

# Literature Study on Implementation of Hydrocarbon Emulsion in Gravel Road

Ramit<sup>1</sup>, Aman Bathla<sup>2</sup>, Jyoti Narwal<sup>3</sup>

<sup>1</sup>Dept. of Civil Engineering (Transportation), Geeta Engineering College, Naultha, Panipat, Haryana

<sup>2,3</sup>Assistant Professor, Dept. of Civil Engineering (Transportation), Geeta Engineering College, Naultha, Panipat, Haryana

---

## ABSTRACT

Starting from the bottom, soil is one among nature's most teeming construction materials. most style of construction is made with or upon the soil. The foremost vital a part of a road pavement is sub grade soil and its strength. If strength of soil is poor, then stabilization is often required. Sub grade sometimes is typically stable or replaced with stronger soil material so on improve the strength. Such stabilization is additionally appropriate once the accessible sub grade is created of weak soil. Increase in sub grade strength might cause economy within the structural thicknesses of a pavement. Cement, fly ash, lime, fibres etc. are terribly normally used for soil stabilization. The main objective of this experimental study is to boost the properties of the gravel soil by adding hydrocarbon emulsion. An endeavor has been created to use emulsion for up the strength of gravel soil expressed in terms of CBR values which can convince be economical. During this study, the entire laboratory work revolves round the basic properties of soil and its strength in terms of CBR. a trifle cement additional to produce higher soil strength. It's discovered that glorious soil strength results by mistreatment cationic hydrocarbon emulsion (CMS) with very little amount of cement used as filler. The acceptable combination conditions for gravelly soil with CMS hydrocarbon emulsion are 1st tried. This is often followed by deciding four explicit material conditions to show the variation in dry density and CBR worth to attain the most effective potential strength properties of gravel soil.

---

## I. INTRODUCTION

Starting from the bottom, soil could be a standout amongst the foremost luxuriant construction materials of nature. Concerning all reasonably construction relies with or upon the soil. Future performance of pavement structures is altogether tormented by the strength and sturdiness of the sub grade soils. in-situ sub-grades frequently do not offer the support needed to realize acceptable performance beneath the traffic loading with increasing environmental demands. Despite the very fact that stabilization could be a well-known possibility for rising soil engineering properties nevertheless the properties determined from stabilization shift loosely attributable to non-uniformity in soil creation, contrasts in small and macro structure among soils, non-uniformity of earth science stores, and attributable to chemical contrasts in concoction interactions between the soil and utilized stabilizers. These properties need the thought of site-specific treatment alternatives that should be accepted through testing of soil-stabilizer mixtures.

Whether the pavement is versatile or rigid, it rests on a soil foundation on associate hill or cutting, usually that's called sub grade. It's going to be outlined as a compacted layer, typically occurring native soil simply to a lower place the pavement crust, providing an acceptable foundation for the pavement. The soil in subgrade is generally stressed to bound minimum level of stresses because of the traffic hundreds. Subgrade therefore ought to be of excellent quality and fittingly compacted so on utilize its full strength to resist the stresses because of traffic hundreds for a selected pavement. This leads the condition for overall pavement thickness. On the opposite hand the subgrade soil is characterized for its strength for the aim of style of any pavement.

Improvement of soil engineering properties is cited soil stabilization. There are two primary ways of soil stabilization. One is mechanical methodology and therefore the different one is chemical or additive ways. Soil could be a gathering or store of earth material, determined often from the breakdown of rocks or rot of brushwood that would be uncovered promptly with force provides within the field or disintegrated by delicate reflex means that within the laboratory. The supporting soil to a lower place pavement and its exceptional beneath course is named sub grade soil. While not interruption soil beneath the pavement is named regular sub grade. Compacted sub grade is that the soil compacted by inhibited development of distinctive types of substantial compactors.

