



AVIJEET AGENCIES

Private Limited
www.avijeetagencies.com

Karnataka-Progress Report on Bio-enzyme Soil Stabiliser TerraZyme (2013-18)

**IT PAYS
TO GO
GREEN**

ECO

100% natural
product

TerraZyme
OPTIMAL SOIL STABILIZER

TerraZyme - A low cost alternate of GSB and WMM for roads.

Accredited By IRC



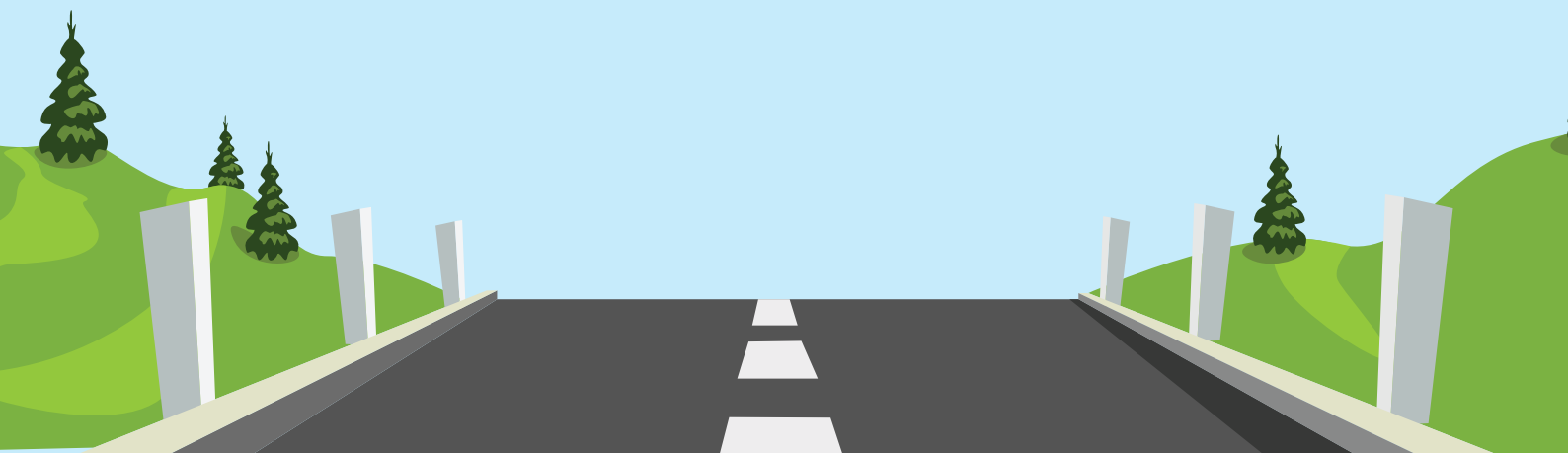
**IT PAYS
TO GO
GREEN**



H.O. H5,25, Ground Floor, Subramanian Manor, 1st Main Road, Anna Nagar (E), Chennai -600 102
Email : apoorva@avijeetagencies.com Mob : 9345635353.

Contents

Sl. No		P. No
1.	Introduction	1
2.	Product brief	2
3.	Certificates & Approvals	6
4.	Cost & Design comparison	13
5.	Construction Methodology	14
6.	List of TerraZyme works 2014-16	16
7.	Performance evaluation - RASTA	17
8.	List of Works in NGNRY4	23
9.	Photographs of Roads NGNRY3	24
10.	Photographs of Roads NGNRY4	26
11.	Cross section Flexible pavement	28
12.	Cross section Rigid pavement	29
13.	Photos of Rigid pavement over TerraZyme layer	30
14.	Conclusion	31



1. Introduction

To;
Shri H K Patil,
Honourable Minister-RDPR,
Government of Karnataka,
Bangalore



Dear Sir,

Thank you for the opportunity given to us to introduce TerraZyme - The Innovative Technology in Road Construction in the RDPR Department.

October 2013, was the landmark for the change in the rural road construction vision, when RDPR department had made a platform that day to know about the various Innovative Technologies for Road construction. Many of the Companies had presented their technologies on that day.

We are happy to inform you that we were also one among them. There by, we put our continuous and sincere efforts to introduce and elucidate our technology to the department. Sir, with your great cooperation and guidance we would able to stand top amongst innovative technology with the highest success rate throughout the state.

Since 2014 to Feb 2018, we have completed 80+ Km roads throughout Karnataka. Among those some of the roads have been evaluated functionally and structurally by State Technical Agencies (RASTA) and results were found to be excellent.

After technical scrutiny, the Highway development board has given accreditation for TerraZyme for the next two years.

Due to this success of past 3 years, we are in tender documents to the tune of 900km in state of Karnataka, Andhra Pradesh and Tamil Nadu, Orissa and Jharkhand under various schemes which included Central and State level schemes like PMGSY, CMGSY etc.

The List of awarded works using TerraZyme in PMGSY and other state schemes

- a) Karnataka - 180 km
- b) Andhra Pradesh - 150 km
- c) Chattishgarh - 190 km
- d) Orissa - 350 km
- e) Tamil Nadu - 80 km
- f) Assam- 220 km

We are very glad to submit the progress and performance report of Bio Enzyme Technology.

Yours Sincerely
Apoorva Modi
Vice President

2. Product Brief



AVIJEET AGENCIES
Private Limited
www.avijeetagencies.com

TerraZyme, manufactured by Nature Plus Inc – U.S is an excellent replacement for WBM and solling. TerraZyme is a liquid extract from sugar molasses that improves the engineering qualities of the soil like CBR values and density and decreases the OMC, plasticity index of soil.

