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STUDY ON MECHANICAL PROPERTIES OF POLYMER CONCRETE

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Abstract - *Polymer Concrete is a component added for the construction purposes which provide strength at sites of various heavy hydraulic structures. Polymer Concrete is composed of fine and coarse aggregates bonded together with cement and polymers mixed with water in a fixed proportion that hardens over time. Compressive strength of a concrete plays a major role in construction of a structure. This paper investigates the impact of polymers added with concrete to carry out changes on the properties of the concrete. Concrete produced and applied at places where presence of water is very much like seas and rivers, can have significant changes on the property of the concrete which can adversely affect the construction. Hence, to carry out the enhancement of its properties so that it can be used at sites where heavy hydraulic structures and presence of water is very much.*

1. INTRODUCTION

The main aim of this paper is to study the changes that occur on the property of the concrete with addition of polymers to it in fixed proportions. So that we can know that whether the polymer behaves in a positive or negative way when the concrete is mixed with polymers and is used at sites like dams, reservoir, harbours etc.

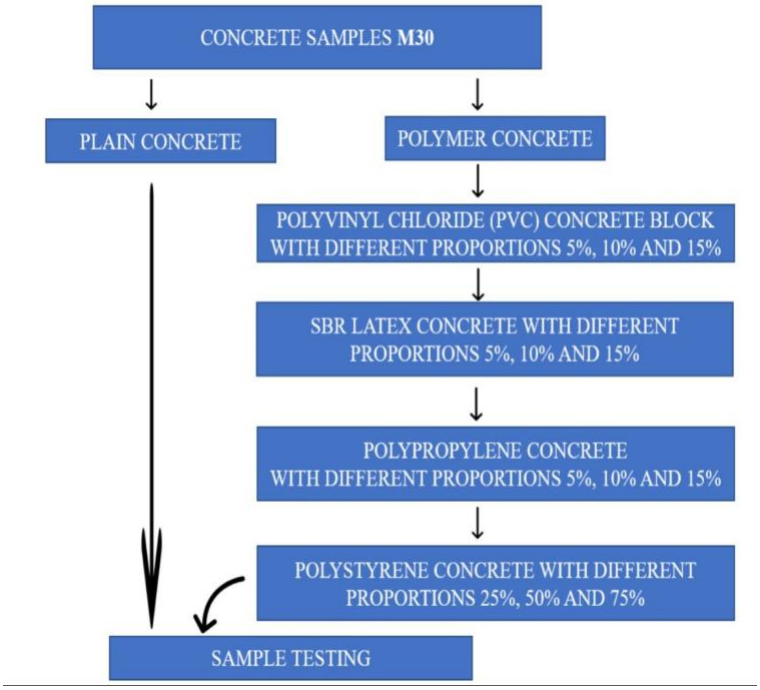
The polymers used are the one's which may help to increase the binding property of concrete at places where water is present in huge amount which can damage the concrete easily, also it can penetrate it and can corrode the reinforcement provided with time and make it lose its basic properties like durability, compressive strength, characteristic strength etc. Therefore, these polymers are used in the project with an aim to increase the concrete properties to withstand such damages.

2. MATERIALS AND METHOD

- Cement
- Coarse Aggregate
- Fine Aggregate
- Water
- Polymers [Polyvinyl Chloride granules (PVC), SBR Latex, Polystyrene (EPS), Polypropylene]

In this paper, concrete cubes of grade M30 are made, first the normal cubes with cement, fine and coarse aggregate and then by replacing the cement by various polymer products in different percentages [Polyvinyl Chloride granules (PVC), SBR Latex, Polystyrene (EPS), Polypropylene].

All tests are performed on 28 days and then comparing the values of the strength of the plain concrete blocks and polymer concrete blocks with each other with the help of the compression testing machine, comparing their workability (by slump test) of concrete and flexural test.



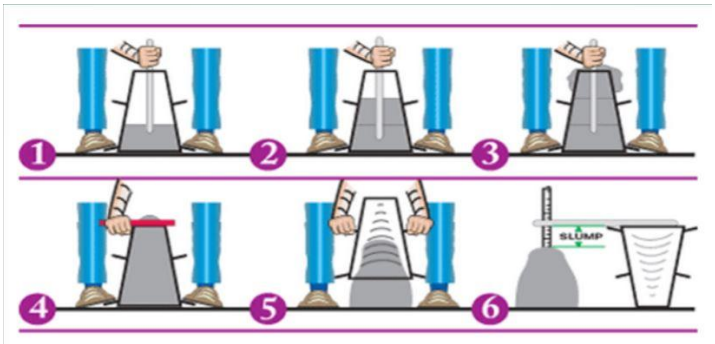
Compression test are done on 28th day of proper curing in fresh water.

