A review on use of Terrazyme as bio-enzyme for the stabilization of soil sub-grade of pavement

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ABSTRACT

The major problem for civil engineers to build any highway is general soil with weak engineering properties. The maximum load of traffic is transferred to soil sub grade therefore soil stability and durability becomes necessary. So, soil stabilization is required before use. There are several methods of soil stabilization out of which terrazyme provides more stability and durability to the sub grade of the soil.When thesoil needs a broad treatment scalethen products like lime, asphalt, fly ash etc. prove to be verycostly and are unsuccessful to any point. A very powerful soil stabilizer is the bio enzyme using it as a soil stabilizer. As the study shows, Terrazyme, a bio-enzyme emerges as a veryeffective soilstabilizing agent. Terrazyme is used as a soil stabilizing agent in the present study. Terrazyme brings with it other significant advantages throughout its treatment application to the soil. The biggest downside it brings with it is that expensive but, as a small dose of Terrazyme, this issue can be counteracted to a large degree by enhancing the engineering properties of the soils. This review highlights effects of terrazyme, advantages, limitations and its applications in soil sub grade in a sustainable way.

Keywords: *Soil sub-grade; highway; terrazyme; stabilization; bio-enzyme.*

Introduction

The big problem faced by civil engineers when building any highway is weak engineering properties. Because the trafficload of any pavementproject is eventually to be shifted to the soilsub-grade, it is most important for thesoil to have virtuous & suitable engg. assets to ensure the road project's steadiness, and longevity along with good serviceability. The soil subgrade should be enough strong to carry traffic loads and heavy vehicle load which is used during the construction of the pavement. Indeed, a major part of India is covered by soil with low-bearing capacity and insufficient strength. Therefore, in this case, it turns out to be very important to use particular prosperous methods to increasethe strengthof the soil to reduce project costs to an optimal level. The low-carrying soil istreated with various techniquesto improves its strength, and engineering assets. Now a day, several strategies for soil strengthens in practice but the keyconcernis technique's efficient and cost-effective method alongwith the technique's ecofriendly behavior. Different methods can be used to strengthen the soil, but the choice of a specific technique on that individual soil. These approaches range fromreplacing top poor soilwith strong engineeringsoil properties to treating local soil with specific soil-stabilizing constituents i.e., cement, coarse aggregates, fine aggregates, fine sand, lime, fly ash, rice ash etc.

Soil-stabilization technique is veryeffective approaches for improving soil engineering assets alongwith lowering plan costs. An efficient soil-stabilization method's selection is important feature before constructing any pavement. The selection of method of soil-stabilization depends on the degree of soil stabilization and properties of local soil. The availability of stabilizing material also helps in the implementation of the strategy of soil stabilization. The goal of the soil stabilization is to increase its bearing capacity and workability as well as to reduce its plasticity index in order to decrease the propensity to swell and shrink that greatly affected the strength and leads to failure of the base. In fact, there are many methods to stabilize soil, such as treating with lime, cement and fly ash. Such materials pollute the atmosphere when mixing with soil and some of these materials cause contamination of the environment during their manufacturing process, so the need for an economical and environmentally friendly method to stabilize the soil is urged. Considering all the aspects of soil stabilization, some bio enzymes specifically terrazyme proves to be very cost effective and environmentally friendly soil stabilizer. This is used in very limited amounts in dilute form, with water, to treat the soil. Although it is not available locally, it is not considerable as it is used in very small

transportation costs. This is produced by extracts of crops, and is non toxic in nature, non-corrosive. It increases soil quality to significant extent, with limited amount use as a stabilizer.

Bio-enzyme as stabilizer

For conventionalpractice, products used for soilstabilization are typically lime, asphalt, flyash, etc., which does significant harmto the atmosphere duringtheir implementation aswell as development. When thesoil needs a broad treatment scalethen these products prove to be verycostly and are unsuccessful to any point. A very powerful soil stabilizer is the bio enzyme using it as a soil stabilizer. As the study shows, Terrazyme, a bio-enzyme emerges as a veryeffective soilstabilizing agent. Terrazyme is used as a soil stabilizing agent in the present study. Terrazyme brings with it other significant advantages throughout its treatment application to the soil. The biggest downside it brings with it is that expensive but, as a small dose of Terrazyme, this issue can be counteracted to a large degree by enhancing the engineering properties of the soils. Anotherproblem with terrazymeis that it needs at least 15 percent of clay content to display the effects, because its key reaction to clay is the impact. Reduce the soil particle load resulting in the reduction in the thickness ofwater layer aroundthe soil particles in order toachieve a high degree ofcompaction. If the soil iscompacted, the strength of the soil increases to the highest degree of compaction. It alsoreduces the soil plasticityindex which reduces thesoil's propensity to swell and shrink in thepresence & absenceof moisture.