The main feature of TerraZyme is the remarkable cost saving aspect. TerraZyme saves cost from up to 20% in comparison to the conventional system of road construction. Maintenance cost is dramatically reduced up to 75%.

Benefits of using TerraZyme (in comparison with conventional structure):

- Cuts construction cost up to 20%
- Higher CBR value / higher road strength: TerraZyme base structures have a much higher CBR value.
- Lowers the maintenance cost by 30-50%. Saves construction time by 50% (2000 -2500 Sq.mt per day)
- The life-cycle of TerraZyme treated roads increase by 200–300%.
- Pavement thickness is reduced by 30-50%, being semi rigid in nature.
- Environment friendly and bio-degradable product.

TerraZyme is used for constructing:

- Highways
- Rural Roads
- Parking lots, Industrial roads
- Townships Road, internal roads.
- Factory Flooring
- Construction roads
- Service roads
- Secondary Roads, Haul roads
- Airport Runways

Laboratory and Field Research:

TerraZyme has been tested and has been proved successful by the following prestigious institutions:

- NITK - Suratkal, STA, PMGSY
- Central Road Research Institute (CRRI), Delhi
- Anna University, Chennai
- Bangalore University "Dr. A. Veeraraghavan", Bangalore
- College of Engineering ,Trivandrum "Dr. Kuncheria P. Isaac", Trivandrum
- Shanmuga College of Engineering, Tanjore

2. Product Brief

The product has been tested in detail by NITK – Suratkal in lab and field conditions for a period of 1 year, which was also certified by the institute. The product has been tested on BC soil by UVCE, Bangalore and it was found that swell % of the soil is reduced by 80%.

All lab test from CRRI, NITK, UVCE and other esteemed organisation prove that with use of TerraZyme, CBR values increases, UCC values are increased by 500% , Fatigue life cycle improves by atleast 300%. Other than this TerraZyme also improves the density of the soil, reduces the OMC and permeability of soil, giving longer and better maintained roads.

Various successful & prestigious projects executed by us for the following clients:
We are the only firm in India who has the experience of using Bio enzyme stabiliser for the past 16 years across various traffic, soil and climatic conditions. We have built National Highways to rural roads under PMGSY and DRDA. We have also constructed many roads in private sector for industries, residential layouts and institutional bodies.

Few are listed below

PMGSY Karnataka
PRED Karnataka
PMGSY Orissa
PMGSY Andhra Pradesh
PMGSY Telangana
PMGSY Chattishgarh
PMGSY Jharkhand
Triton Valves
Tata Housing
Hiranandani Construction

Wipro Ltd
Sobha Developers
Bharat Forge - Pune
Puravankara Estates
Maytas Infrastructure
Mantri Developers
Semac Consultants
Shapoorji Pallonji
Dalal Mott MacDonald
Tata Power Corporation Ltd

International Projects :

Nature Plus product, TerraZyme Soil Stabilizer, was selected by USAID as the principal product for stabilizing the roads being reconstructed in Honduras due to the extensive damage from Hurricane Mitch under Project RECAP/USAID-FHIS 004.

Nature Plus product, TerraZyme Soil Stabilizer, is a approved product for the World Bank/MOPC road rehabilitation project in Paraguay, BIRF 3685-PA.

2. Product Brief

Nature Plus product, TerraZyme Soil Stabilizer, has been tested by department of transportation, under severe climatic conditions in Commonwealth of Pennsylvania for a period of 8 years (1992-2000) and has been granted provisional approval for its use in the Commonwealth of Pennsylvania.

Nature Plus product, TerraZyme Soil Stabilizer, has also been tested extensively in field conditions in countries like Brazil, Malaysia, Thailand, Mexico, Honduras, Mexico, Columbia and Uganda with successful results and has got approvals for use in various countries.

Based on above criteria and successful implementation of roads in India for past 16 years, we would request you to grant us the permission to use TerraZyme for constructions of roads under World Bank funding scheme

We have enclosed a detailed write up on TerraZyme and also its benefit and details of its track record in India. The enclosure also includes letters of approval from CRRI, NITK Suratkal, approval from MORD and other prominent bodies across the world

Our Services

We specialise in helping government agencies, concessioners, BOT operators, contractors to make economical feasible design based on IRC 37 and IRC 72 using TerraZyme.

We also give quality control supervision with trained personnel deputed at the site, during the application process of TerraZyme during the entire duration of the project.

We help in getting the most economical pricing and structural strength of the roads in all kinds of traffic, soil and weather conditions. We ensure the work involves minimal import of soil and metal but still match all criteria's of road design laid down by MORTH and IRC.

Our Achievements

We have our rate approved in the states of Karnataka, Tamil Nadu, Andhra Pradesh, Telengana, Orissa.

We have completed over 80+ kms of roads work which is working well past 2 monsoons and also we have over 900km of road work under our kitty

