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STABILIZATION OF SOIL BY USING PLASTICS

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Abstract

Since the dawn of civilization, heaving soils due to season moisture have plagued builders, cracking foundations and roadways. Romans 3000 years ago mixed lime with sub grade foundation soils to stabilize expansive clays, but because the lime was only surface deep, the effect were short lived.

Soil stabilizers assist in strengthening soil and increasing its water resistance and it reduce movement thereby reducing need of fill material for buildings. Various stabilizers are used since age of lime, which basically include cement, calcium chloride, asphalt etc. however with any category of construction operation where both problems and potential remedies are so numerous and individualistic in nature, it is important that the specific potential remedy be carefully tailored to the end purpose to be served, and in this case, to the soil type or types involved. As soil is one of the most important parts of our environment having a lot biological value is soon depleting and need to be enriched more for a lot of purposes.

On the other hand plastic: which can be used as soil stabilizer is one of the most controversial issue; due to its excessive use. As it is creating a threat to environment because it does not deplete in level, air or even water. Therefore it is necessary to utilize plastic wastes effectively with bio technological measures. Adjoin both the concerning issue of soil stabilization and plastic utilization for environment benefit. Researchers are thus conducting research on the possible use of waste plastic for soil stabilization in the form of plastic resins fed in soils and others whose results and process indicates that adding plastic strips in soils increases its strength. Thus plastic as soil stabilizers is the most awaited and recent biotechnique which act in benefit of soil and thus environment.

Key words:

Plastic, soil stabilizer, resins, soil erosion, water proofing, PI.

Introduction:

Soil is a natural body consisting of layers of mineral constituents of variable thickness, which diffharacteristics. It is composed of particles of broken rocks that have been layered by chemnd aqueous states. Most soils have a density between 1 and 2 gm /cm^3. Soil is also known as earth: it is the substance from which our planet takes its name. In engineering, soil is referred to as regolith, or loose rock material.

Biological factors such as plants, animals, fungi, bacteria and humans affect soil formation. Animals and microorganisms mix soils and form burrows and pores allowing moisture and gases to steep into deeper layers. In the same way, plant roots open channels in the soils, especially plants with deep tap roots which can penetrate many meters through the different soil layers bringing up nutrients from deeper in the soil. Microorganisms including fungi and bacteria affect chemical exchanges between roots and soils and act as a reserve of

nutrients. Humans can impact soil formation by removing vegetation cover, which promotes erosion.

Uses of soils

1) Soil is used in agriculture, where it serves as a primary nutrient base for the plant.
2) Soil material is a critical component in the mining and construction industries.
3) Soil resources are critical to the environment, as well as to food and fiber production
4) Waste management often has a soil component.

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5) Landfills use soil for daily cover.
6) Both animals and humans in many cultures, occasionally consume soils.

Degradation of soils:

Land degradation is a human induced or natural process which impairs the capacity of land to function. Soils are the critical component in land degradation when it involves acidification, contamination, desertification, erosion or salination.

Soil erosion loss is caused by wind, water, ice, movement in response to gravity. Erosion is an intrinsic natural process, but in many places it is increased by human land use.

Soil stabilizers:

Soil stabilizers assist in strengthening soil and increasing its water resistance. This allows the soil to be used later as a durable building material. The use of soil stabilizers is quite beneficial because it reduces movement, thereby eliminating or reducing the need for additional support for slabs or fill materials when building. Today's soil stabilizers are inexpensive and work quickly. There are three primary ways to use soil stabilizers to improve soil. One of these methods is to strengthen existing soil, which enhances its load bearing capacity. Other soil stabilizers are used to control dust by preventing it or eliminating it altogether. Finally, waterproofing soil stabilizers assist in preventing the natural or constructed strength of the soil by protecting the surface from water. Additives such as cement, lime, and calcium chloride are often found in soil stabilizers. Some soil stabilizers also have a cement treated base, which further helps to improve the soil's quality.

Soil stabilizers are usually injected into the soil through a regulated pump at an optimum pressure. Stabilizers can stabilize high plasticity soils quickly and inexpensively with lime, lime- slurry, high pressure water injection, high pressure chemical injection. High pressure injection achieves the desired result for both commercial and residential customers, both pre-construction or as a remedial treatment.

Soil stabilization cost also must be given consideration when judging the usefulness of given stabilization agent. Included should be the relationship between performance achievable and costs of stabilization, including maintenance as well as initial costs. There are three principal stabilization agents: Lime, Cement and Asphalt (bitumen).

Methods of soil stabilization:

There are four methods for soil stabilization techniques which basically aimed to improve soil, strengthen it to protect and preserve it. These methods include:

1) Mat method
2) Asphaltic Method
3) Impervious blanket method
4) Injection method

Basic types of soil stabilization

1. **Lime Stabilization:** Lime is an unparalleled aid in the modification and stabilization of soil beneath road and similar construction projects. Lime is an excellent choice for short-term modification of soil properties. Lime can modify almost all fine –grained soils, but the most dramatic improvement occurs in clay soils of moderate to high plasticity. Modification occurs because of calcium cations which replace the cations present on the surface of clay. Altered clay produce following benefits:
   - Plasticity reduction
   - Reduction in moisture-holding capacity
   - Swell reduction
   - Improved stability
   - The ability to construct a solid working platform.