Soil-stabilization

Soil stabilizationis the engineering of improving the soil's engineeringproperties, while also making itmore stable, removing or reducing the undesirableproperties that make it unfit forengineering works. Generally, soil-stabilization involves compaction, excavation, pre-consolidationand several other mechanical &chemical activities that enhance the soil's engineering resources, a need emerges to consider some inexpensive and environmentally sustainable strategy to stabilize the soil. Emerging need of road network A material withcementing properties or other chemicals that can aid in soil stabilization may be applied to naturalsoil for soil stabilization purposes. Since the modern procedures of soil stabilization by lime,cement& other cement products are not environmentally friendly& un-economicalfor mass requirements together with their reduced, Accessibility and flexibility to climate change; the need for other economical and environmentally sustainable approaches with superior results and longevity also arises.

Uses

In the following method, soil stabilization found to be useful;

- To boost soil engineering properties
- Firming natural soil
- Reduces surface permeability
- Increasing the shearstrength of the available local soil
- Growing locally usable soil bearing potential
- Reducing vulnerability to climate change
- Allow various charging conditions

Soil-stabilization methods

The techniques for soil-stabilization could be roughlyclassified into 2 types:

- **Mechanicalstabilization**

This isthe procedure in which the consistency of the locallyavailable natural soilis improved by mixing it withsoil from abroad or aggregateto obtain the ideal soil texture and compacting itto the required degree of density.Soil compaction can be defined as mechanical stabilisation at maximum moisture content.

- **Chemicalstabilization**

It is the method of stabilizing the naturally available soil by applying other chemicals that can be seen to be efficient in stabilizing the soil by increasing the degree of compaction and imparting the cemented property to the soil. By reducing the voids between the particles in order to achieve a high degree of compaction some chemicals may prove successful.

Mechanismof Terrazyme forsoil-stabilization

In general, solid particlesare accompanied by negative charged ion which makes it possible to interact with positive ion. Moisture isadded to the soil to have sufficient moisture quality and achieve a high degreeof compaction. Such ingested water includes metal ions that are positivelycharged and bound to the negativelycharged particles surrounding the sample, thereby creating dense clouds of needed to balanced soil particles, resulting in an rise in the soil's void ratio, which in effect imparts low compaction rates. In this case, terrazyme can be shown to be very efficient in decreasing the void ratio by minimizing the electrical charge on the water molecule, resulting in a decrease in the thickness of the water layer over the sample, thereby decreasing the void and compacting the soil with less effort to a higher degree. The following figure illustrates Terrazyme 's simple and general mechanism for reducing the thickness of water layer over the soil particle.

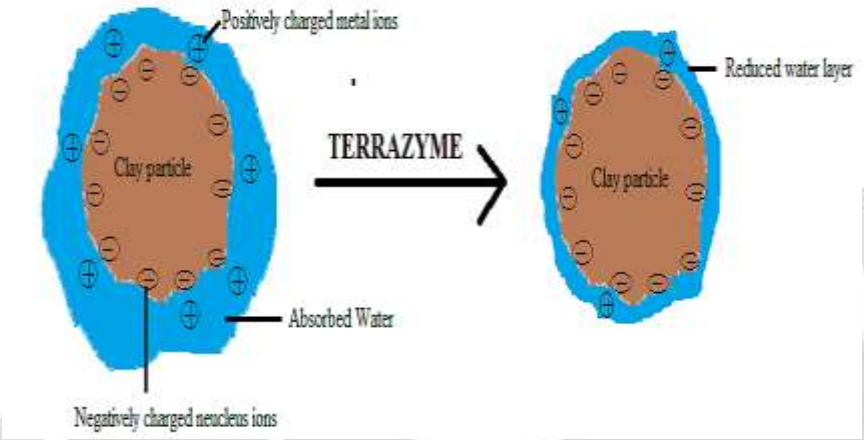

Figure 1: Mechanism of terrazyme

Terrazyme (Bio-enzyme) as stabilizer

This isbio-enzyme that originates from fruit and vegetable extracts. This is renewable, non – toxicin its nature. This replicates the hue brunette with the fragrance of molasses.It can be easily mixed with water, and then returned to the soil for production. It lowers the voids among particles in the soil and maximizes the degree of compaction.

