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Influence of Various Polymer to Cement Ratios on Concrete Properties

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Abstract

A **polymer** (*poly*-, "many" + *-mer*, "parts") is a large molecule, or macromolecule, composed of many repeated subunits.
Polymer concretes are a type of concrete that use polymers to replace lime-type cements as a binder. In some cases the polymer is used in addition to portland cement to form Polymer Cement Concrete (PCC) or Polymer Modified Concrete (PMC). Polymers in concrete have been overseen by Committee 548 of the American Concrete Institute since 1971.

Introduction

In polymer concrete, thermoplastic polymers are used, but more typically thermosetting resins are used as the principal polymer component due to their high thermal stability and resistance to a wide variety of chemicals. Polymer concrete is also composed of aggregates that include silica, quartz, granite, limestone, and other high quality material. The aggregate must be of good quality, free of dust and other debris, and dry. Failure to fulfill these criteria can reduce the bond strength between the polymer binder and the aggregate.

- Here SBR (Styrene Butadiene Rubber) polymer is used as binder material to improve the compressive strength of concrete.
- SBR is a mixture of approximately 75% Butadiene and Styrene (C8H8).It can be used to replace cement binders to improve tensile, flexural and compressive strength of concrete. SBR is a white thick liquid in appearance .

METHODOLOGY ADOPTED-: Concrete is a mix of cement, fine aggregate (sand), coarse aggregate (gravel or crushed stone), and water. Concrete is the most widely used construction material in the world. Concretes are similar in composition to mortars which are used to bond unit masonary. Mortars, however, are normally made with sand as the sole aggregate, whereas concretes contain both fine aggregates and much larger size aggregates and thus usually have greater strength. Concretes therefore have a much wider range of structural applications, including pavements, footings, pipes, unit masonry, floor slabs, beams, columns, walls, dams, and tanks. In this study the comparison between various percentage of polymer to cement ratio (P/C) and concrete strength using destructive test equipment have been carried out. In this study SBR (Styrene Butadiene Rubber) polymer and normal aggregate were used for prepairing cube specimens. Four types of mixed proportion are used – M15, M20, M25 and M30. The concrete cube prepared on normal aggregate and 60% and 40% different size 10 mm (40%), 20 mm (60%) aggregate is utilize for concrete cubes and polymer SBR is used in different proportions to cast

concrete cube. These cubes are tested on 7, 14, and 28 days. The compressive strength of these cubes is determined with the help of destructive equipment. The cement used in all mixers is Portland pozzolanas cement and natural sand is used in the experiment. The size of sand is 2 mm to 4.75 micron. The universal test machine (destructive) were performed on various specimens from different high strength concrete mixtures. In order to determine the effect of SBR polymer, Cube specimens with standard dimensions were tested at 7, 14 and 28 days. The determination of the strength of each mixture and specimen ages are based on the average of 3 Specimens.

OBJECTIVE

- The objective of this study is to see the effect of polymer addition on compressive strength of various grades of concrete at various polymer to cement ratios.
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EPERIMENTAL STUDY

TESTING OF MATERIALS-: Following laboratory methods are used to perform the test of materials:

- Specific gravity
- Gradation
- Silt content of sand
- Impact value
- Flakiness & Elongation index test .
- Standard consistency test of cement.
- Initial and Final setting time of cement
- Compression test by UTM.

Tests Results

Flakiness index= 14.39 %

Elongation index = 24.33 %

SEIVE ANALYSIS OF FINE AGGREGATE

Sieve Size (mm)	% Reataning wt.	%Cumulative wt.	Finner % (N)	LIMITS
4.75	1.35	1.35	98.65	**90-100**
2.36	10.4	11.75	88.25	**75-100**

1.18	29.75	41.5	58.5	**55-90**
0.6	24.1	65.6	34.4	**35-59**
0.3	25.7	91.3	8.7	**8-30**
0.15	5.45	96.75	3.25	**0-10**

Thus for fine aggregate
Fineness modulus=3.08
Sand is of zone – II
Silt content of sand = 5%

SEIVE ANALYSIS OF COARSE AGGREGATES

For 20 mm aggregate

Sieve Size (mm)	% Reataning wt.	%Cumulative wt.	Finner % (N)
40	0.00	0.00	100.00
20	4.00	4.00	96.00
10	92.67	96.67	3.33
4.75	3.33	100.00	0.00

F.M. = 7.01

For 10 mm aggregate

Sieve Size (mm)	% Reataning wt.	%Cumulative wt.	Finner % (N)
12.5	0	0	100
10	2	2	98
4.75	21.5	23.5	76.5
2.36	76.5	100	0

F.M. = 6.26

SPECIFIC GRAVITY

Material	Specific Gravity
20mm	2.79
10mm	2.75
Sand	2.61
Cement	3.10

CONSISTENCY

The consistency of the cement in the study was found to be 35%.

