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Experimental Studies on Mechanical Properties of Modified Previous Concrete as a Rigid Pavement for Low Volume of Traffic

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A B S T R A C T

The main objective of this investigation is to develop a strong pervious concrete mix using with waste tyre rubber powder. In addition, it is also aimed to compare the mechanical properties of these modified mixes with pervious concrete. The properties such as compressive strength, indirect tensile strength, flexural strength and permeability tests are performed to determine the suitability. From the study it is concluded that using of fine aggregate and waste tyre rubber powder as partial replacement material in coarse aggregate shows significant improvement in the mechanical properties (i.e. compressive strength, indirect tensile strength and flexural strength) with maintaining required permeability. Among all the considered modified mixes, MPC-4 (i.e. 10% waste tyre rubber powder as partial replacement material in coarse aggregate) performs better.

1. INTRODUCTION

As urbanization increases in India and many parts of the world the problem of water logging and requirement of drainage is also increase. This is partly due to impervious nature of the bituminous and concrete pavements. Pervious concrete which has an open celi helps significantly to provide high permeability due to its interconnected pores. Pervious concrete (also called porous concrete, permeable concrete and no fines concrete is a special type of concrete with a high porosity used for concrete flatwork applications that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing groundwater recharge. Pervious concrete is made using large aggregates with a little to no fine aggregates. Pervious concrete has been used in the united state for over 30 years. Pervious concrete was first used in the 1800s in Europe as pavement surfacing and load bearing walls. Cost efficiency was the main motive due to a decreased amount of sand. It became popular again in the 1920s for two story homes in Scotland and England. It became increasingly viable in Europe after the second world war due to the scarcity of cement. India is facing a typical problem of ground water table falling at a fast rate due to reduce recharge of rainwater into subsoil and unplanned water withdrawal for agriculture and industry by pumping. Pervious concrete if adopted for construction of pavements, platform/ walkways, parking lots designed for lighter load.

1.1 Objectives of Study

following are the objectives of the present study.

• To determine the optimum pervious concrete mix.

• To determine the mechanical properties of modified pervious concrete by partial replacement of coarse aggregate by 5% and 10% of fine aggregate.

• To determine the mechanical properties of modified pervious concrete by partial replacement of coarse aggregate by 5% and 10% of waste tyre rubber powder.

• To compare the mechanical properties of modified pervious concrete with Control Pervious concrete.

1.2 Scope of study

• The present investigation addressed the strength and permeability aspects of pervious concrete mixes.

• Aggregate to cement ratio of 4:1 used for this study.

• Studied compressive strength, split tensile strength, flexural strength and permeability of pervious concrete and modified pervious concrete.

• 5% and 10% of coarse aggregate of pervious concrete is partially replaced by waste tyre rubber powder as one case study.

• 5% and 10% of coarse aggregate of pervious concrete is partially replaced by fine aggregate as another case study.

2. TEST METHODOLOGY

In order to develop the pervious concrete technology, trial-and-error process is implemented. Focus of the study is to identify elements that influence the mix proportions and the properties of pervious concrete.

The test procedure includes the initial steps of deciding the tests to be conducted and choosing number of aggregate ratios for the pervious concrete. This was followed by conducting the imaginary mix design and compressive strength tests on these samples to determine the mix proportion that performed most successfully. To determine the properties of aggregates, cement, laboratory investigation is carried on standard hardened concrete. Tests for compressive, flexure, indirect tensile strength and permeability tests are conducted.

2.1 Methodology representation:

• Literature study on pervious concrete applications

• Defining the problem

• Conducting of tests on materials

• Determining the optimum percentage of pervious concrete mix

• Determining the optimum content of additives in plain pervious concrete

• Determining and compare the strength in compression, tension and flexure of pervious concrete using optimum percentage of additives

• Conclusions

3. MATERIALS USED IN THE EXPERIMENTAL WORK:

The materials used in experimental work are:

• Cement

• Coarse aggregate

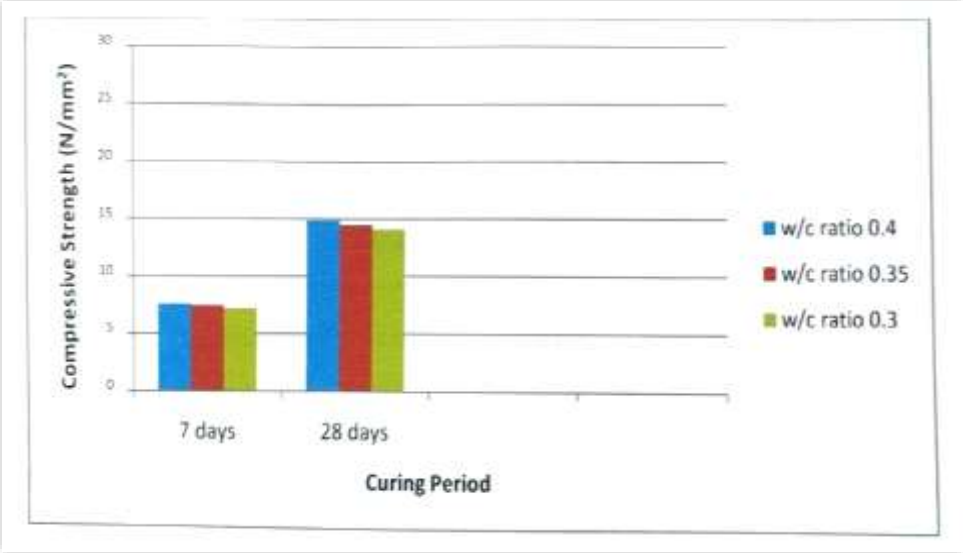
• Water

• Waste tyre rubber

4. Results and Discussion

Compressive strength:

