

EFFECT OF TITANIUM DIOXIDE IN PERCOLATION CONCRETE

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ABSTRACT

This paper reports an experimental investigation of flood control using percolation road by providing titanium dioxide without using any admixtures. Titanium dioxide is used as partial replacement of cement to increase the strength. Pervious concrete is a mixture of cement, coarse aggregate, with or without fine aggregate also known as no fines, gap graded. The compressive strength of concrete for 3%, 6% and 9% replacement of titanium dioxide attains the strength as 33.5 N/mm², 35.2 N/mm², 31.8 N/mm². The result of this paper shows the replacement of 6 % of titanium dioxide achieve good compressive strength.

Keyword: -Pervious Concrete, Titanium dioxide, Compressive strength and Split tensile strength.

1 INTRODUCTION

The aim of the project is to control the flood during heavy rainfall and anyother natural disasters. Percolation is nothing which filters the liquid and percolates into the soil to increase ground water level using pervious concrete and titanium dioxide. In ordinary concrete road the water may remain stagnant but in case of percolation road the water gets filtered into the ground. The pervious concrete observes water in sidewalks, pavements, parking lots, driveways including highways rather than impervious concrete. Thus pervious concrete plays an important role in filtration and rain water harvesting due to its porosity. This creates a balance in natural ecosystem to a host of problems including erosion, floods, ground water level depletion and pollution of rivers, lakes, and costal water. This type of concrete is significant and sustainable in solving environmental issues.

1.1 Pervious Concrete

Pervious concrete is also called as porous concrete, permeable concrete, no fines and porous pavement. It was first used in the 1800's in Europe and it became popular in 2000 in India. It is a special type of concrete with high porosity which passes through directly and reduces run off to allow ground water recharge. Pervious concrete is a composition of coarse aggregate and with or without fine aggregate. It is ecofriendly and economical in nature. This mixture contains water cement ratio of 0.28 to 0.40 with void content of 15 to 25%. Pervious concrete was estimated in terms of compressive strength, tensile strength and water permeability. This type of concrete is used in parking areas, pedestrian walk way, light traffic areas, residential streets

Pervious concrete is a mixture of coarse aggregate, water, Portland cement, little more fine aggregate. This pavement surface has 20 - 25% voids and allows 4 – 8 gallons of water per minute to pass through. The aggregate used for pervious concrete is in the type of gap graded aggregate (pieces of small in size). This gap graded aggregate gives “drainable” concrete. This will allow the water freely. Mix design is a important part for a successful pervious placement. Adding too much of water and cement will make weaken the final structure. The best pervious mix is placed relatively dry and stiff but with a paste that would be wet and also sticky.

The pervious concrete should place the cover within 20minutes, because of that it does not dry out quickly. Proper curing pervious concrete is essential for structure. Curing will ensures the sufficient hydration of

cement paste to provide the strength in the pavement and it is mostly applicable in warm climatic area. The advantage of pervious concrete is

1. Absorbs less heat than regular or ordinary concrete.
2. It repels salt water intrusions.
3. It controls pollution in water seepage to ground water recharge.
4. It will reduce the need of air conditioning.
5. Managing effective runoff from pavement surface.
6. Prevents contamination of run off water.
7. It requires less power to cools the product or structure.

The maintenance of pervious concrete is

- To ensure the porous pavement is free of sediment monthly.
- It should verified monthly that the pavement system dewater between the storms.