2. Product Brief

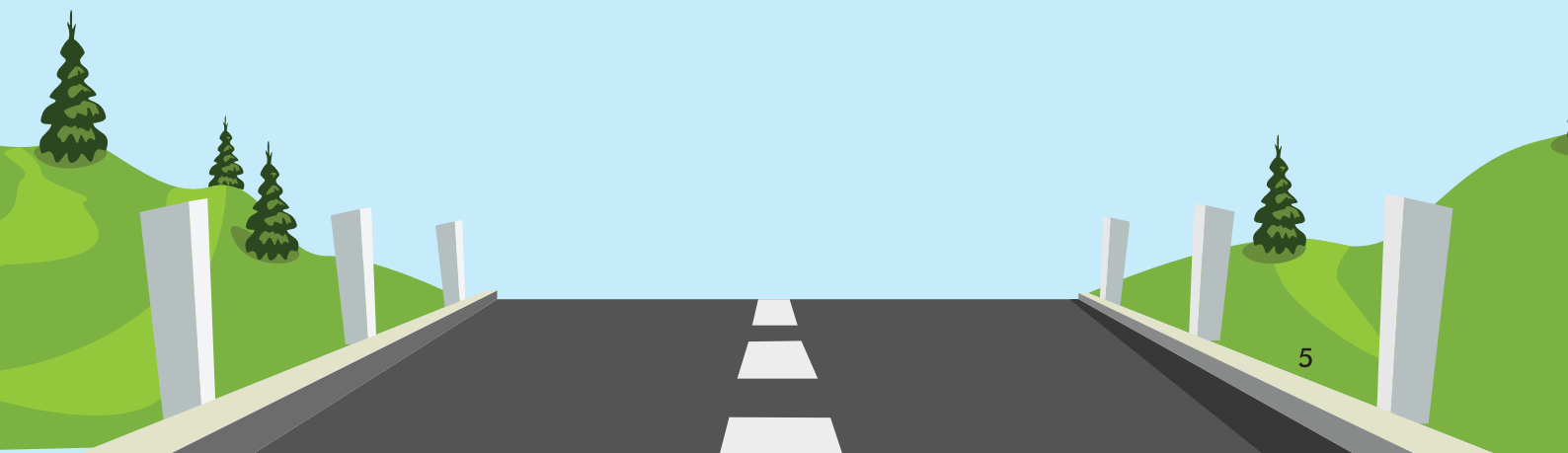


We are pioneers in alternate technology with experience over 17 years in the field constructing roads in different traffic, soil, rainfall conditions

We are also consulting and training engineers from Afghanistan, Bangladesh and Nigeria. Based on our performance our accreditation with IRC has been renewed for 2 more years successfully.

We hope that the information provided by us would provide you with a broader perspective on the usage of TerraZyme. Please feel free to contact me or my staff for any further assistance. Thanking you and assuring you of our services always, we remain

Regards
Apoorva Modi
Vice President



3. Certificates & Approvals



AVIJEET AGENCIES

Private Limited
www.avijeetagencies.com



भारतीय सड़क कांग्रेस
कामा कोटि मार्ग, सेक्टर - 6
आर के पुरम, नई दिल्ली - 110 022 (भारत)
INDIAN ROADS CONGRESS
Kama Koti Marg, Sector- 6
R.K. Puram, New Delhi - 110 022 (INDIA)
Tel. : +91 (11) 2618 5303
E mail : secygen.irc@gov.in

No.IRC-24(12)2016/Terrazyme

Dated: 29.10.2016

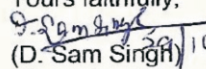
M/s Avijeet Agencies Pvt. Ltd.,
H 25(5), Subramanian Manor,
Ground Floor, H Block,
1ST Main Road,
Anna Road(E),
Chennai-600102
E-mail: apoorva@avijeetagencies.com

Subject: **Renewal** of Certificate of Accreditation of New/alternative materials/techniques/ technologies/equipments for adoption in the Highway Sector namely "**Terrazyme**"

Sir,

I am directed to state that the presentation was made to the Accreditation Committee of IRC on **16th September, 2016** by the rep. of M/s Avijeet Agencies Pvt. Ltd. for renewal of validity of Accreditation for the product stated in the subject which was earlier accredited by IRC vide letter No.IRC-**24(12)/2009-(ACC-44) dated 03.07.2013**. It was presented that the proposed new material i.e. "**Terrazyme**" an environmental friendly & biodegradable material, which is in fact a liquid extract from sugar molasses that improve soil strength/density by decreasing OMC, Plastic Index and hence save upto 40% cost in comparison to conventional construction of GSB/WBM (non-bituminous sub-base/lower base) of pavement besides save construction time. The committee taking into cognizance the performance report/certificates from construction agencies in support of its performance evaluated, has recommended to renew the accreditation of the proposed material under the trade name "**Terrazyme**" promoted by M/s Avijeet Agencies Pvt Ltd. Taking into account the recommendations of the Committee, the accreditation of the proposed new material under the trade name "**Terrazyme**" is hereby renewed on *trial basis* for adoption in the Highway Sector subject to the following :

- (i) This Accreditation certificate shall remain **valid for a period of two years** from the date of issue of this Certificate i.e. 29.10.2016 or till the date the licensee (Manufacturer/distributor/Vendor etc) enjoys the legal production/marketing right interested/passed on him by the patent company/sole proprietor of material /technology in terms to the agreement, whichever is earliest.
- (ii) The developer/promoter shall have to strive to furnish the **performance reports** of the accredited material/technique from the client/user agency (State PWD/NHAI/BRO/NHIDCL/Rural Road Agencies/Corporate Bodies etc) evaluated over a period of time (**preferably half yearly cycle**) to establish their suitability for adoption and formulation of guidelines and codes of practice for their future usage in the Highway Sector.
- (iii) The promoter/developer of the accredited material/technique shall be required to bear the extra cost involved in the field trials.
- (iv) The developers/promoters shall strive to establish permanent base in India and show long term commitment to the goal of innovative infrastructure development in India.