Presently each construction project can use one or each of those stabilization ways. the foremost well-known style of mechanical soil stabilization is compaction of the soil, whereas the addition of cement, lime, hydrocarbon or alternate executors is alluded to as an artificial or additional substance strategy for stabilization of soil. Yank Association of throughway and Transportation officers (AASHTO) arrangement could be a soil arrangement specially designed for the development of roads and highways employed by transportation engineers. The system uses the grain-size distribution and Atterberg limits, like Liquid Limits and physical property Index to classify the soil properties. There are differing types of additives out there. Not all additives work for all soil varieties. Generally, associate additive could also be accustomed act as a binder, when the impact of wet, increase the soil density. Following are some most generally used additives: Portland cement, calcined lime or calcium hydrate, Fly Ash, salt, hydrocarbon etc. But, mechanical soil stabilization alludes to either compaction or the introduction of sinewy and different non-biodegradable reinforcement of soil. This observe doesn't oblige compound modification of the soil and it's regular to utilize each mechanical and concoction intends to achieve elaborated stabilization. There are a few routines used to accomplish mechanical stabilization like compaction, combining, soil reinforcement, enlargement of stratified combination materials and mechanical correction.

Any land-based structure depends upon its foundation characteristics. For that reason, soil could be a terribly essential component influencing the success of a construction project. Soil is that the earliest a part of the inspiration or one in every of the raw materials utilized in the complete construction method. Thus the most issue associated with United States soil stabilization is nothing however the method of maximizing the CBR strength of soil for a given construction purpose. Such a lot of works are done on cement, lime or ash stabilization. however only a few works are found on hydrocarbon soil stabilization.

### **Objective and scope of labor**

The main objective of this experimental study is to boost the properties of the gravelly soil by adding hydrocarbon emulsion as stabilizing agent and tiny bit cement as filler. An effort has been created to use emulsion for rising the strength and geotechnical properties of gravel soil. Terribly principally, use of use of hydrocarbon emulsion is environmentally accepted. To realize the full project some experimental investigation is required in laboratory. The experiments that to be conducted square measure relative density of the soil sample, Grain size Distribution of soil sample and liquid limit plastic limit take a look at to spot the fabric and customary Proctor take a look at to get most dry density and optimum wetness content of soil sample, cosmic background radiation take a look at of soil sample commixture with emulsion and cement. therefore the main objective is to maximize the cosmic background radiation worth by checking some conditions to extend the cosmic background radiation worth of soil subgrade.

## **II. LITERATURE REVIEW**

Bitumen emulsion is employed as chemical stabilizer. Cement is employed here as a binder solely to boost strength of road. Antecedently numerous work was done on sand hydrocarbon stabilization and gravel soil hydrocarbon stabilization in numerous places. This study is being impressed from those researches. Here gravel red colored soil is employed, because it is out there in many countries of Bharat. Some similar works, done before, is mentioned below.

Chinkulkijniwat and Man-Koksung (2010) directed a take a look at analysis on compaction aspects of non- gravel and gravelly Soils employing a very little compaction device. the quality delegate take a look at has been generally utilized and acknowledged for characterizing soil similarity for field compaction management. During this study a relationship developed between the summed up optimum water substance of the fine division within the gravelly soil and also the gravel content in normal molds exploitation compaction results from the planned very little device.

Razouki et al. (2002) propose Associate in Nursing experimental study on Granular stable Roads. hydrocarbon was used as a helpful agent could act as a binder or as a water-proofing material. Soil-bitumen systems had found the best employed in road bases and surfaces.

Michael (1993) had planned regarding Bench-Scale analysis of Asphalt Emulsion Stabilization of Contaminated Soils. During this study, it had been mentioned regarding the appliance of close temperature asphalt emulsion stabilization technology and mentioned to the environmental fixation of soils contaminated by organic contaminants.