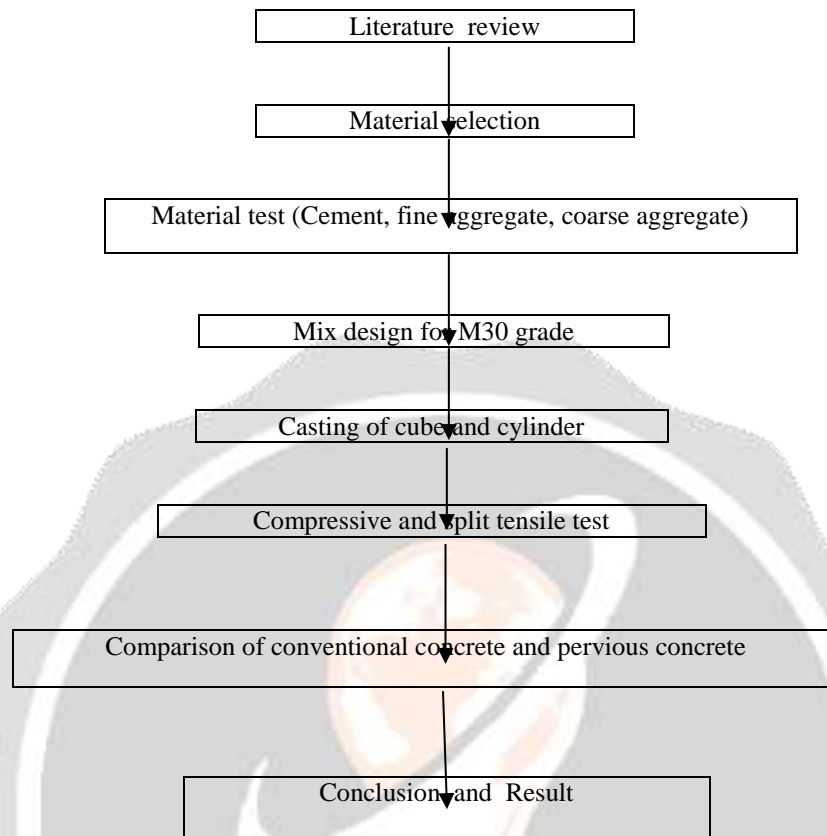
1.2 Titanium dioxide

Titanium dioxide is a oxide of titanium and its chemical formula is TiO_2 . It is also used as a pigment. The appearance of titanium dioxide is white in colour and powdery in nature. It can oxidize oxygen or organic material and also added to paints, cements, window tiles etc... Additionally, TiO_2 is exposed to ultra violet light and it becomes to increase hydrophilic. It acts as anti logging coating or self cleansing windows. Titanium dioxide is a water soluble reagent and used as a cosmetic graded product. When it is used as a pigment it is known for titanium white or pigment white 6. Titanium dioxide is also known as titanium(IV) oxide or titania. The appearance of titanium dioxide is

- TiO_2 is a naturally occurring mineral and used as a bright white pigment.
- It is obtained from ilmenite, rutile and anatase.
- Pure TiO_2 is a fine, white powder that provides a bright, white pigment.



2 METHODOLOGY



3 SCOPE AND OBJECTIVES

- To control the flood and to increase the ground water level percolation road have been used.
- To check the mechanical properties such as compressive strength, water permeability and porosity of the Pervious concrete trial mixes with different size of fine aggregates.
- To find the strength of the pervious concrete made with the replacement of cement with titanium di oxide at 3%, 6% & 9% in each mix proportions.

4 PERCOLATION PROCESS

4.1 Mix proportion

Grade selection : M30 grade , Mix proportion : 1 : 1.9: 2.9, Water cement ratio : 0.45

4.2 Compressive Strength

The compression test have been conducted for the cube having the dimension of 150 x 150 x 150 mm. The compression test is tested using the compression testing machine. The compressive strength of the concrete cube can be determined using the formula given below.

$$\text{Compressive strength} = \text{Compressive load (N)} / \text{Cross sectional area of cube (mm}^2\text{)}$$

Table 1: Compressive Strength of percolation Concrete

Compressive strength in N/mm ²	CEMENT In %	FA %	CA %	TiO ₂ %	7 days in N/mm ²	14 days in N/mm ²	28 days in N/mm ²
	100	10	90	3	21.6	28	33.5
	100	10	90	6	23.1	29.8	35.2
	100	10	90	9	18.2	25.6	31.8

The above Table 1 shows the compressive strength of the percolation concrete for 3 % replacement of titanium dioxide for 7 days , 14 days and 28 days attains 21.6 N/mm², 28 N/mm², 33.5 N/mm² and for 6 % of replacement attains 23.1 N/mm², 29.8 N/mm², 35.2 N/mm² and also 9 % replacement of titanium dioxide for 7 days , 14 days and 28 days attains 18.2 N/mm², 25.6 N/mm², 31.8 N/mm².

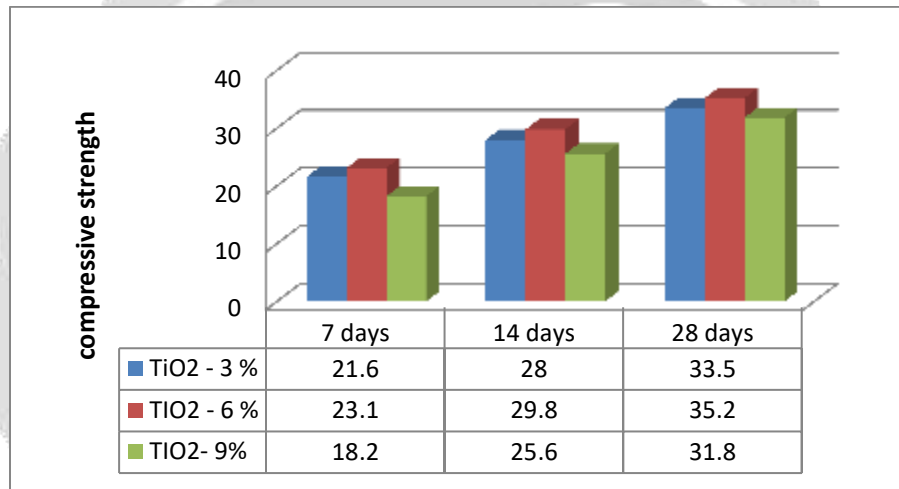


Fig 1: Compressive Strength of percolation Concrete

The above figure shows that the various replacement of titanium dioxide and corresponding compressive strength of percolation concrete.