Initial and Final setting time

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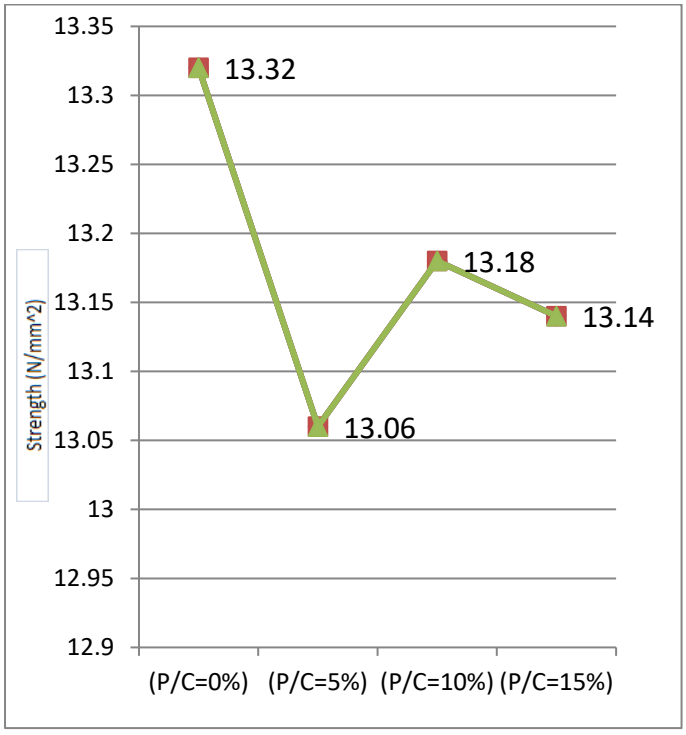
Type of cement	Initial setting time	Final setting time
PPC	55 min	483 min

RESULTS AND DISCUSSION



Graph 1: comparative study of M15 concrete having different P/C ratio at 7 days

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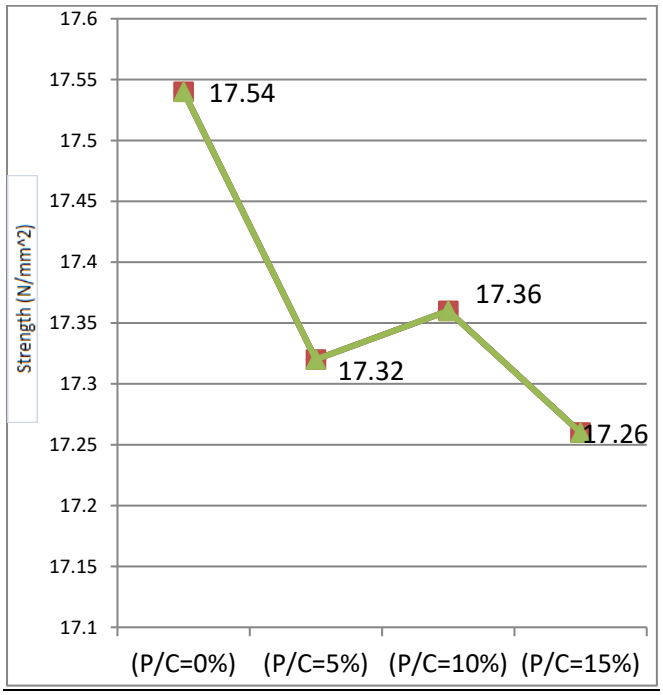
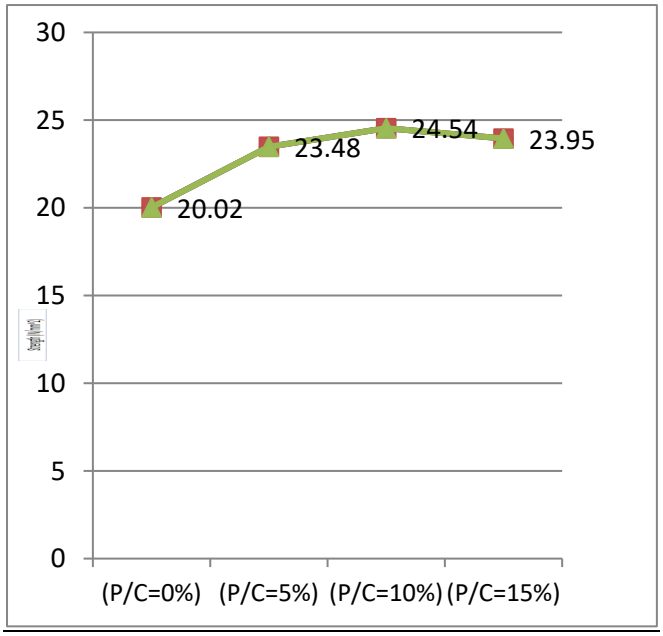
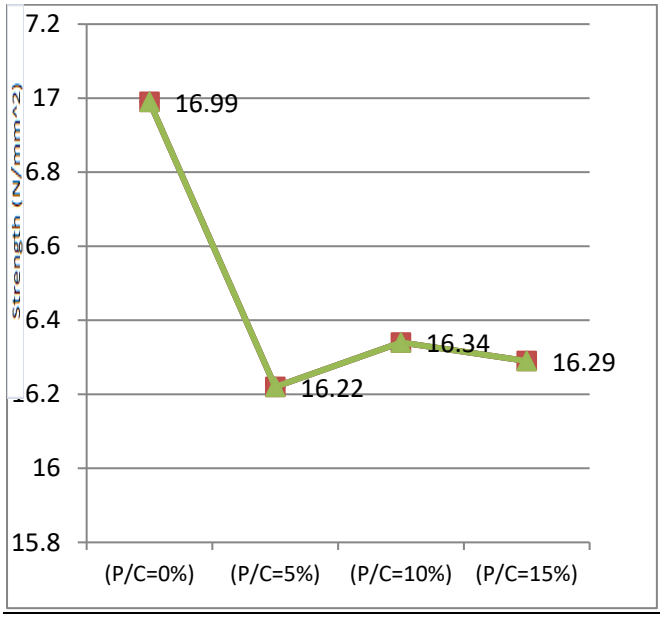