Paul et al. (2011) urged Associate in Nursing introduction to soil stabilization in pavement taking a mix of hydrocarbon and well-graded gravel or crushed mixture. When compaction it gave Associate in Nursing extremely steady waterproof mass of molding or base course quality. The basic system concerned in asphalt stabilization of fine-grained soils may be a waterproofing marvel. Soil particles or soil agglomerates were coated with asphalt that forestalls or abates the doorway of water that may frequently originate abatement in soil quality. What is additional, asphalt stabilization will enhance sturdiness qualities by creating the soil run-resistant to the unfavorable impacts of water, for instance, volume. In non-iron materials, for instance, sands and gravel, pounded gravel, and smashed stone, 2 basic systems are dynamic: waterproofing and adhesion. The asphalt coating on the union less materials offers a movie that

anticipates or hinders the doorway of water; afterwards reducing the inclination of the fabric to lose quality within the locality of water. The second instrument had been distinguished as adhesion and characteristics of gravelly soils.

Marandi and Safapour (2012) worked aboard Course Modification through Stabilization exploitation cement and hydrocarbon. the most objective of this analysis was to research the employment of hydrocarbon emulsion in base course stabilization. in order that it had been examined as replacement with typical pavement in regions with quality materials. Stabilization of soils and aggregates with hydrocarbon shows it differs greatly from cement stabilization. the essential mechanism concerned in hydrocarbon stabilization was a waterproofing development.

Jones et al. (2012) conducted Associate in Nursing experimental study on hydrocarbon soil stabilization. Here asphalt emulsion may be a mixture of asphalt binder, water, and emulsifying agent. during this case, a series of Indirect strength (ITS), Unconfined Compressive Strength (UCS) and Marshal Tests were allotted. it's liquid at close temperature to facilitate handling at lower application temperatures. It accelerates breaking of the emulsion and for added early strength to accommodate traffic throughout set of the layer.

Cokca et al.(2003) focused on the impacts of compaction moistness content on the shear quality of Associate in Nursing unsaturated mud. during this study, the impacts of compaction moistness substance and soaking on the unsaturated shear quality parameters of mud were investigated. Experiments were allotted on specimens compacted at optimum moistness content, on the dry aspect of optimum and on the wet aspect. it had been found that fringe of erosion reductions quickly with increasing moistness substance, the union phase of shear quality earned its high value at around optimum wetness substance and later on diminishes.

Hussain (2008) did a wonderful work to ascertain the correlation between cosmic background radiation worth and un-drained shear strength worth from Vane Shear take a look at. it had been shown that un-drained shear strength worth and cosmic background radiation worth hyperbolic with increasing malleability index. Finally it had been achieved that shear strength and cosmic background radiation worth is reciprocally proportional to the water content of that material.

L. Lauren (2011) performed Associate in Nursing experimental take a trial at soil stabilization merchandise just like the compound emulsion for having all the earmarks of being the stabilization executors for what is to return. each one of the 3 polymer-emulsions was utilized as a district of this testing project performed eminently creating solid examples that every one gave appropriate cosmic background radiation qualities to ways that. The cosmic background radiation take a look at was utilized for this venture on the grounds that it's been effectively connected with quality capability of the subgrade, sub base, and base course material for utilization in street and runway development.

Martinet al. (2009) developed a paper deals with foam hydrocarbon stabilization. Foamed hydrocarbon may be a mixture of hydrocarbon, air and water. Here a pair of % of cement and three.5 % of hydrocarbon foam was used. From here it's been found that Rehabilitation exploitation foamed hydrocarbon had proved to achieve success due to its ease and speed of construction, its compatibility with a large vary of mixture sorts and its relative immunity to the consequences of weather.

A. P. Chritz (2006) mentioned regarding performance analysis of mixed in situ hydrocarbon stable shoulder gravel. Here it had been showed a cost-effective maintenance of gravel shoulders, a really common drawback is facing by route agencies.

Nikraz (2012) worked on Bitumen-cement Stabilized Layer in Pavement Construction Using Indirect Tensile Strength (ITS) Method. In this study, the goal was to mix and blend Portland concrete and bitumen emulsion with soil for upgrading the quality, strength and durability of the dirt. So as to upgrade the soil quality and decrease its weakness to water, soil stabilization is obliged to be connected to the soil. In accordance with this, enhanced burden exchange was added to the asphalt establishment by having the bond impact which really supports the firmness and Bitumen emulsion impacts which enhance versatility and soil penetrability of the settled layer.