4.3 Tensile strength test

Split tensile testing is a measure of the ability of material to resist a force that tends to pull it apart. The Split tensile test have been conducted for the cylinder having the dimension of 300 x 150 mm. The Split tensile strength of the concrete cylinder can be determined using the formula given below.

$$\text{Split tensile strength} = (2P) / (3.14 DL) \text{ N/mm}^2$$

Table 2: Tensile Strength of Percolation Concrete

Tensile strength in N/mm ²	CEMENT In %	FA %	CA %	TiO ₂ %	7 days in N/mm ²	14 days in N/mm ²	28 days in N/mm ²
	100	10	90	3	1.39	1.9	2.41
	100	10	90	6	1.68	2.2	2.74
	100	10	90	9	1.27	1.69	2.14

The above Table 2 shows the **Tensile Strength** of the percolation concrete for 3 % replacement of titanium dioxide for 7 days , 14 days and 28 days attains 1.39 N/mm², 1.9 N/mm², 2.41 N/mm² and for 6 % of replacement attains 1.68 N/mm², 2.2 N/mm², 2.74 N/mm² and also 9 % replacement of titanium dioxide for 7 days , 14 days and 28 days attains 1.27 N/mm², 1.69 N/mm², 2.14 N/mm².

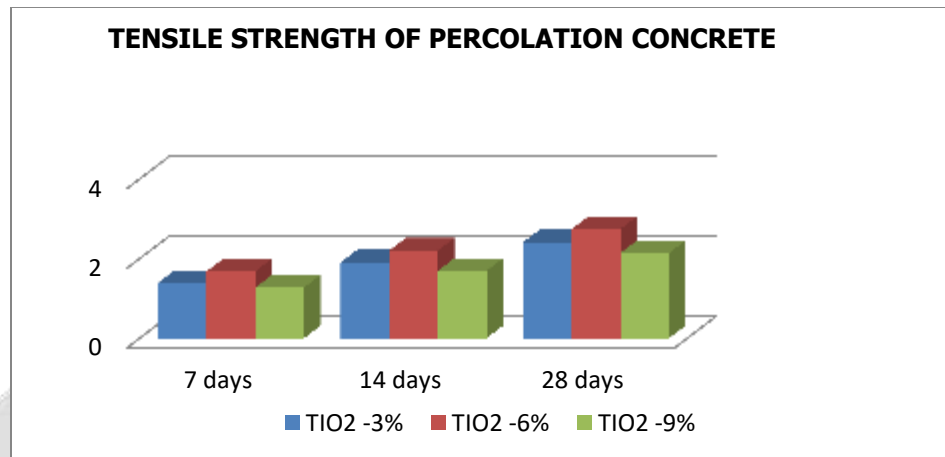


Fig 2: TENSILE STRENGTH OF PERCOLATION CONCRETE

The above figure shows that the various replacement of titanium dioxide and corresponding tensile strength of percolation concrete.

5 RESULTS AND DISCUSSION

- Highest compressive strength (28 days) for pervious concrete is observed as 35.2N/mm² for 6% replacement of cement with titanium dioxide.
- Addition of titanium dioxide up to 3% as partial replacement of cement in pervious concrete resulted in increase of 33.5N/mm² in the compressive strength.
- Addition of titanium dioxide up to 9% as partial replacement of cement in pervious concrete resulted in decrease of 31.8N/mm² in the compressive strength.
- In this project, the amount of Fine aggregate & Coarse aggregate is reduced to make the concrete permeable & TiO₂ is added to increase the strength.
- From this it is found that, the compressive strength of the conventional concrete is 32.7 N/mm² & the Split tensile strength of the conventional concrete is 2.32 N/mm².
- The Compressive strength of the pervious concrete for addition of 3% of TiO₂ is 33.5N/mm² which is higher than conventional & it reaches the maximum strength at 6% & for further addition the strength gets reduced.
- The Split tensile strength of the pervious concrete for addition of 3% of TiO₂ is 2.41N/mm² which is higher than conventional & it reaches the maximum strength at 6% & for further addition the strength gets reduced.

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