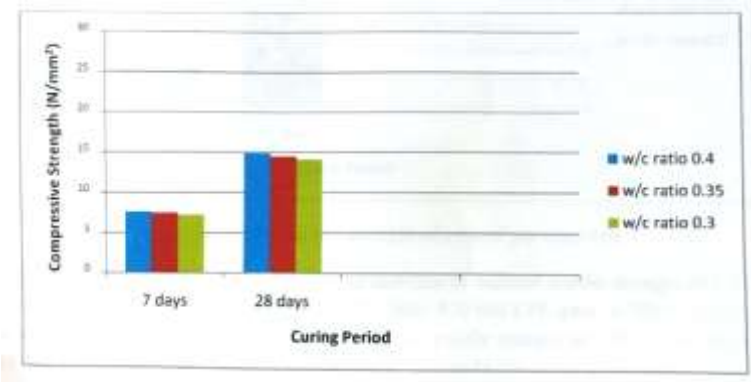
the compressive strength results of control pervious concrete of aggregate to cement ratio 4:1 with different water/cement ratio of 0.3, 0.35 and 0.4 at 7 days and 28 days curing period. Refer fig. 5.1 for compressive strength Vs curing period with different



Indirect tensile strength:

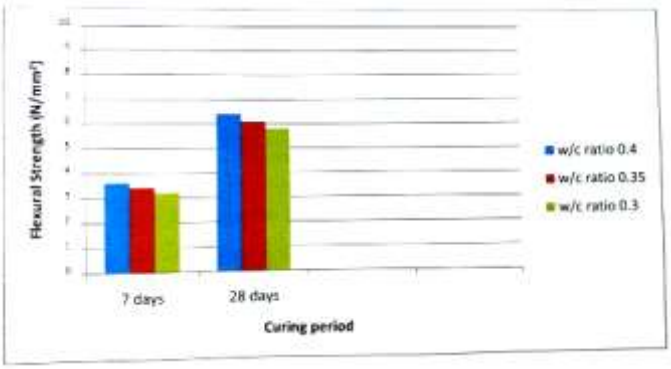
the indirect tensile strength results of control pervious concrete of aggregate to cement ratio 4:1 with different water/cement ratio of 0.3, 0.35 and 0.4 at 7 days and 28 days curing period. Refer fig. 5.2 for Indirect tensile strength Vs curing period with different W/C ratios.

Permeability test for control pervious concrete mix



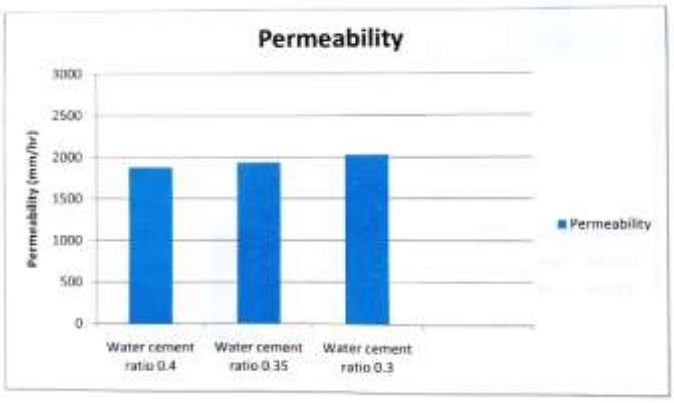
Flexural strength

Flexural strength results of control pervious concrete of aggregate to cement ratio 4:1 with different water/cement ratio of 0.3, 0.35 and 0.4 at 7 days and 28 days curing period. Refer fig. 5.3 for Flexural strength Vs curing period with different W/C ratios.



Permeability test

permeability test results of control pervious concrete of aggregate to cement ratio 4:1 with different water/cement ratio of 0.3, 0.35 and 0.4. Refer fig. 5.4 for permeability Vs different W/C ratios.



B) **Indirect tensile strength:**

Table 5.2 shows the indirect tensile strength results of control pervious concrete of aggregate to cement ratio 4:1 with different water/cement ratio of 0.3, 0.35 and 0.4 at 7 days and 28 days curing period. Refer fig. 5.2 for Indirect tensile strength Vs curing period with different W/C ratios.

Permeability test for control pervious concrete mix

CONCLUSIONS

1.A water cement ratio of 0.4 is found to be in optium strength point view for control previous concrete mix.

2. Compressive strength,split tensile strength and flecural strength properties of modified previous concrete are increased due to presence of fines

3. Permeability decreased by 5.1%,11.4%,8.77%

References

[1 **Jain and Chouhan [1] (2011)** conducted an experimental work on shape of aggregate used in manufacturing of pervious concrete have remarkable bearing on compressive strength and permeability of pervious concrete.

2. **Uma Maguesvaria and Narasimhan [18] (2013)** studied about the influence of fine aggregate and coarse aggregate quantities on the properties of pervious concrete. Materials used are OPC Type I, fine aggregate corresponding to grading II and four sizes of coarse aggregate namely, 4.75mm to 9mm, 9mm to 12.5mm, 12.5mm to 16mm, 16mm to 19.5mm.

3.Rui Liu [1] (2013) studied about the reuse potential of tire chips as coarse aggregates in pavement concrete was examined in this research by investigating the effects of low- and high-volume tire chips on fresh and hardened concrete properties. One concrete control mixture was designed, which well exceeds CDOT Class P concrete requirements.

4.Harish Nayak et al[4] (2015) developed a strong and durable pervious cement concrete (PCC) mix using Polyester Fiber. In addition it is also aimed to compare the properties of these PCC mixes to lay concrete pavers.