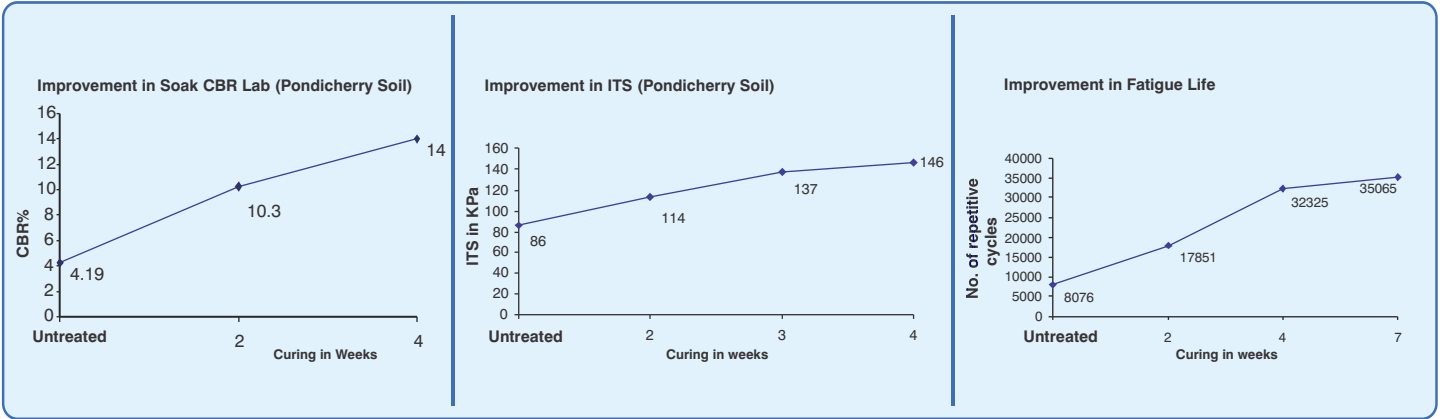
IRC 37 Standard case

	Vertical Coordinate	Vertical Displacement	Vertical Stress	Vertical Strain	Radial Stress	Radial Strain	Tangential Stress	Tangential Strain
	0	0.08721	560	-6.54E-04	1672.149	3.27E-04	1672.149	3.27E-04
BC	4	0.09047	519.783	1.81E-04	212.87	-9.03E-05	212.87	-9.03E-05
DBM	13	0.08311	311.81	1.03E-03	-238.148	-5.46E-04	-238.148	-5.46E-04
WMM	38	0.05857	81.792	5.78E-04	-34.177	-2.78E-04	-34.177	-2.78E-04
GSB	64	0.0466	28.399	3.62E-04	-29.306	-2.15E-04	-29.306	-2.15E-04