Some researcher's study on bio-enzyme

Lacuoture and Gonzalez, (1995) Handle the nutrient stabilizer Terrazyme as well as its appropriateness for sub-base and subgrade soil at work. The input from the Terrazyme-treated soil was monitored and the untreated test soil was noted and contradicted. The change in soil properties was monitored over a short period of time and it was concluded that there was no major variation in soil properties in cohesion soils for a small period of time but it showed improved soil properties and strength with the lapse of time.

Hitam and Yusof, (1998), Run research analysis on the way to plantation. Such roads are used to supply market fruit and field manure. Due to the harsh weather conditions road becomes out of reach and problems with transport begin to increase. Soil road with Terrazyme composition shows really good results and for 3 years there was no need for maintenance. Terrazyme has improved soil road stability and removed the requirement for taking soil from the borrowing pit as national available soil can be optimized.

Bergmann, (2006) This research paper on 'Soil Stabilizers on widely efficient Trails,' EMC squared baptize enzyme for the consolidation of the drifted ground and discovered that bio enzyme required specific clay pleased in the mineral aggregate to successfully complete the reactivity in order to give the structural performance, as well as finding that the result has been retrofitted as the clay content has broadened.

Agarwal and Kaur, (2014) Conduct a compressive strength check of Terrazyme-treated expansive soil and figure out that Terrazyme-treated soil has a surprising rise of up to 200 percent in Black Cotton Soil UCS. It also argued

that course of treatment plays an important role in the attainment of power. It was found out that optimal Terrazyme lethal dose was noted as 1mlof of terrazyme per 5 kg of soil.

Saini and Vaishnava, (2015) Conduct laboratory experiments on region soil (from the Ballapur road) work with Terrazyme in various dosages and notice that specific gravity rises by approx. 7 percent. The liquid cap also decreased by 17%, the solid cap by 27% and the plasticity index by 42%.

Panchal et al., (2017) Run a laboratory check for the CBR value of Terrazyme serving soil and noticed that for 500ml of Terrazyme / m^3 soil, the CBR value was improved by 12.89 per cent after the first week of healing and raised by 18.25 per cent after the second week, but it was also observed that 900ml of Terrazyme / m^3 soil after 2 weeks of healing provides prime results and increases the CBR value by nearly 131.5 per cent.

Brazetti and Murphy, (2000) A field research on the usage of Terrazyme as a soil stabilizer for road building is carried out in Brazil. They select a broad range of soil composed of silty mud, sandy clay, plastic and non-plastic clay, sandy silt, sandy loam, loam clay mixes and reclaimed surface bits of dirt. The DCP (dynamic cone penetration) study was frequently conducted mostly on field period and they came to the conclusion after judgment that use of the Terrazyme as a soil stabilizing representative is a productive and economical strategy to preserve soil in addition to highway construction.

Sharma, (2001) Execute his research on tree forms of soil involving clay o flow plasticity (CL), high plasticity clay (CH) and low plasticity silt (ML) assisted with Bio enzyme and noticed that CH soil indicated 260 percent extension in its CBR value alongside decrease in saturation from 40 percent to 20 percent when 4 weeks of stabilization were enabled. CL soil has no major shift in its CBR value, but has a decline in saturation humidity from 44% to 35%. ML soil texture reported an increase of 209.90 percent in its CBR value together with a reduction in saturation moisture from 12.9 percent to 9.98 percent just before 4 weeks of stabilization were allowed.

Venkatesh and Reddy, (2017) Carried out an study of Black cotton soil treated with Terrazyme using it as a subgrade and reported that soil shear strength improved by 415 percent from 0 percent to 27.5KPa at 5 percent from 5.4KPa. For an improvement in the dosage of Terrazyme the un-soaked performance of CBR increased by approx. A mere 105 per cent.Via 3.91 to 8.35.In the case of soil samples treated with terrazyme, the CBR value is directly proportion to the Soaking sequence. Tri-axial test results indicate that soil cohesion rises 465 percent from 6.84KPa at a dose of 0 percent to 38.9 KPa at a dose of Terrazyme at 4 percent.

Isaac et al., (2003) Centered on their detailed work into a collection of soil reforms obtained from Kerala use Terrazyme as a stabilizer, it was found that the result in CBR values of operated soil and soil served with Terrazyme was significant. Terrazyme 's feedback with soil was assessed and compared to governed soil, and the transition in the CBR value has been between 135 and 1810**.** Ultimately, they reached a point where Terrazyme is quite competitive and beneficial to stabilize clayey soil but far less impressive to silty soil.