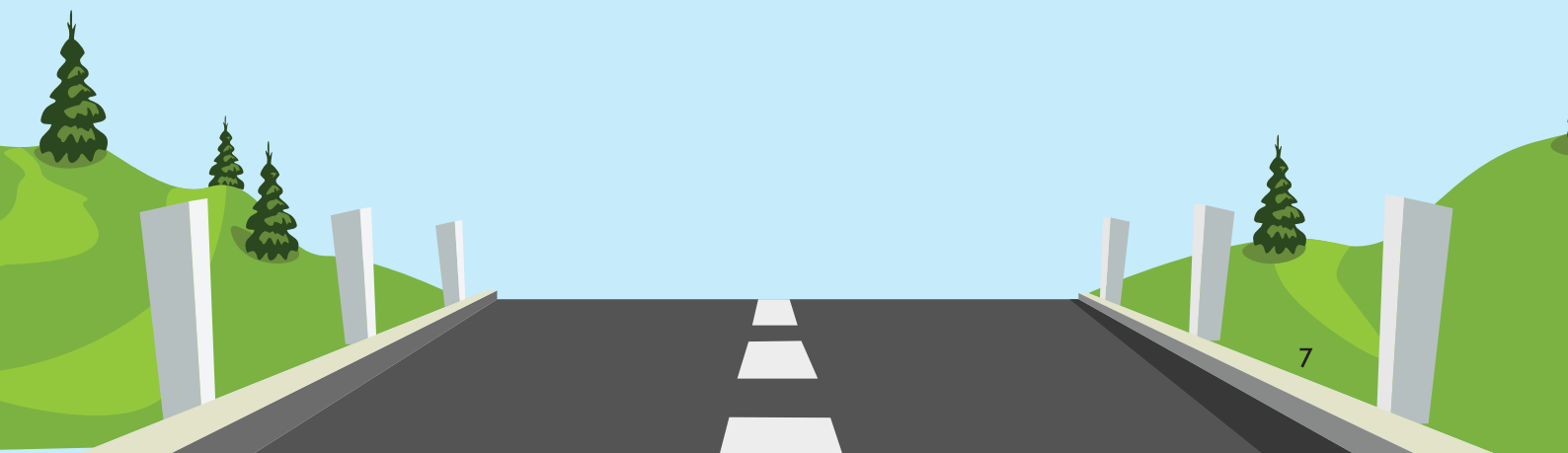
Yours faithfully,

(D. Sam Singh)
Deputy Secretary (I/c)

3. Certificates & Approvals



AVIJEET AGENCIES

Private Limited
www.avijeetagencies.com



3. Certificates & Approvals



AVIJEET AGENCIES
Private Limited
www.avijeetagencies.com



Phones 6832173, 6832325, 6832376
(EPDQ) 6832427, 6313376, 6913266

केन्द्रीय सड़क अनुसंधान संस्थान

(वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद्)

Fax 91 11 6845943
E-Mail crri@simetd.ernet.in

CENTRAL ROAD RESEARCH INSTITUTE

(COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH)

Delhi-Mathura Road, P.O. CRRI, New Delhi - 110 020 (INDIA)

ISO/FPD/02/2A(0)/757

Dated 10-10-2001

Apporva Modi
Avijeet agencies Pvt. Ltd.
42, Ritherdon Road
Purasawalkam, Chennai
600007, India

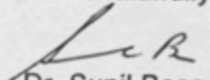
Dear Mr. Modi,

We would like to thank you and your consultants, for the efforts you have made to introduce to us the bio-enzymatic soil stabilizer "Terrazyme", manufactured by Nature Plus, Inc. As mentioned in our previous letter, CRRI is most interested in new technologies, which can lower the life-cycle cost of roads.

The results of the preliminary laboratory test we conducted correlate with the information from the various test reports you provided. We observed that positive behavioural changes occur in some soil types after stabilisation with the product. However these require a detailed study before any positive conclusions are drawn, and we would like to observe the behaviour of roads stabilised with TerraZyme under normal traffic conditions. We invite you to join us for the further discussion on the possibilities of utilisation of your product in the construction of rural and urban roads.

Thanking you

Yours faithfully


Dr. Sunil Bose 12/10/01

Head, Flexible Pavements Division

3. Certificates & Approvals



AVIJET AGENCIES
Private Limited
www.avijetagencies.com

NATIONAL HIGHWAYS

FROM

Thiru K. Thangarasu, M.E., MIE,
Superintending Engineer,
National Highways,
H.R.S. Campus, Guindy,
Chennai-600 025.

TO

M/s AVIJET AGENCIES (P) LTD.
CHENNAI-600 007.

Dated : 07-02-2003.

Gentleman,


I like to inform that M/s Avijet Agencies (P) Limited have tried the bio-enzymatic soil stabilizer Terrazyme, in the formation of the diversion road for the work of "Reconstruction of the minor bridge at Km 42/8 of NH-65".

The work was done as an experimental basis. After the formation of the earthen embankment the sub-base and base were treated with Terrazyme. No asphalt layer was laid.

Since no W.B.M. and P.C. layers were done, the cost of the diversion road was very much reduced (nearly 50%).

The diversion road withstood for 8 months during the construction of the bridge. Even during rainy days, with heavy traffic, there was no damage to the diversion road. No deformation, no slush forming or any ill effects were found.

It is concluded that the use of Terrazyme is found to be satisfactory.


Superintending Engineer,
NH:Chennai-25.

3. Certificates & Approvals



AVIJET AGENCIES
Private Limited
www.avijetagencies.com



Republic of the Philippines
Department of Public Works and Highways
Office of the Secretary

CERTIFICATE OF CONDITIONAL APPROVAL

Product Accreditation

This is to certify that

TerraZyme

which is supplied in the Philippines by :

PHILSLINUS Inc.
3-B Scouter Ojeda Street
Barangay Paligsahan
Quezon City 1103

and

ARMINEX Inc.
72 Scout Chuatoco St.
Roxas District
Quezon City

is duly accredited for use in DPWH projects as soil stabilizer, subject to its specifications (hereto attached) pursuant to the provisions of DPWH Department Order No. 189, series of 2002.

This Accreditation shall remain in force until expiry date printed below, subject to compliance with the requirements of the aforementioned Department Order.