2.1. Batching of the Constituent Material

In general, concrete is mixed with the accurate proportion according to the nominal design as well as calculated mixed design. Batching is done in a quality control laboratory. For batching of concrete properly coarse aggregates are further taken into two parts in which 60% aggregates are taken which are passing from 20mm size sieve and retaining on 10mm size sieve, and the remaining 40% aggregates are taken which are passing from 12.5 mm size sieve and retaining on 2.36 mm size sieve, Cement used was 43 grade ordinary Portland cement and fine aggregates or sand are mixed in the mixer with water with a water cement ratio of 0.45.

2.1.1. Slump Test

The slump test helps us to find the workability that determines the ease and homogeneity with which the concrete can be mixed, placed, consolidated and finished. The slump values of the concrete mix can be taken out with the help of slump cone in the shape of frustrum with upper diameter as 100mm, bottom diameter as 200 mm and height as 300mm.



2.1.2. Compression Testing

Compression testing is done on concrete cubes to determine the strength of the concrete. For compression testing Universal Testing Machine is used which is a machine assembly that applies load on one side of concrete cube (of size

150mm * 150mm * 150mm) by 10 KN/mm2 per minute. The load is applied to the cube till it breaks and the readings are noted accordingly.

2.1.3. Flexural Testing

Flexural test is done on concrete beams to determine the tensile strength of the concrete. According to Indian standard specified loading rate of 180kg/min for 100mm specimen is applied with the help of flexural testing machine. In the present investigation, the test apparatus used have a least count of 0.5KN and max limiting value of 100KN.

If 'a' be the distance between the line of fracture and the nearer support, then for finding the modulus of rupture, these cases should be considered.

1. When a > 133 mm for 100 mm specimen,
   fcr = PL/bd2
   Where P = total load applied on the beam
   L= average length of the specimen at fracture
   b= average width of the specimen at fracture
   d= average depth of the specimen at fracture

2. When 110 mm < a < 133 mm,
   fcr = 3Pa/bd2

3. When a < 110 mm, the result should be discarded.

3. RESULTS

3.1. Slump Test

The result of slump test for plain concrete M30 cube comes out to be 52mm.

S.NO.	POLYMER	SLUMP OF DIFFERENT SAMPLES					
		SAMPLE 1		SAMPLE 2		SAMPLE 3	
1.	PVC	5%	58mm	10%	55mm	15%	50mm
2.	SBR LATEX	5%	60mm	10%	63mm	15%	68mm
3.	POLYSTYRENE	25%	50mm	50%	52mm	75%	51mm
4.	POLYPROPYLENE	5%	56mm	10%	60mm	15%	61mm

Workability of the concrete mix is best with the SBR Latex polymer at 15% usage. This tells us that the ease of work with polymer concrete at the 15% of SBR Latex is maximum of all the polymers used and with increase of percentage of SBR Latex, the workability of concrete increases.

3.2. Compressive Strength Test on Cubes Compressive strength in N/mm2

Compressive Strength for plain concrete at 28 days comes out to be 36.2 N/mm2

S. No.	POLYMER	%	SURFACE AREA (mm2)	RESULT (N/mm2)
1.	PVC	5	22500	40.12
		10	22500	42.53
		15	22500	41.26
2.	SBR LATEX	5	22500	41.18
		10	22500	43.07
		15	22500	41.80
3.	POLYSTYRENE	25	22500	37.46
		50	22500	33.49
		75	22500	25.49
4.	POLYPROPYLENE	5	22500	32.20
		10	22500	35.69
		15	22500	33.57

Compressive strength for different polymers at different percentage is shown in the above table.

3.3. Flexural Test

Tensile Strength for plain concrete at 28 days comes out to be 4.32 MPa

S,NO.	POLYMER	FLEXURAL STRENGTH (Fcr) Mpa
1.	Plain M30 0%polymer	4.32
2.	Pvc 5%	4.43
3.	Pvc 10%	4.56
4.	Pvc 15%	4.49
5.	Sbr latex 5%	4.49
6.	Sbr latex 10%	4.59
7.	Sbr latex 15%	4.52
8.	Polystyrene 25%	4.28
9.	Polystyrene 50%	4.05
10.	Polystyrene 75%	3.53
11.	Polypropylene 5%	3.97
12.	Polypropylene 10%	4.18
13.	Polypropylene 15%	4.05

Tensile strength for different polymers at different percentage is shown in the above table.

4. CONCLUSIONS

- Value of slump of concrete is increasing with the addition of SBR latex at 15%.
- Strength of the concrete is increasing with the addition of SBR latex at 10% and is lowest for polystyrene and polypropylene at all the percentage compared to the plain M30 concrete cube.
- Tensile Strength of SBR Latex concrete beam at 10% is maximum compared to all the polymers and plain concrete beam.
- Addition of PVC granules and SBR Latex to concrete gives us the required increase in the compressive strength as well as tensile strength of concrete.
- Addition of Polystyrene and Polypropylene to concrete is not good as the desired properties of concrete are not achieved.
- With the help of this research paper we have concluded that PVC granules and SBR Latex can be added to the concrete at places where heavy hydraulic structures are used that will help to give more compressive strength and tensile strength to them.

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