

Partial Replacement of Cement with PVC Powder

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Abstract— This study is mainly aimed to increase the compressive strength of concrete by partially replacing cement with PVC Powder. Cementitious concrete has great practical difficulties in achieving high compressive strength and durability of high performance structures. But it becomes a challenge to increase the compressive strength and durability of particular cementations composite and also maintaining basic desirable properties of concrete. This project addresses these problems by the addition of PVC powder. The use of PVC powder as concrete admixtures not only extends technical advantages to the properties of concrete but also contributes to the environmental pollution control. Extensive research has been done all over the world on the benefits that could be accrued in the utilization of PVC powder as a supplementary cementations material. High volume PVC Powder in concrete is a subject of current interest all over the world. The main aim of this study is to analyze the compressive strength of concrete by partially replacing cement by PVC powder in concrete. In this study, An experimental study has been carried out by replacing cement with PVC powder in the proportions of 2%, 4% and 6% (by weight of cement). The mix design used in this study was M20 and the mix proportion of M20 concrete was arrived by using IS 269-1989 and The cube specimens were casted, cured and tested after 7 days and 14 days to find out the compressive strength of cube specimens.

Keywords: Cementitious Concrete, PVC Powder, Compressive Strength

I. INTRODUCTION

Concrete is a mixture of cement, fine aggregate, coarse aggregate, water and admixture. Admixture is basically added to improve the workability of concrete. Cement acts as a binding material in concrete. A cement is a substance that sets, hardens and adheres to other materials. Cement is used with sand to produce mortar for masonry. Cement used in construction is usually inorganic.

A. Concrete

Concrete is a composite material that is composed of fine and coarse aggregate bonded together with cement paste that hardens over time. Most concretes used are lime-based concretes or concretes made with other hydraulic cements. Asphalt concrete is the concrete which is frequently used for road surfaces. In asphalt concrete the cement material is Bitumen and sometimes polymer concretes are used where the polymer is a cementing material.

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B. PVC Powder

Polyvinyl chloride additionally called as polyvinyl or vinyl has been usually curtailed PVC. It is the world's third-most broadly created manufactured plastic polymer, polyethylene

and polypropylene being first and second in rank individually.

There are essentially two types of PVC specifically Rigid, that is RPVC and Flexible. The inflexible type of PVC has an extensive hugeness in development for funnels and in profile uses of entryways and windows. It is likewise used to make bottles, non nourishment bundling and bank and enrollment cards and so forth.

To make it gentler and more adaptable, plasticizers might be included the most regularly and generally utilized being phthalates. In its adaptable frame, PVC is of incredible use in pipes, electrical link protection, impersonation cowhide, signage, phonograph records, inflatable items and a considerable lot of those applications where it can substitute elastic.

C. Aim of Present Study

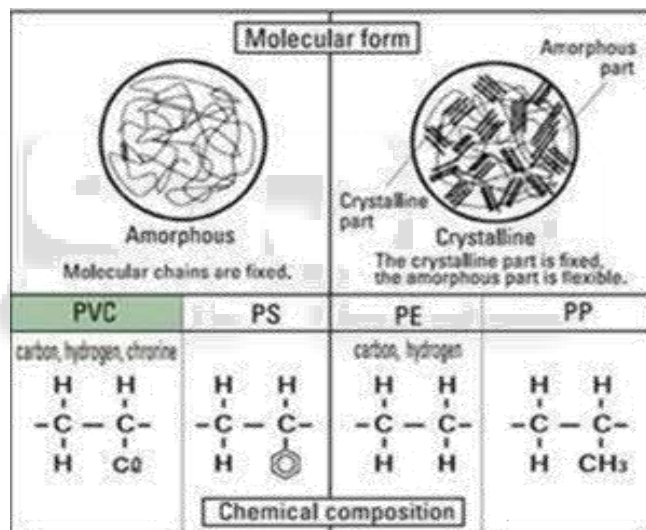


Fig. 1: Molecular Structure of PVC

The main aim of this research work is to basically increase the compressive strength of concrete cubes by partially replacing cement by PVC Powder. Infrastructure required today are progressively increasing day by day, for which we require alternate material availability. Our research is basically aimed to enhance the quality of concrete.