2. **Cement Stabilization:** A mixture of cement, soil and water has the general appearance and properties of the raw soil during and immediately after mixing. Materials required for soil stabilization includes:

- **Compacted Soil cement:** In this form the soil cement mixture should contain sufficient water to permit adequate compaction and hardening by cement hydration.
- **Plastic soil cement:** This is also a soil cement mixture but has greater quantity of water present at the time of placement producing a wet, workable mixture having the consistency of plastering mortar.
- **Cement modified soils:** For the desired end product i.e. a hardened mixture of soil and cement, smaller quantities of Portland cement are required. The principal changes in soil are reduced PI & water holding capacity and increased bearing capacity.

3. **Asphalt stabilization:** There are two categories of bituminous materials; Asphalt and tars. The former are naturally or refined petroleum bitumen, while the latter are produced by destructive distillation of organic materials such as coal, lignite and wood. While tars have been used and can be used as soil stabilizers, asphalt is the bituminous material most used for this purpose.

For asphalt stabilization, no material having PI higher than 10 for the material should be used. The choice of asphalt to be used with specific soil types should be based on availability of asphalt materials and mixing methods. There are two fundamental approaches of stabilization with bitumen: mixing the entire mass of the soil to be stabilized with bitumen so that soil particles are bound together with bitumen cement and isolating a soil mass within impervious bitumen envelop thus preventing changes in moisture content of the soil mass and the consequent change in engineering properties.

What is Plastic: Plastic is the general common term for a wide range of synthetic or semi synthetic organic amorphous solid materials suitable for the manufacture of industrial products. Plastics are typically polymers of high molecular weight and may contain other substances to improve performance and/ or reduce costs. There are two types of plastics: thermoplastics which soften and melt if enough heat is applied and thermosets which do not soften or melt, no matter how much heat is applied.

Plastics are used because they are easy and cheap to make and they can last a long time. Unfortunately these same useful qualities can make plastic a huge pollution problem. Its persistence in environment can do great harm. Urbanization has added to the plastic pollution in concentrated form in cities. Unfortunately, recycling plastics has proven difficult. The biggest problem with plastic recycling is that it is difficult to automate the sorting of plastic waste and it is labor intensive.

Plastic as soil stabilizer: Use of plastic products such as polythene bags, bottles, containers and packing strips etc. is increasing day by day. As a result amount of waste plastic is also increasing. Therefore it is necessary to utilize the wastes effectively with technical development in each field. Possible use of plastic waste as soil stabilizer is being carried out by various researchers. The results show that the addition of plastic strips in soil, shear strength and tensile strength of soil increases and preserve the environment too.

Soil stabilization experiments with plastic resins: The possibilities for stabilizing silty and pure sand soils with synthetic resins have been investigated in the laboratory and reported in the papers. A variety of synthetic resin compounds and catalytic agents were used with admixture ranging from 5-15% by weight of soil. These compounds were: **1)** urea resin with formaldehyde (ratio 1:1.5), **2)** urea resin with formaldehyde (ratio 1:2), **3)** melamine resin with formaldehyde (1:2.5), **4)** melamine resin with formaldehyde (1:2.5) where the solid content of its resin is slightly higher than that of the previous one.

Except for the last resin all the resins have an extremely low viscosity nearing that of water with the addition of the catalytic reagents the resins harden and assumes a cellular form structure. In general it is shown that the compressive strength of the stabilized soil increases with the addition of any of the resins and increases with increasing resin content by weight of soil. The successful application of resins for stabilization in water proofing of soils is seen to be influenced by no. of factors. Most important of which are the grain size distribution of the soil, concentration of the resin, the period of the gel formation, and the pH value of the medium in which the hardening process takes place.

In general it is shown that higher strength values are obtained in finer grain soils. However when the soil fraction in the fine range reaches to fine clay size, the gain in strength is reduced. Clay contents exceeding 3% may produce and appreciable loss in strength. pH value higher that 7 or 8 in pore fluid will have an adverse effect on both the gaining strength and water proofing.

In general results show that synthetic resins are superior to sodium silicate in soil stabilization both as far as strength and range of effectiveness are concerned. At the same time cost in stabilization are comparable to those of the methods involving use of sodium silicate.

Various tests performed on soil to check its stabilization effectiveness, these are: Proctor Test, Plasticity test., Compressive strength of soil.

Benefits on environment for plastic as soil stabilizer: As the new advancing techniques are increasing day by day, major problems associated with plastics indicates

1) Can to be burnt as it induces hazardous fumes and gases on burning which poses threat to living beings.
2) Can not be thrown in water as it will block drains pipes and poses threat to sea and other aquatic life.

Thus a lot of bio degradable plastics in being developed to compensate the negative effect of plastic. Moreover reuse or recycling of plastic is basically encouraged by government so that low cost plastic which is an easy access to urban people can be reused and thus lowers it negative effects.

Soil, though it is a renewable source of energy is being posed in threat as it is constantly eroding, constantly depleting and loosing its natural ingredient of productivity.

Here is where plastic as soil stabilizer idea come in to play as it will:

1) Increase soil strength
2) Plastic granules used means plastic can be utilized for better purposes and thus reducing its negative effects and purposely used.
3) Mixing plastic with soil does not even create destruction with soil or reduces its quality as the soil having plastic resins is used basically for construction purposes which can be used again when required,
4) Increases soil compaction.
5) Decreasing soil erosion.

Conclusion:

Though it has been practically done to use plastic resins in soil to be used as soil stabilizers, a lot has to be done in the same field with different types of soils and different conditions. Using the concept of plastic as soil stabilizer provides a new insight in the field of biotechnology for preserving of much concerning issue of soils and getting another way of decreasing the threats posed by plastics. The results of the studies indicates that by adding plastic strips in soil; shear strength, tensile strength and California bearing ratio (CBR) value of soil increases. Thus the new concepts of using it in soil give the path for researchers to establish a good way to deal with much concerns issue of environmental threat.

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