Conditional Approval No. : 006
Date Issued : March 2005
Expiry Date : March 2010

HERMOGENES E. EDDANE, JR.
Acting Secretary



WIN5U00002

3. Certificates & Approvals



AVIJEET AGENCIES
Private Limited
www.avijeetagencies.com



BANGALORE UNIVERSITY
FACULTY OF ENGINEERING – CIVIL, UVCE

Phone: Off. 22961936

Dr. S. Gangadhara
Associate professor

Jnana Bharathi
Bangalore – 560 056

12.06.2012

To,
M/s Avijeeth Agency
Chennai

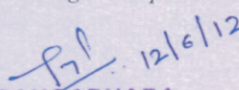
Sir

Sub: Evaluation report on “Terrazyme” as a stabilizer for Expansive soils

With reference to the above, please find enclosed the detailed evaluation report on the “Terrazyme” as a stabilizing agent to control the swelling of expansive soils and to improve the strength of expansive soils based on the investigations conducted at the Soil mechanics laboratory of the Department of Civil Engineering, Bangalore University during the period 2008-2012.

The laboratory experiments are conducted with the objective of ascertaining the possibility of using the “Terrazyme” to control the swelling of expansive soils and to study the strength improvement due to “Terrazyme stabilization”. Experiments are carefully designed and conducted as per the testing program outlined in the report. Based on the results of the experiments the following conclusions are drawn and the recommendations are made.

- 1) The ‘Terrazyme’ can be effectively used to control swelling in expansive soils. The swell potential and swell pressure of expansive soil specimens reduces considerably upon treatment with ‘Terrazyme’.*
- 2) The dosage of ‘Terrazyme’ plays an important role in reducing the swelling of expansive soils. It was found that at 2% ‘Terrazyme’ content, maximum reduction in swelling was achieved. The reduction in swelling was up to 80%*


Dr. S. GANGADHARA
M.E. Ph.D. (Geo Technical Engg)
Associate Professor
Department of Civil Engineering
UVCE, Jnanabharathi,
BANGALORE UNIVERSITY
BANGALORE - 560056 INDIA.

3. Certificates & Approvals

depending on other influencing parameters such as initial compaction condition, curing period etc.

3) The reduction in swelling characteristics of 'Terrazyme' treated specimens is accompanied by reduction in plasticity of soil, increase in shrinkage limit and reduction in percent finer of soil particles. The magnitude of reduction in these parameters depends on dosage of 'Terrazyme'.

4) The scanning electron microscopy images indicated the dispersed structure for the 'Terrazyme' treated specimens. The specimens with dispersed structure exhibit low swelling compared to specimens with flocculated structure.

5) It is inferred that the addition of bio enzyme increases the Unconfined Compressive strength of the expansive soil specimen. The magnitude of increase depends on initial density and the initial water content.

With the above findings, it can be inferred that the 'Terrazyme' can definitely be used in expansive soil areas to control the swelling of such soils and to improve their strength characteristics. 'Terrazyme' may become more useful as it is water soluble and hence may be applied to the soil easily. Further the water soluble 'Terrazyme' can penetrate deep in to the ground there by stabilizing the ground to a deeper depths.

Reduction in swelling and increase in strength of the soil upon treatment with "Terrazyme" may facilitate better road design and construction practices in Expansive soil areas.

P71 12/6/12
Dr. S. GANGADHARA
M.E. Ph.D. (Geo Technical Engg)
Associate Professor
Department of Civil Engineering
UVCE, Jnanabharathi,
BANGALORE UNIVERSITY
BANGALORE - 560056 INDIA.

4. Cost & Design comparison

Cost Comparison of Terrazyme technology with Coventional design

Cost Comparison Ballary CBR 5, T4 using TerraZyme							
Conventional Cost Calculation For WBM-II, WBM-II and GSB (Per KM)							
Particulars	Unit	No	Length	Width	Depth	Rate	Total Amount
WBM Grading - III	Cum	1.00	1000.00	3.75	0.075	2260.00	6,35,625.00
WBM Grading - II	Cum	1.00	1000.00	3.9	0.075	1912.00	5,59,260.00
Granular Sub Base	Cum	1.00	1000.00	7.5	0.15	1073.00	12,07,125.00
Earthern Shoulders	Cum	2.00	1000.00	1.50	0.175	306.00	1,60,650.00
Total Cost of WBM - II WBM- III and GSB (Per KM)							25,62,660.00

TerraZyme Cost Calculation For WBM - III and GSM/ TerraZyme treatment (Per KM)							
Conventional Cost Calculation For WBM-II, WBM-II and GSB (Per KM)							
Particulars	Unit	No	Length	Width	Depth	Rate	Total Amount
WBM Grading - III	Cum	1.00	1000.00	3.75	0.075	2260.00	6,35,625.00
Base with TerraZyme	Cum	1.00	1000.00	3.90	0.100	1105.66	4,31,206.42
		1.00	1000.00	4.05	0.100	1114.66	4,51,437.00
Granular Sub Base	Cum	2.00	1000.00	1.50	0.100	1073.00	3,21,900.00
Earthern Shoulders	Cum	2.00	1000.00	1.50	0.100	306.00	91,800.00
Total Cost of WBM - II WBM- III and GSB (Per KM)							19,31,968.68

Savings 6,30,591.32

Cost of Conventional Design = Rs. 25,62,660.00

Cost of TerraZyme technology design = Rs. 19,31, 968.68

Total Savings per km = Rs. 6.30,691.00 (24,61% Savings per km)

5. Construction Methodology

The concept of bio-enzymatic soil stabilization is to improve the engineering characteristics of local soils by uniformly introducing the quantity of water and catalytic organic ions into a pre-selected soil such that they will promote efficient compaction and catalyse improvements in the clay structure. It is clearly mentioned in the literature provided by the producer NPI that successful stabilization of a soil depends on three criteria.