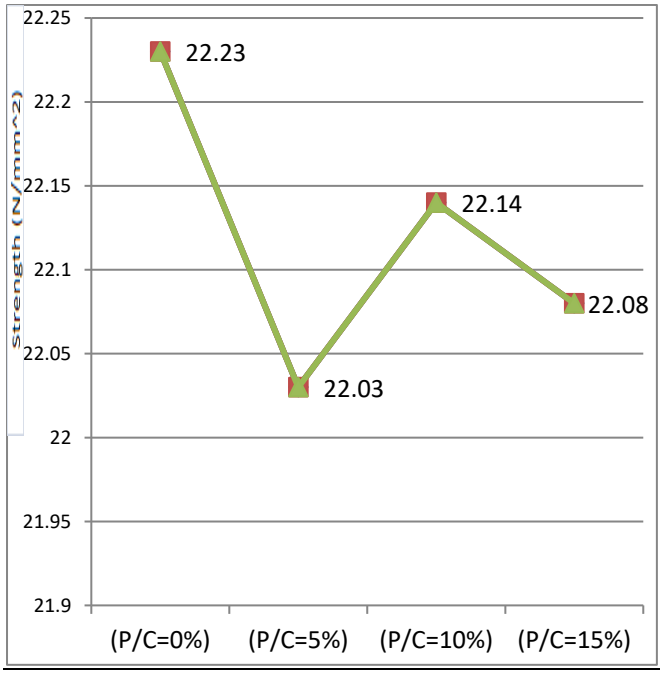
Graph 2: comparative study of M15 concrete having different P/C ratio at 14 days



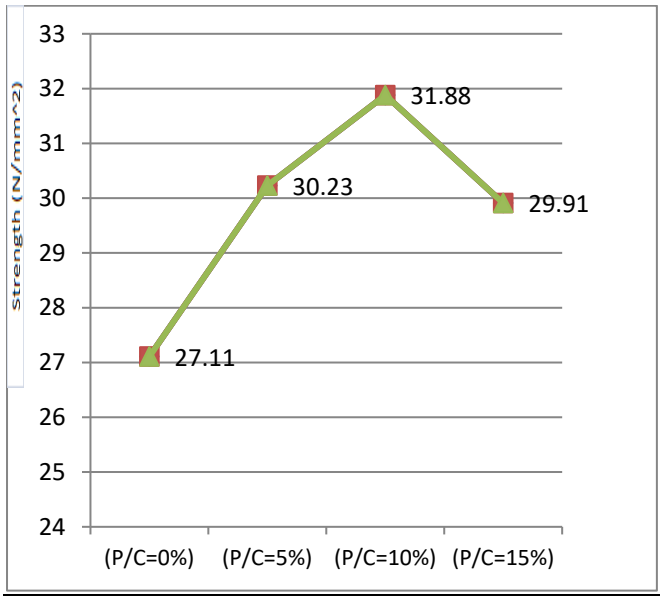
Graph 3: comparative study of M15 concrete having different P/C ratio at 28 days