Shukla et al., (2003) conducted their analysis to predict the feasibility of Bio enzyme as a soil stabilizing agent and picked five separate forms of soil with varying amounts of clay through poor to heavy, and carried out numerous experimental studies on the soil sample provided with Bio enzyme and monitored sample. From their research they discover a small to very large improvement in the physical characteristics of the soil handled with the Bio enzyme. So, they instructed that the Bio enzyme stabilized soil should be checked in laboratory before working in the region. They often locate out that the stabilization impact reconfigured very weak soil like silty soil and sandy soil to CBR and UCS.

Applications ofTerrazyme

This may be used in thefield of soil stabilization

- Highlights
- Bridges in the works
- Subgrade upgrades
- All rural conditions
- Yard and parking lots
- Basis floors
- Within municipal highways

- Closing of reservoirs and discharges
- Clear shoulder
- Highway operation
- Emergency motorway link

Advantages of using Terrazyme

Terrazyme's principal benefit is its cost saving feature. This cut building expenses up to 40% relative to traditional road development activity and often decreases repair costs up to 75% based on the parent property of natural resources.

- Eco-friendly-as it isnon-toxic and non-corrosive, not detrimental to humans and animals
- Cost-effectiveness- is attributed to the limited volume needed for soil care, even though it is costly.
- Simple handling- because it isnon-toxic and needed in limited amounts, making it easier to manage.
- Durability-results of soil materials are irreversible, meaning that it is stable.

Limitations of using Terrazyme

- **Availability**, Since the Terrazyme production method requires complicated activity and there arevery few Terrazyme producers worldwide, it takes time to get itfrom the supplier.
- **UniformlyApplication**, since a relatively limited amount of the use terrazyme to maintain the soil in a diluted manner, it is important to disperse it uniformly across the appropriate area so as to avoid material wastage and to maximize the intensity uniformly.
- **Affinity to Clay to ProduceResults**, Researchers know that Terrazyme interacts withclay, so the effects of Terrazyme treated soil must be at least 15 per cent clay in the soil. As we know, Terrazyme interacts with clay, so the effects of Terrazyme treated soil must be at least 15 per cent clay in the soil.

Impact of terrazyme on various soil

Terrazyme may be used to strengthen different soils, from black-cotton tomurram. Terrazyme can demonstrate its impact on soil that has 15 percent clay because it allows clay to react and increase the degree ofcompaction along with the creation of cemented substrate to strengthen soil.

Terrazyme as cost-effective material

Terrazyme may show cost savings through imparting resilience together with can soil sensitivity to temperature and improving its power. While high, depending on the parent property of the naturally accessible soil, Terrazyme will reduce the project expense by 15 to 40 per cent. Soil with very bad engineering properties may need more Terrazyme dose relative to soil with quality engineering properties before any procedure, but total project cost would probably decrease along with decreased maintenance costs. Relative to traditional stabilization techniques, the maintenance costs of Terrazyme stabilized soil can be decreased by 50-75 per cent. By adding Terrazyme in the soil for stabilization purposes, the soil's bearing potential decreases by a considerable amount and therefore the thickness of different pavement layers may be decreased in order to minimize the project's expense. Several reports indicate that terrazyme may be used as a substitute for GSB and WMM.

Conclusion

Soil-stabilization technique is veryeffective approaches for improving soil engineering assets alongwith lowering plan costs. An efficient soil-stabilization method’s selection is important feature before constructing any pavement.For conventionalpractice, products used for soilstabilization are typically lime, asphalt, flyash, etc., which does significant harmto the atmosphere duringtheir implementation aswell as development. When thesoil needs a broad treatment scalethen these products prove to be verycostly and are unsuccessful to any point. A very powerful soil stabilizer is the bio enzyme using it as a soil stabilizer. As the study shows, Terrazyme, a bio-enzyme emerges as a veryeffective soilstabilizing agent. Terrazyme is used as a soil stabilizing agent in the present study. Terrazyme brings with it other significant advantages throughout its treatment application to the soil. The biggest downside it brings with it is that expensive but, as a small dose of Terrazyme, this issue can be counteracted to a large degree by enhancing the engineering properties of the soils. For the further studies several experiments can be carried out to stabilize the soil by using terrazyme, also the efficiency of terrazyme can be evaluated with different types of soils.

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