Experimental Study on the Use of Waste Tire Powder and Plastic Powder in Concrete Paving

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Abstract— In developing countries utilization of concrete blocks as paving material is widespread. Rubber mold paver blocks are the recent solution for low-cost outdoor applications. The rubber mold paver block is accepted widely in different uses. This intricate a growing concern for protecting the environment and preservation of natural resources. The addition of plastic waste in the construction of pavement reduces plastic shrinkage and dry shrinkage. Plastic is harmful to animal, human and environment. Disposal of plastic waste in an environment is considered to be a big problem. The degradation rate of plastic waste is also very slow hence this study is helpful in reducing plastic waste in helpful way. The main aim of this study is to replace the percentage sand by the PVC plastic waste in the paver block to reduce the harmful effect on the environment. It gives the solution for the plastic waste management to reduce the plastic waste form the environment. This plastic is effectively utilized by manufacturing of paver blocks by replacing percentage of sand in 10%, 15%, and 20% by the PVC plastic waste and adding the fix percentage of superplasticizer in 5%. Compressive strength test on above blocks for the 7, 14, and 28 days are conducted and compare it with the compressive strength of conventional paving block. According to the result the compressive strength of the paving block remain constant. Due to use of PVC waste the cost of paving block also reduces.

Keywords: Concrete Paving, Plastic Powder, Partial Replacement, Cement, Experimental Study, Tire Rubber Powder

I. INTRODUCTION

In developing countries utilization of concrete blocks as paving material is widespread. Rubber mold paver blocks are the recent solution for low-cost outdoor applications. The rubber mold paver block is accepted widely in different uses. This intricate a growing concern for protecting the environment and preservation of natural resources. The addition of plastic waste in the construction of pavement reduces plastic shrinkage and dry shrinkage.

In our project, we replace aggregate by PVC plastic waste by its volume. To overcome the decrease in strength of paving block we introduce an admixture which added in paving by 2% of the weight of the cement of paving bock. Different type of admixture are available in construction industries of different purpose. By varies studies taking advice from different expert we prefer to use superplasticizer as admixture for paving block. This paving block consist of M25 grade of concrete mixture which are mostly suitable for non-traffic areas like pathway, public garden, pedestrian etc. . . . material used for construction of paving block are fine aggregate , cement , coarse aggregate , water , PVC crushed powder , admixture i.e. superplasticizer . The PVC plastic is replaced by 10%, 20%, and 30% of the coarse aggregate. The test on paving block are conducted after 7 day, 14 day, 28 day

A. Material

1) Cement

Cement is a binder, a substance that sets hardens and adheres to other materials, binding together. Here, Ordinary Portland cement of 53 grade is used.

2) Fine Aggregate

The fine aggregate was sieved by using 4.75mm sieve size.

3) PVC Waste Plastic

PVC means polyvinyl chloride. The PVC its production, use, and disposal results in the release of toxic, chlorine-based chemicals. These toxins are building up in the water, air and food chain. The result severe health problems, including cancer, immune system damage, and hormone disruption. Over the past few decades, Polyvinyl Chloride (PVC) plastic, commonly known as "vinyl," has become one of the most widely-used types of plastics. We find it all around us: in packaging, home furnishings, children's toys, automobile parts, building materials, hospital supplies, and hundreds of other products. Its advantages are that it is highly versatile and relatively inexpensive. But the price we pay for a low-cost and seemingly harmless piece of PVC pipe or soft vinyl toy is far steeper than it may at first appear.

In fact, this common plastic is one of the biggest contributors to the flood of toxic substances saturating our planet and its inhabitants. PVC contaminates humans and the environment throughout its lifecycle during its production, use and disposal. While all plastics pose serious threats to human health and the environment, few consumers realize that PVC is the single most environmentally damaging of all plastics. Since safer alternatives are available for virtually all uses of PVC, it is possible to protect human health and the environment by replacing and eventually phasing out this poison plastic.

4) Admixture

Superplasticizer are mainly used for increasing the strength of the concrete paving block. VTNB A-2 is a superplasticizer we used as an admixture in concrete paving block. VTNB A-2 is a superplasticizer which is manufactured by RAZON ENGINEERING COMPANY PRIVATE LIMITED.

5) Application

VTNB A-2 is specially designed for manufacture of dry mix concrete products such as pavers, bricks, paving block, concrete tiles, curb stone, dividers, garden walls etc.

Advantage of VTNB A-2:

1) Workability: Improved workability improved flow, better compaction at low water cement ratio.
2) Strength: improve strength within 24 hours, 72 hours, and 168 hours. Capable of providing 100% strength in 72 hours even in minimal water/mist curing.

3) Surface imperfection: VTND A-2 is designed to eliminate any type of surface imperfection like cracks, honeycombs etc. if at all ensuring a first grade final product.
4) Fire: VTNB A-2 is non-flammable.
5) Consistency: VTNB A-2 ensure consistency of final product in spite of small difference between batches.