Uniform distribution of the liquid formula over the area selected for treatment.

Uniform mixing of the formula throughout the depth of the soil.

Compaction of the uniformly treated soil at OMC.

TerraZyme is provided to the contractor in concentrated form in 20 litre or 220 litre containers. The road is constructed in the following methodology



Application Procedure :

A Ploughing:

The existing murrum road was watered and overnight. Thereafter the road was ripped using a cultivator to the required depth. This operation requires minimum of 4 passes

b. Pulverizing of Soil :

The soil is pulverized using the rotary tiller/plough. The pulverization helps in getting maximum surface area of soil particles in contact with TerraZyme. This operation requires minimum of 2 passes



5. Construction Methodology



AVIJEET AGENCIES
Private Limited
www.avijeetagencies.com



c. Adding of the enzyme in water: after establishing the amount of water needed to be added to the soil to reach OMC minus 2 or 3 percentage points, the engineer can dilute the quantity of enzyme as indicated the specifications in a water tanker. The water is used to bring the soil to OMC

e. Mixing of the enzyme through the soil: after the spraying of water is complete the engineer can start mixing the enzymes through the soil with the help of mixing implements. A rotary tiller/rotovator/plough is recommended -until the enzyme mix is thoroughly and uniformly distributed throughout the soil. It is important that the water and enzymes come into contact with all of the soil particles in the treated layer



f. Final camber formation: may take place if necessary after completion of the mixing process and during the initial compaction.

g.: After the mixing process is completed the engineer will Compaction start compaction once the soil approaches OMC. If the soil is below OMC after the mixing process, the engineer can add additional water on top of this soil layer and mix it evenly into the soil to raise the moisture content. No additional TerraZyme will be needed if the correct amount has been added previously. Compaction will take place with multiple passes of a heavy vehicle



6. List of Work done 2014-16

Sl	District	Scheme	Length in km	Year of completion
1	Bagalkot	NGNRY3	3	2015
2	Gadag(Kalasapur)	NGNRY3	4	2016
3	Gadag(Hombal)	PRED	3	2015
4	Tumkur	NGNRY3	4.7	2016
5	Ballary	PMGSY	4.5	2016
6	Sedam	NGNRY3	1	2015
7	Kolar	NGNRY3	1.6	2016
8	Joida	PMGSY	11	2016
9	Raichur	PMGSY	1	2016
10	Channapatna	NGNRY3	1.5	2016
11	Chennarayapatna	NGNRY3	0.6	2016
12	Gadag(Annigeri)	NHND	0.4	2016
		TOTAL	36.3	

Note :

- ◆ Total GSB Material saved for 36.3 km is 27,225 cum
- ◆ Total Quantity of Metals saved is approx. 18,800.00 tonne (1000 trucks)
- ◆ Fuel consumption saved is 3,00,000 Litres of fuel)

7. Performance Evaluation - RASTA

Performance evaluation was conducted for above mentioned projects by RASTA-Center for Road Technology in the year 2016-17

SI No.	Name of the Work	Scheme	Length in km	Year of Completion	Performance evaluation Results (CBR in %)	Remarks
1	Bagalkot	NGNRY3	3	2015	Above 100	Excellent
2	Hombal to huvilgol road, Gadag	PRED	3	2015	100	Very good
3	Dollenhalli and Dollenapalya, Tumkur	NGNRY3	4.7	2016	90	Excellent
4	Ballary	PMGSY	4.5	2016	Above 100	Excellent
5	Bhumiwada to Patriwada, Joida	PMGSY	11	2016	80-100	Good
6	Raichur	PMGSY	1	2016	Above 100	Excellet
7	Tumbinakere, Channapatna	NGNRY3	1.5	2016	Above 100	Excellent
8	Madalgere, Chennarayapatna	NGNRY3	0.6	2016	75	Excellent
9	Kondikoppa (Annigeri)	NHND	0.4	2016	20-60	For BC soil Results excellent
10	Kalasapur road (Gadag)	NGNRY3	2016	2016	Above 100	Excellent

Salient Points

- a) Thickness reduced by 1". The thickness reduced was based on AASHTO structural numbers.
- b) The base CBR was 2 to 6%

7. Performance Evaluation - RASTA

- a) The field test and other results showed that the even with reduced thickness the layers were stable and no additional layers were needed.
- b) The chances to reduce the thickness is more, since the field results have proved that CBR values attained are much higher than the minimum used for the design for the both layers of TerraZyme.
- c) The conventional GSB and G II was eliminated with 2 layer of TerraZyme design
- d) GSB material saved per km is 607.50 cu.mt
- e) Metal saved per km approx 390 cu.mt

Model Report copy of Performance Evaluation given by RASTA

1. Name of the work: Madalgere, Channarayapatna, Hassan

2. Length of the work: 1 km

"Standard" Design CBR 5 T5				Strength Estimate			
Layer	Material Description	CBR %	Coefficient	Thickness	Thickness	Structural Number	
			(CBR Correlation Chart)	(cm)	(Inches)		
Wear (Base)	WBMIII	100%	0.140	7.5	2.95	0.41	
Subbase a	WBMII	80%	0.132	7.5	2.95	0.39	
Subbase b	GSB	20%	0.095	17.5	6.89	0.65	
subgrade	IBS	10%	0.080	0.0	0.00	0.00	
Subgrade	CBR unimproved	5%		32.5	12.80	0.00	
			Combined	Structural Number		1.46	
Stabilization Design "TZA" CBR 5 T5				Strength Estimate			
Layer	Material Description	CBR % Minimum	Coefficient	Thickness	Thickness	Structural Number	
			(CBR Correlation Chart)	(cm)	(Inches)		
Wear (Base)	WBMIII	100%	0.140	7.5	2.95	0.41	
Subbase a	borrow soil cbr 8% with 25% metal + TZA	60%	0.128	10.0	3.94	0.50	
Subgradeb	insitu existing soil + TZA	30%	0.108	12.5	4.92	0.53	
subgrade a	IBS	10%	0.080	0.0	0.00	0.00	
Subgrade b	CBR unimproved	5%		30.0	11.81	0.00	
			Combined	Structural Number		1.45	