### III. ANALYTICAL STUDY

The magnitude relation between the mass of any substance of a particular volume divided by mass of equal volume of water is outlined as relative density. For soils, it's the amount of times the soil solids area unit heavier within the assessment to the equal volume of water gift. thus it's essentially the amount of times that soil is heavier than water. Specific gravities for various kind of soils don't seem to be same. within the time of experiment it ought to be cared concerning the temperature correction and water ought to be gas-free H<sub>2</sub>O. This relative density of soil is denoted by „G<sup>r</sup>“. relative density is extremely a awfully vital property wont to calculate alternative soil engineering properties like void magnitude relation, density, body and saturation condition.

As it is mentioned, the magnitude relation between the load of the soil solids associate degree weight of an equal volume of water is termed as relative density. The measurements is completed in associate degree exceedingly in a very

meter flask in an experimental setup wherever the degree of the soil is recognized and its weight is then more divided by the load of equal volume of water.

### Particle Size Distribution

The composition of soil particles are of a spread of sizes and shapes. The vary of particle size gift within the same soil sample is from many microns to many centimeters. several physical properties of the soil like its strength, permeability, density etc are relied on completely different size and form of particles gift within the soil sample.

Well hierarchal or poorly hierarchal are in the main the categories of soil found. Well hierarchal soils have completely different particles of various size and form in an exceedingly sensible quantity. On the opposite hand, if soil has particles of some sizes in excess and deficiency of particles of different sizes then it's aforementioned to be poorly or uniformly hierarchal.

The results from sieve analysis of the soil once planned on a semi-log graph with particle diameter or the sieve size in mm because the coordinate axis with index axis and also the share finer because the coordinate axis. This semi-log graph offers a transparent plan regarding the particle size distribution. From the assistance of this curve, D10 and D60 are resolute. This D10 is that the diameter of the soil below that 100 percent of the soil particles lie. The magnitude relation of, D10 and D60 offers the uniformity constant ( $C_u$ ) that successively could be a live of the particle size point the soil sample.

### Compaction take a look at (Modified Proctor Test)

Proctor take a look at is actually for determination of the connection between the wet substance and dry density of soils compacted in an exceedingly mould of a given size with a two.5 kilogram ram born from a stature of thirty cm. it's an enquiry center take a look at system for through an experiment deciding the optimum wet content (OMC) at that a given soil kinds can get most thick and attain its most dry density ( $Y_d$ ). The name Proctor is given out of appreciation for R. R. Proctor for demonstrating that the dry density of soil for a compactive elbow grease depends on upon the live of water the soil holds throughout soil compaction in 1933. His distinctive take a look at is most typically alluded to because the normal Proctor compaction take a look at, that recently was overhauled to create the new compaction take a look at. that's changed Proctor take a look at. In case of changed proctor all the procedures stay same with solely a couple of very little changes. most significantly here the compaction load is higher. Here ram size four.5 kilogram which born from height of eighteen inches. typically these research laboratory tests area unit consists of compacting soil at recognized wet content into a cylindrical mould of normal measurements.

The soil that's usually compacted into the mould to an exact live of equivalent layers, every one receiving variety blows from a customary weighted sledge at a customary height. this system is then rehashed for distinctive qualities of wetness substance and also the dry densities area unit determined for every one case. during this case materials area unit stuffed in 5 equivalent layers with twenty five blows in every one layer. The hammer and also the mould for changed proctor take a look at area unit shown below.