6) Water

It is important ingredient of concrete as it chemically reacts with cement. The water which is used to make concrete should be free from impurities and should have pH between 6 to 8, portable and clean

7) Coarse Aggregate

The coarse aggregate was sieved by using 2-10mm sieve size. It having specific gravity of 2.6.

B. Procedure

The different aggregate should be stored separately and in such a way they are well drained. The proportion of mix design is 1:1.48:1.37. In mix proportion there is a replacement aggregate with PVC plastic with 10% , 20% , 30% by volume .After batching the aggregate and binder are discharged separately or simultaneously, together with PVC plastic into the mixture and thoroughly mixed before any additional water is added. Mixes having high fines contents may require longer mixing. Based on measurement of variable moisture content of the aggregate or visual assessment by experienced personnel, water is added to the mixture. Uniformly important because difference in water content from batch to batch will result in difference in quality. After adding water mixture is mixed thoroughly. While mixing 2% of super plasticizer by weight of cement is added into the mixture. After mixing, the mixture is stored in hopper and ready for dispensing into the molds.

Most production machines operate on one of two basic principles. In the first and more widely used system, an amount of mixture is progressively compacted under vibration until a predetermined height has been reached. In the second system, a gauged quantity of mixture is compacted for a set period. In both cases, variations in density will result if the gauged quantities are not consistent or the mixture is not uniformly distributed within the mold. These variations are over and above those due to variations in moisture content. Filling is usually facilitated by a period of prelibation after which the molds are “topped up” with a second filling of mixture. Thermal curing newly molded paving blocks are placed in an insulated chamber for a period of 24 hours. Temperature is increased by the heat of hydration of the cement and no additional heat is provided. The method is therefore inexpensive. A constant temperature of 35°C or more can be maintained with this system. A high humidity is provided from moisture within the units and good curing can be achieved. After initial curing by one of the methods described above, the pavers are sufficiently hard for stacking, packaging, etc. Shrink-wrapping helps retain moisture for extended hydration but might promote lime bloom.

The optimum period of vibration must be determined experimentally in the plant but is usually 3 to 12 seconds. Good compaction is more difficult to achieve in thicker blocks and those that have acute angles. For this reason concrete pavers with a thickness greater than 80 mm are seldom manufactured. Frequency and amplitude of vibration should be optimized for the specific materials being used and the number of blocks being molded per cycle.

As with all concrete products, the quality of concrete pavers is improved by water curing. However, it is not practicable to apply significant amounts of water onto newly molded pavers or subsequently to subject them to water sprays or immersion in water. The phenomenon of efflorescence further complicates curing in practice. Here the calcium hydroxide combines with carbon dioxide from the atmosphere to form less soluble calcium carbonate which is white in color.

II. CALCULATION

A. Water Absorption Test Calculation

In this test, blocks are weighed in dry condition and let them immersed in fresh water for 24 hours. After 24 hours of immersion, those are taken out from water and wipe out with cloth. Then, block is weighed in wet condition. The difference between weights is the water absorbed by block. The percentage of water absorption is then calculated.

Water absorption = {[W2 – W1] / W1} x 100

Where, W1= Weight of dry block (kg)

W2 = Weight of wet block (kg)

III. RESULTS

Curing Days	Applied Load (KN)	Compressive Strength (N/mm2)
7 Days	290	19.33
14 Days	404	26.93
28 Days	445.50	29.70

Table 3.1.1: Conventional Paver Block Compressive Test Result

Curing Days	Applied Load (KN)	Compressive Strength (N/mm2)
7 Days	275	18.33
14 Days	400	26.6
28 Days	441	29.40

Table 3.1.2: Conventional Paver Block Compressive Test Result by 10% replacement of PVC admixture

Curing Days	Applied Load (KN)	Compressive Strength (N/mm2)
7 Days	260	17.30
14 Days	388	25.86
28 Days	432	28.80

Table 3.1.3: Conventional Paver Block Compressive Test Result by 20% replacement of PVC admixture

Curing Days	Applied Load (KN)	Compressive Strength (N/mm2)
7 Days	248	16.53
14 Days	382	25.46
28 Days	427	28.46

Table 3.1.4: Conventional Paver Block Compressive Test Result by 30% replacement of PVC admixture

Particular	10% Plastic Additive	20% Plastic Additive	30% Plastic Additive
Dry Weight	3.70	3.41	3.03
Wet Weight	3.76	3.46	3.07

Water Absorption in %	1.62	1.47	1.32

Table 3.1.5: Comparative Water Absorption Results

IV. CONCLUSION

1) The plastic in concrete reduce the unit weight of concrete.
2) The minimum compressive strength is obtained at the age of 28 days.
3) As plastic has the basic properties of water resistance, the concrete mix require less quantity of water than calculated amount during mixing.
4) The cost of plastic paver block decreases with increase in PVC replacement.

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