RASTA

Center for Road Technology

4th Road: Madalagere, Channarayapatna (T), Hassan (D), Karnataka

- 1) Length of section evaluated: 0.5 km
- 2) Date: 30/11/2016
- 3) Sectional details:
 - a. Terrazyme Layer – 1: 100mm
 - b. Terrazyme Layer – 2: 125mm
- 4) Rut depth measured using a 3m bar in each 25m section: Nil
- 5) Percent of bituminous surface cracked (based on visual estimation) and class of cracks: Nil
- 6) Extent of edge failures, if any: Nil
- 7) Number and extent of potholes: Nil
- 8) Extent of patching done: Nil
- 9) Length, width and depth of depressions: Nil
- 10) Extent of raveling: Nil
- 11) Longitudinal and transverse cracks: Nil
- 12) Pavement Condition Index (PCI): 100, The rating is Excellent as no cracks were observed
- 13) Subgrade moisture content: 5.48%
- 14) Surface Roughness using MERLIN: 116mm
- 15) Dynamic Cone Penetration: above 60% CBR
- 16) Air temperature: 29.6°C
- 17) Pavement temperature: 35.2°C
- 18) Benkelman Beam Deflection:
 - a. Characteristic Deflection: 0.79
 - b. Overlay Requirement: Not Required



Photo – 11: DCPT Test carried out at Madalagere, Channarayapatna

7. Performance Evaluation - RASTA



AVIJEET AGENCIES
Private Limited
www.avijeetagencies.com

RASTA Center for Road Technology



Photo – 5: BBD Test carried out at K Hosur, Turvekere



Photo – 6: DCPT Test carried out at K Hosur, Turvekere

7. Performance Evaluation - RASTA

RASTA Center for Road Technology



Photo – 7: DCPT Test carried out at Dollenahalli, Gubbi



Photo – 8: BBD Test carried out at Dollenahalli, Gubbi

7. Performance Evaluation - RASTA



AVIJEET AGENCIES
Private Limited
www.avijeetagencies.com

RASTA

Center for Road Technology



Photo – 15: BBD Test carried out at Hombal, Gadag



Photo – 16: MERLIN Test carried out at Hombal, Gadag

8. List of Work done - NGNRY4



AVIJEET AGENCIES
Private Limited
www.avijeetagencies.com

List of works done under NGNRY4 in 2017-2018

Sl No.	Name of the work	District	Length in km
1	Kulageri to Tappasakatti road	Badami	3
2	Sakkrihalli to SH-40, HADAGALI		5
3	Upparagatta to SH-40, H.B.HALLI	Ballary	3
4	Approach road to sirurwadi		1.77
5	MH Border to Halsitugaon & Alwai	Bidar	1.27
6	Improvements to Road - Kountoji to Gudihal	Muddebihal	3
7	Improvements to Road - Venkatakrishnammanahalli to B.B.Road	Chikkaballapur	0.5
8	Improvement and asphaltting to road from Palakihally to D.Madakaripura (Gemyanayakanahatty) Via Doddiganahal, Hosahatti	Chitradurga	3.93
9	Channagiri 1		1.06
10	Channagiri 2		1.23
11	Channagiri 3		0.52
12	Bethur		3.27
13	Bisleri		3.2
14	Haluvagilu		0.35
15	Duggavati	Davanagere	0.7
16	Harihar		0.81
17	Honnali		2.39
18	Shagale to bada		1.2
19	Gangankatte		0.6
20	Huvinmadu		0.98
21	Kalghatagi		4.5
22	Mundaragi	Dharwad	3.7
23	Hothnalli	Gadag	2
24	Gundur	Haveri	2.5
25	Anavatti	Shimoga	2
	Total		50.5

Total GSB Material saved for 50.5 km is 37,875 cum
Total Quantity of Metals saved is approx. 25,700 tonne (1300 trucks)
Fuel consumption saved is 3,83,500 Rs (6500 Litres of fuel)