II. EXPERIMENTAL PROGRAM

A. General

In the present study an experimental program was carried out to test various cube specimens of cement concrete to determine various properties coarse aggregate, fine aggregate, cement, PVC Powder. The simple step by step procedure of our project is as follows:

- 1) Firstly the mix design of the selected grade M20 of concrete was done using the Indian Standards.
- 2) Then according to the design batching of the materials was done.

- 3) The materials were weighed on the weighing machine.
- 4) One by one they were added in the machine mixer and were mixed properly.
- 5) After mixing, the concrete is then collected and is poured in slump cone apparatus for testing the slump value.
- 6) The concrete cube was then poured into cube of 15cm*15cm*15cm dimension.
- 7) The cube moulds were placed on the vibrator machine which helps in filling the air gaps. Then the concrete is allowed to set for few days.
- 8) The moulds are then removed and the blocks were placed in the water tank for curing.
- 9) Finally the compressive strength of the blocks was checked using compression testing machine i.e. at 7 days & 28 days respectively.

B. Materials

1) Ordinary Portland Cement

Ordinary Portland Cement (OPC) of 43 grade conforming to IS 8112:1989 is used throughout this investigation. This cement is by far the most important type of cement. The OPC is classified into 3 grades, namely 33 grade, 43 grade and 53 grade depending upon the strength of cement at 28 days when tested as per IS 4031-1988.

Description	Values
Grade	43
Fineness(retained on 90 micron sieve) in %	1.17
Initial Setting Time (minutes)	90
Final Setting Time (minutes)	540
Specific Gravity	3.15

Table 1: Properties of cement

2) Aggregates

Aggregates can be classified on the basis of the size of the size of the aggregates as coarse aggregate and fine aggregate. The aggregates that pass through 4.75mm sieve are known as fine aggregates and the aggregates that are retained on 4.75mm sieve are known as coarse aggregates.

3) Sand, Coarse Aggregate and PVC Powder

Pycnometer apparatus is used to measure specific gravity and bulk density, fineness modulus of aggregate is found by using set of sieves.

S.NO	Properties	Specific Gravity
1	Cement	3.15
2	Fine Aggregate	2.65
3	Coarse Aggregate	2.75
4	PVC powder	2.4



Fig. 2: Specific Gravity of PVC



Fig. 3: Compressive Strength test on Cube

4) Mix Design of M20 Grade Concrete

We did mix design of M20 grade concrete and got the following result:

Obtained ratio = 1:1.5:3

We casted 2 cubes of normal proportions with no partial replacement of cement, 2 cubes with 2% partial replacement of cement, 2 cubes with 4% partial replacement of cement & 2 cubes with 6% partial replacement of cement. We tested 2 sets of each variety of cubes in 7 days and remaining 2 sets of cubes in 28 days.

C. Results

The following results were obtained after the completion our research work:

- 1) The 7 day compressive strength of cubes was found out to be 5.44 N/mm².
- 2) The 7 day compressive strength of cubes was found out to be 4.64 N/mm².
- 3) The 7 day compressive strength of cubes was found out to be 5.51 N/mm².
- 4) The 7 day compressive strength of cubes was found out to be 5.58 N/mm².
- 5) The 14 day compressive strength of cubes was found out to be 21.78 N/mm².
- 6) The 14 day compressive strength of cubes was found out to be 16.67 N/mm².
- 7) The 14 day compressive strength of cubes was found out to be 20.88 N/mm².
- 8) The 14 day compressive strength of cubes was found out to be 24.44 N/mm².

- 9) The test performed by us results that the strength of 2% partially replaced cubes is found to be slightly less than that of the standard cube both at 7 days and 14 days.
- 10) The test on 4% partially replaced cubes results approximately same as of standard cube.
- 11) The test on 6% partially replaced cubes results in slightly higher strength than the standard cubes.

Graph 1: Graphical comparison in 7 days

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