TerraZyme Modified case

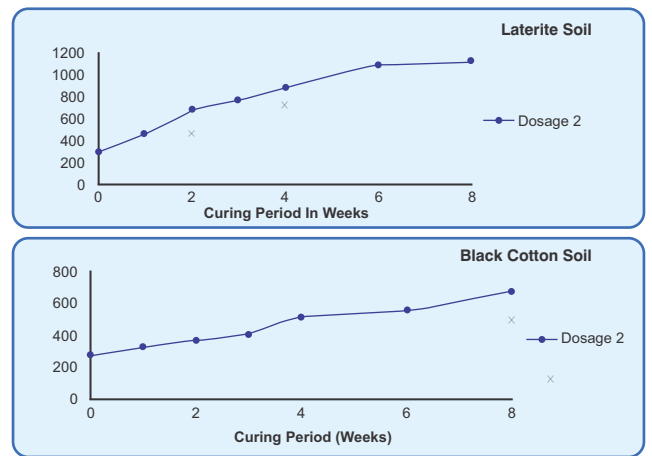
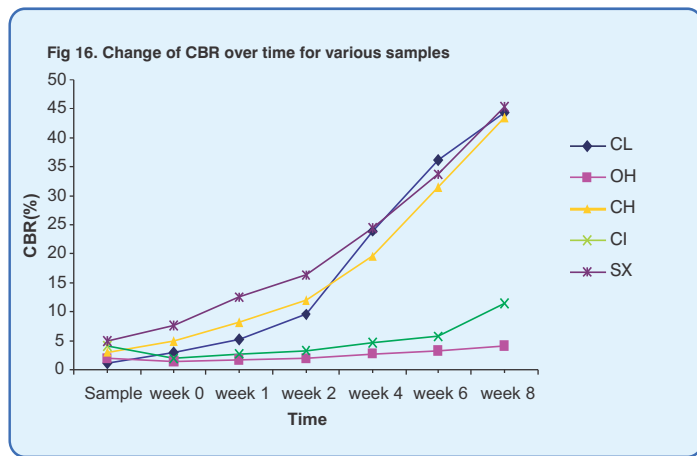
	Vertical Coordinate	Vertical Displacement	Vertical Stress	Vertical Strain	Radial Stress	Radial Strain	Tangential Stress	Tangential Strain
	0	0.04336	560	-1.81E-04	722.094	9.06E-05	722.094	9.06E-05
BC&DBM	7.5	0.04561	499.39	1.57E-04	231.725	-7.87E-05	231.725	-7.87E-05
WMM	22.5	0.04119	222.758	2.21E-04	2.622	-8.75E-05	2.622	-8.75E-05
Soil + TZA + 30% metal	32.5	0.03938	107.409	1.51E-04	-54.248	-7.55E-05	-54.248	-7.55E-05
Soil + TZA + 20% metal	47.5	0.03723	27.789	1.65E-04	-171.534	-1.14E-04	-171.534	-1.14E-04
Mod. SG	62.5	0.03427	15.175	1.94E-04	-25.473	-1.17E-04	-25.473	-1.17E-04

From the above Tables it can be observed that, the vertical stress at centre line of loading is 560 KPa (at vertical coordinate of 0). When the depth of the pavement increases the stress reduces and it become 28.399 KPa at the point just above the subgrade. This stress level has to be kept as the bench mark. When the conventional layers are replaced by the enzyme stabilized soil the stress levels have to be lesser than that of the standard cases. Trial and error method was adopted to find out the minimum thickness of the stabilized material. Similar observation can be made in terms of vertical displacement.