9. Photographs of works done -NGNRY3

Photographs of works done under NGNRY3



Bagalkot



Bellary

9. Photographs of works done -NGNRY3

Chennapattana



Chennarayapattana

10. Photographs of works done -NGNRY4

Chitradurga



Badami-Bagalkot



Hagaribommanhalli-Bellary



muddebihal-Bijapur



Hothnahalli-Haveri

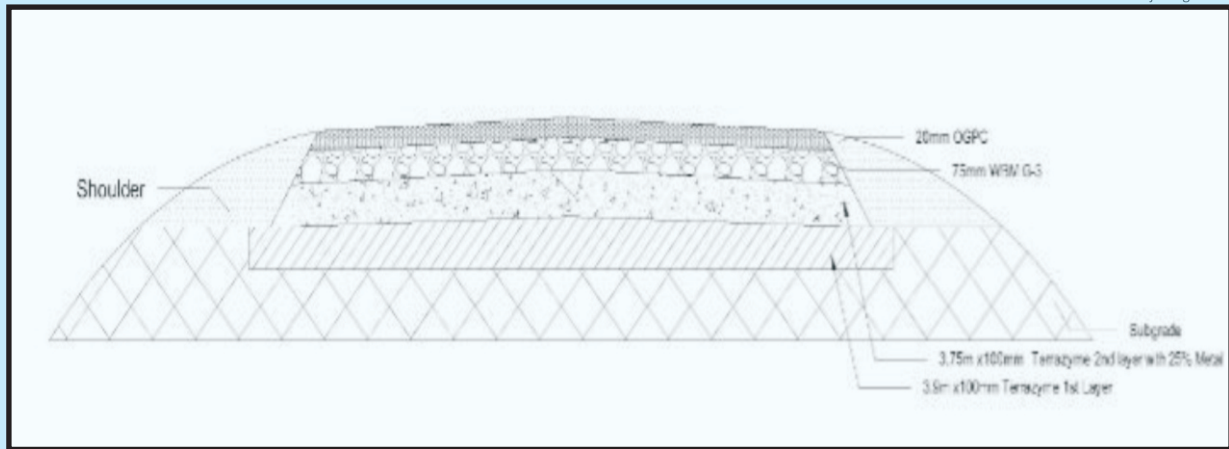


10. Photographs of works done -NGNRY4

Different Roads in Davangere District



11. Cross section Flexible Pavement



TerraZyme Technology Pavement crust (By replacing GSB and WBM G2 Layer)

1. Existing subgrade treatment with TerraZyme (1st layer) - 100mm
2. Treatment to the Borrow soil + 25% metal with TerraZyme (2nd Layer) - 100mm
3. Construction of Conventional G3 Metalling - 75mm
4. Construction of Conventional thin bituminous layer
5. Construction of Side Shoulders

Costing's:

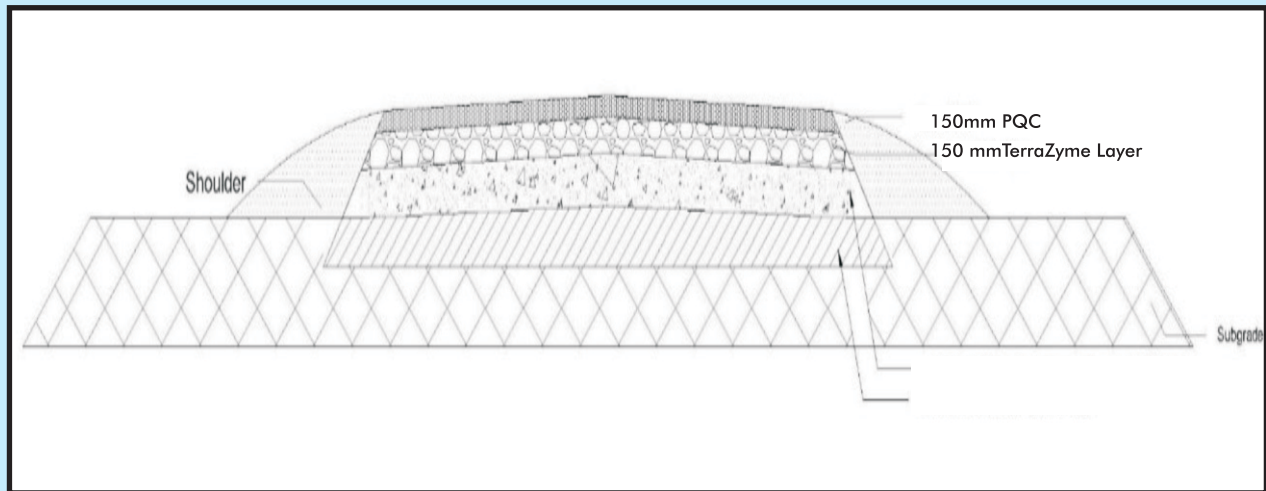
1. Cost per km = 25 to 27 Lakhs per Km (Conventional Method)
2. Cost per km = 20 to 22 Lakhs per Km (TerraZyme Technology)

Savings:

10 to 15 % cheaper than the conventional method of construction

12. Cross section Rigid Pavement

Rigid Pavement cross section



TerraZyme Technology Pavement crust (By replacing GSB and WBM G3 Layer)

1. Preparation of subgrade
2. Treatment to the Borrow soil + 25% metal with TerraZyme (1 Layer) on prepared subgrade - 150mm
3. Construction of Conventional Concrete - 150mm

Costing's:

1. Cost per km = 53 to 55 Lakhs per Km (Conventional Method)
2. Cost per km = 43 to 45 Lakhs per Km (TerraZyme Technology)

Savings:

15 to 20 % cheaper than the conventional method of construction

13. Rigid pavement section with TerraZyme Layer



14. Conclusion

- TZ definitely helps in improving the workability of the soil through much better parameters leading to elimination of sub base and base which helps to construct the roads in much faster ways leading to enormous commercial benefits.
- The product helps in minimising the usage of natural materials, majorly aggregates and soil.
- With this we would be able to make a great effort in controlling the environmental damages, definitely a Bio enzyme stabilizer is categorised as Green road concept
- With respect to the total length completed till February 2018 in Karnataka, below are the statistical highlights :

Total length constructed = 86 km

Total metal saved= 45000 tonnes of metal (2300 No of trucks of material)

Total Gravel saved= 65000 cum

Total Fuel saved= 12000 litres (7Lakh savings)

For construction of conventional GSB and G2 Layers it requires 18 to 20 days, whereas TerraZyme based construction requires 8 to 10 days to construct the replaced layers using TerraZyme Technology (50% of Construction time saved)

We would like to thank you Sir, for the extraordinary support and encouragement for development and implementation of new technology in RDPR department, Karnataka.

With your blessings we have successfully completed 80+ Km out of which 40 km has undergone over 2 monsoons with satisfactory performance evaluation report. These roads were performed well under varying terrain, traffic, soil and climatic conditions.

We hope with this successful performance with TerraZyme in Karnataka state, more road projects would be constructed using TerraZyme in coming days.

Thanking you sir

With the best Regards

Apoorva Modi - Vice President