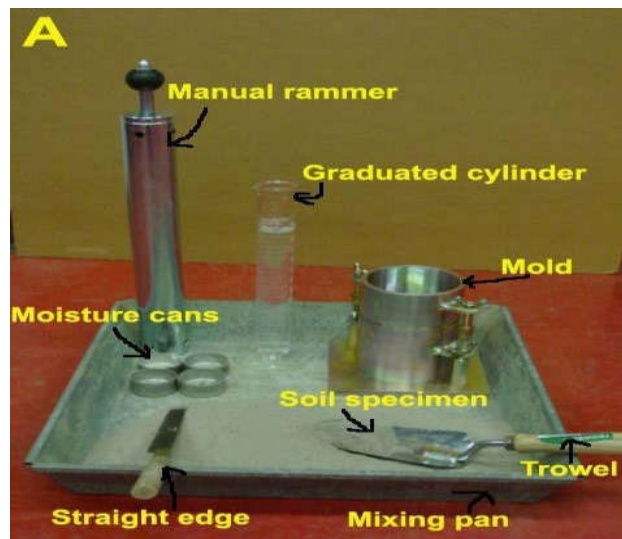


Fig. 1: Modified Proctor test apparatus



**Fig. 2: Modified Proctor test apparatus**

The graphical relationship of the dry density to wet content is then forethought considering the values found to ascertain the compaction curve. The determined curve comes in parabolic form and dry density worth is increasing up to a most limit and at that time once more the worth reduced. the utmost dry density is finally obtained from the height purpose of the compaction curve and its corresponding wet content, that is thought because the optimum wet content (OMC). Used formulas square measure listed below.

Normal wet density = [(weight of wet soil in mould gms) / (volume of mould cc)]  
 wet content (%) = [(weight of water gms) / (weight of dry soil gms)] 100%

$$\text{Dry density } \gamma_d \text{ (gm/cc)} = \frac{\text{wet density}}{1 + \frac{\text{moisture content}}{100}}$$

### CONCLUSIONS

In this paper, the author has studied the various facts about the implementation of hydrocarbon emulsion in gravel road and its related work performed in the past. Several modifiers have been tried to improve the properties of soil subgrade in terms of engineering properties and performance criteria to derive the maximum benefits to withstand the wheel loads of the modern day traffic causing heavy stresses. Bitumen emulsion is one additive which is found to enhance the performance of the gravel soil.

### REFERENCES

- [1]. Alayaki, F. M., Bajomo, O. S. (2011), Effect of Moisture Variation on the Strength
- [2]. Characteristics of Laterite soil. Proceedings of the Environmental Management Conference, Federal University of Agriculture, Abeokuta, Nigeria.
- [3]. A. Hodgkinson., A.T. Visser (2004), University of Pretoria and Concor Roads (Pty) Ltd, The role of fillers and cementitious binders when recycling with foamed bitumen or bitumen emulsion.
- [4]. Cokca.E., Erol,O., Armangil. (2004), "Effects of compaction moisture content on the shear strength of an unsaturated clay", Geotechnical and Geological Engineering
- [5]. Chauhan.(2010)," a laboratory study on effect of test conditions on subgrade strength". Unpublished B.Tech Thesis, N.I.T Rourkela.
- [6]. Consoli, N. C., Prietto, P. D. M., Carroro, J. A. H., and Heineck, K. S.(2001). "Behavior of compacted soil-fly ash-carbide lime mixture."J. Geotech. Geoenviron. Eng., 127(9), 774–782.
- [7]. D. Jones., A. Rahim., S. Saadeh., and J.T. Harvey (2012), Guide lines for the Stabilization of Subgrade Soils In California, Guideline: UCPRC-GL-2010-01

- [8]. Gregory Paul Makusa. (2012), Department of Civil, Environmental and Natural resources engineering, Luleå University of Technology, Sweden.
- [9]. Jaleel,Z.T.(2011), Effect of Soaking on the CBR-Value of Subbase Soil. Eng. and Tech. journal, vol.29.
- [10]. Mouratidis A.(2004), Stabilization of pavements with fly-ash, Proceedings of the Conference on Use of industrial by-products in road construction, Thessaloniki, 47-57.
- [11]. Nugroho,S.A., Hendri,A., Ningsih,S.R.(2012), Correlation between index properties and california bearing ratio test of pekanbaru soils with and without soaked. Canadian Journalon.