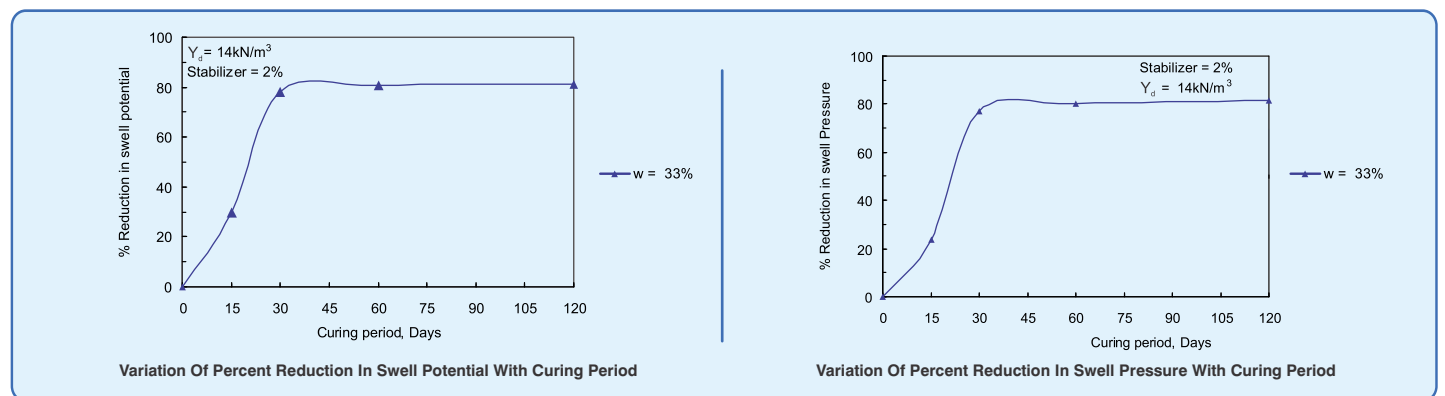


UNIVERSITY OF BANGALORE

UCS RESULTS – NITK SURATHKAL



IMPROVEMENT BLACK COTTON SOIL



PERMEABILITY TEST RESULTS

Dosage (% of Enzyme)	Lateritic soil Permeability in(cm/sec)	Shedi soil Permeability in(cm/sec)
0	1.809×10^{-7}	1.635×10^{-9}
2	1.793×10^{-7}	1.578×10^{-8}
4	1.787×10^{-6}	1.543×10^{-7}
6	1.786×10^{-5}	1.512×10^{-7}
8	1.786×10^{-5}	1.487×10^{-7}



ADVANTAGES

The main feature of TerraZyme is the cost saving aspect. TerraZyme saves cost upto 30% in comparison to conventional system of road construction and maintenance cost of roads is reduced by 50%

- Cuts construction cost by 10% - 30%
- Higher CBR value / higher road strength : TerraZyme base structures have a higher CBR value
- Lowers the maintenance cost by 30 - 50%
- Saves construction time by 50%
- The life-cycle of TerraZyme treated roads increase by 200–300%
- Pavement thickness can be reduced by up to 30 %, being semi rigid in nature
- Environment friendly and bio-degradable product

USES OF TERRAZYME

TerraZyme can be used anywhere where GSB and WMM are used in construction as it replaces them.

- Highways
- All weather rural roads
- Internal roads in townships
- Service roads
- Factory roads
- Parking Lots and Yard area
- Sealing of ponds, landfills
- Temporary access roads
- Subgrade improvements
- Floor bases
- Road shoulders
- Construction roads

SUCCESSFUL TESTING OF TERRAZYME IN INDIA

We have been working with all reputed institutes across India for the past twelve years. Some major institutions that have associated with us are :

- Central Road Research Institute (CRRI)- Delhi
- IIT Roorkee
- IIT - Bhubaneswar
- University Of Bangalore - Pavement Engineering Lab
- Anna University - Chennai
- SASTRA - Tanjore
- NITK - Surathkal
- NIT - Calicut
- NIT - Trichy
- NIT - Warangal
- NIT - Jharkhand

INDIAN CLIENTS AND REFERRALS

We are proud to state that we have made TerraZyme based and Conventional roads across India, on various soil, climatic and traffic conditions. In every project TerraZyme has proved that it is cheaper than conventional methods and long lasting with a lower maintenance cycle.

- NH-66 , NH Department (Chennai circle)
- NH4A, NH Department (Goa)
- Semac Potential Consultants
- Torrent Pharma
- Godrej Properties Ltd.
- Shapoorji Palonji
- JMC Projects
- Applewoods Township - A'bad
- Tata Housing
- Visteon
- Ennore Port
- Tata Motors - Sanand
- HN Safal
- Arvind Smartspace LLP.
- Grainspan
- Renault Nissan
- Pacifica Group
- Wipro Ltd
- Rico Auto India Ltd
- Mott Mac India
- Infosys
- Daimler Trucks
- KRRDA, Karnataka
- PRED, Karnataka
- APRRDA, Andhra Pradesh
- TSRRDA, Telangana
- DRDA, Tamil Nadu
- ORRDA, Orissa
- CGRRDA, Chattishgarh
- JRRDA, Jharkhand
- APWD, Assam

INTERNATIONAL APPROVALS

- Pennsylvania Highway Department
- Canadian PWD
- Brazil Highway Department
- Paraguay
- Russia
- Phillippines
- Malaysia
- Uganda
- Equador
- China
- Japan
- Honduras
- USAID Projects
- World Bank Approved

ROADS CONSTRUCTED IN INDIA



NH 66 - Tindivanam



NH 4A - Goa



TATA Motors - Sanand



Alstom - Sanand



Orissa - DRDA Road



Schwing Stetter Factory



Reitzel India Factory



Torrent Pharma



Rann of Kutch



Arvind Tata JV Township



Arvind Uplands



Applewoods Township A'bad

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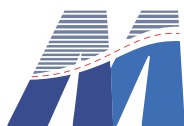


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