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Research article

Permeability of Engineered Sand Backfill Admixed with Recycled Tyre Wastes: A Concise Overview wnd Research Plan

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Introduction

Backfills are used in the construction of retaining walls as they provide support and stability to retaining walls, ensuring their structural integrity, and preventing soil erosion. Retaining wall is designed to resist the lateral pressure of soil while maintaining stability through its self-weight. This type of wall as shown in Figure 1 relies on its massive weight to counteract the pressure exerted by the retained material, preventing sliding, or overturning [1]. Sand is the main material to be used in a backfill of a retaining wall as it has a finer grain, it is easier to be compacted by using various compaction processes.

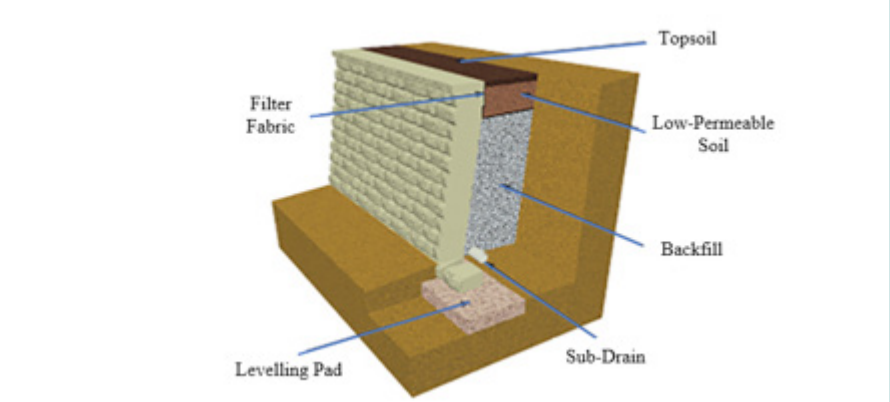

Figure 1: Backfills in gravity retaining wall.

Problem Statement

Sand is the most used natural resource, particularly in the construction industry. Simply said, sand is a natural resource that will eventually run out [2]. Moreover, unused tyre wastes are also hazardous as it fills the landfill and release chemicals into the land, water and air that alter the ecosystem. This unused tyre also become the platform for the mosquito to breed and leading to the increasement of dengue cases. Therefore, this study efforts are to replace and reduce the usage of sand in backfill by using tyre waste material as replacement specifically the rubber granule and fibre from the recycled tyres. This study determines the compatibility of the rubber granule and fibre to be replaced with particular sand ratio to get satisfactory permeability performance of the sand mixture as engineered backfill materials. Thus, utilizing rubber waste as an alternative material to replace sand, the demand for sand can be reduced, leading to the conservation of natural sand resources and provides an opportunity for effective waste management and recycling. Promoting the use of rubber waste can

mitigate the environmental impacts and foster a more sustainable approach to resource management [3,5].

Objective and Scope of Study

The objective of the study is to evaluate the permeability characteristics of sand admixed with recycled tyre wastes and formulate the optimum mix ratios for best permeability performance of the sand recycled tyre wastes composite to be used as an engineered backfill of retaining wall [6,7]. The main laboratory testing is constant head permeability test as it determines the permeability of materials containing little or no silt like sand and gravel. The test is conducted with accordance to British Standard (BS 1377: Part5:1990). The permeability coefficient, k, is computed by using Darcy's Law. The test will be conducted by using four different admixture ratio. The ratios used for sand and rubber is as shown at Table 1. The purpose of using different ratio in the test is to accumulate the optimum mix ratios for best permeability performance of the sand recycled tyre wastes composite. In order to make sure that the sand and rubber chips are compatible mixture as the rubber are being replaced with sand, the sand and rubber particle size were kept in the same range. Both materials were sieved with sieve No. 10 which is passing through size of 2 mm.

Table 1: Sand and Rubber Ratio Used.

Ratio	
Sand	Rubber
100%	0%
90%	10%
80%	20%
60%	40%

Retaining Wall's Permeability

Permeability of backfill plays a crucial role in the designing a retaining wall. Permeability determines how effectively water can flow through the backfill material. Proper drainage is required to prevent hydrostatic pressure from building up behind the retaining wall. If water cannot drain properly, it might exert excessive pressure on the wall, resulting in instability, wall failure, or even hydraulic heaving that might lead to soil erosion. Hence, promoting efficient drainage can reduce the potential for erosion and maintains the long-term stability of the wall. Retaining walls are often exposed to water from various sources, such as rainfall or groundwater. If the backfill material is impermeable or has low permeability, it can become saturated, resulting in increased weight and reduced stability [8,9]. A permeable backfill helps to prevent saturation and maintain the stability of the wall.

Rubber Substitution for Sand

Since permeability of backfill in a retaining wall is very crucial, the material for sand replacement also need to meet the requirement for best permeability performance. Simply said, if the rubber cannot provide a good drainage for the retaining wall, then the rubber cannot be used as sand replacement. Since rubber granules are also more porous than sand which allows for better drainage, rubber granule can be a good substitution material of sand. The good permeable characteristic of rubber can help to prevent the buildup of water pressure behind the wall, which can lead to instability. However, rubber granule is less dense than sand and are less effective in providing compaction. This can affect the overall stability and load-bearing capacity of the retaining wall. Hence, only certain relevant mixture ratio will be tested to maintain the structural integrity in which the retaining wall is functional at its best.

Permeability relationship of sand and rubber granule

The objectives of the proposed study can be obtained by conducting the constant head permeability test with accordance to British Standard (BS 1377: Part 5:1990) as mentioned earlier. This test uses the disturbed samples that are dry poured into the cell. The permeability constant head test measures the ability of soil and rubber to allow fluid flow that is used to determines the value of permeability coefficient, k, of the rubber and sand. Finally, the ratio of in which the admixture shows the same degree of permeability with sand indicates the mixture as the optimum mix ratio for the best permeability performance of the sand recycled tyre wastes composite to be used as an engineered backfill of retaining wall. A follow-up to this publication that includes these new research and findings will be published soon.

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