REUSE OF NON-DEGRADABLE WASTE PET BOTTLES FOR GROUND IMPROVEMENT

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Introduction:
Rapid increase in infrastructure development and scarcity of materials necessitate the need to develop and use alternate/ waste materials for construction or improve the engineering properties of existing materials. Soil is the most fundamental material since it provides foundation for all types of construction. Soil stabilization means improvement of stability or bearing power of the soil by the use of controlled compaction, proportioning and/or the addition of suitable admixture or stabilizers.

Geocells (Fig. 1) are 3D honeycomb interconnected structures which are used to provide cellular confinements to the soil. These cells completely encase weak material such as soil, stones, etc and provide all round confinement due to its three dimensional structure thus preventing the lateral spreading of the material due to which a much stiffer mat like structure is formed and distributes the overcoming load to a much wider area.

Lightness, durability, and chemical resistance of plastics have increased its use in the life of a common man but its negligent littering and unscientific disposals has disturbed the ecological balance of our environment in few years. In recent days we witness considerable reduction in the use of plastic bags owed to the regulations imposed by government on its use. However compactness and easiness in handling has led to increased consumption of plastics in packing industry. This experimental study aims to give a solution to increase the bearing capacity of soil by using plastic raw bottles as cellular confinements.

Objectives:
Following objectives are identified for this project.

Perform laboratory CBR tests on quarry dust and investigate the following:
1. Study the performance of waste PET bottle embedded sections over plain sections.
2. Study the effect of aspect ratio of bottles in performance improvement.
3. Study the effect of different configuration of bottles in improving the bearing resistance of the section.
4. Compute the reduction in pavement thickness achieved by embedding plastic bottles within quarry dust and compare the improvement factors.
Methodology:
1. Collect of waste PET bottles and quarry dust.
2. Characterize quarry dust for index and engineering properties
3. To study the effectiveness of waste PET bottles in improving the bearing capacity using CBR tests.
4. California Bearing Ratio test was carried out on different configuration by arranging the bottles in different pattern such as triangle (3 bottles), diamond (4 bottles), circular (5 bottles) at different heights (taken cut bottles at 11.6cm, 9.3cm, 6.6cm) to achieve the desirable optimum aspect ratio i.e. height and diameter ratio. The bottles were placed at a depth of 5 mm below the plunger.
5. The different test configurations prepared within CBR moulds are presented in Fig. 1

Results & conclusion:
To study the performance of waste PET bottle embedded sections, following comparisons are made
1. Comparison of CBR values to identify the section which gives maximum CBR value
2. Comparison of load vs settlement / pressure vs settlement to study performance improvement with respect to configuration and height of bottles.
3. Compare improvement factors to estimate the range of penetration at which maximum benefit is observed.

From the experimental studies it is observed that 4 bottle configuration with a height of 6.3 cm performed better and resulted in maximum CBR value. The improvement factor is maximum at low levels of penetration.

Conclusion:
The following conclusions can be drawn from the experimental studies carried out:
- Benefit of plastic geocell is high when load is directly applied at the junctions as seen in 3 bottle and 4 bottle configuration.
- Though the area of confinement provided is more in 5 bottle configuration, pressure sustained is dependent upon the strength of joints at which load is applied.
- Use of waste PET bottles increases the elasticity of the model sections because improvement factor is highest at 2-4 mm.
• Walls of plastic bottle being weak, it is subjected to buckling when the height of bottle is increased.
• Use of plastic geocell can result in overall pavement thickness reduction by 50%.

**Scope for Future work:**

In the present study, only one bottle size is considered. However, there are many bottles and it is a constraint to use uniform bottle sizes. Performance for random configuration of bottles under repeated loading needs to be investigated. Preferably the experimental studies need to be extended to field scale to study a realistic performance.