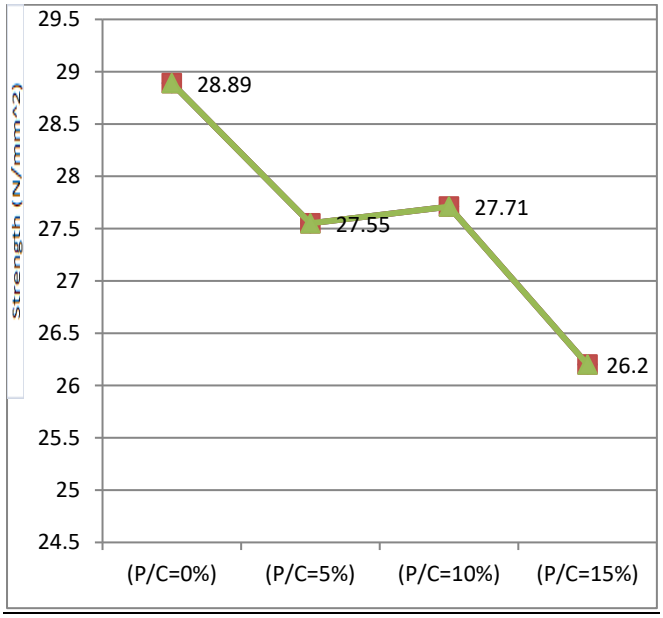
Graph 4: comparative study of M20 concrete having different P/C ratio at 7 days



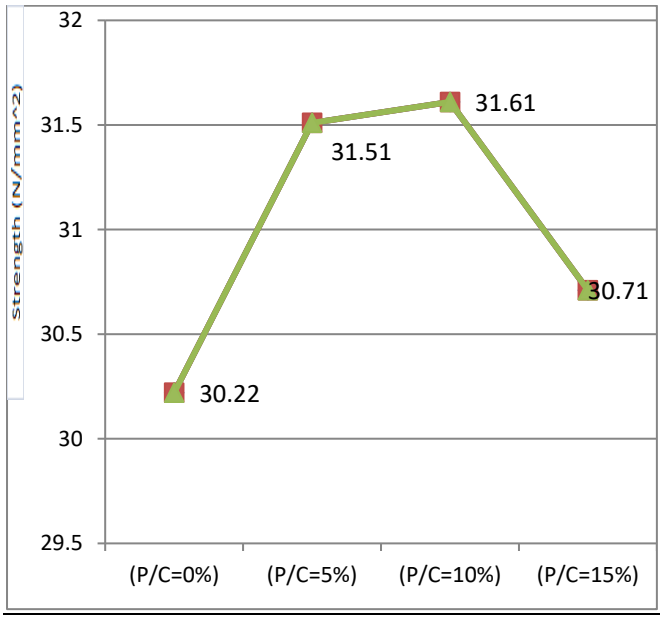
Graph 5: comparative study of M20 concrete having different P/C ratio at 14 days



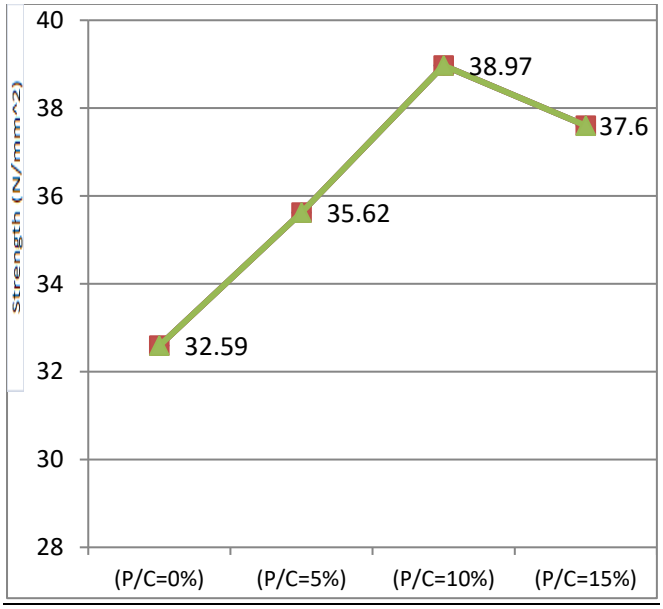
Graph 6: comparative study of M20 concrete having different P/C ratio at 28 days



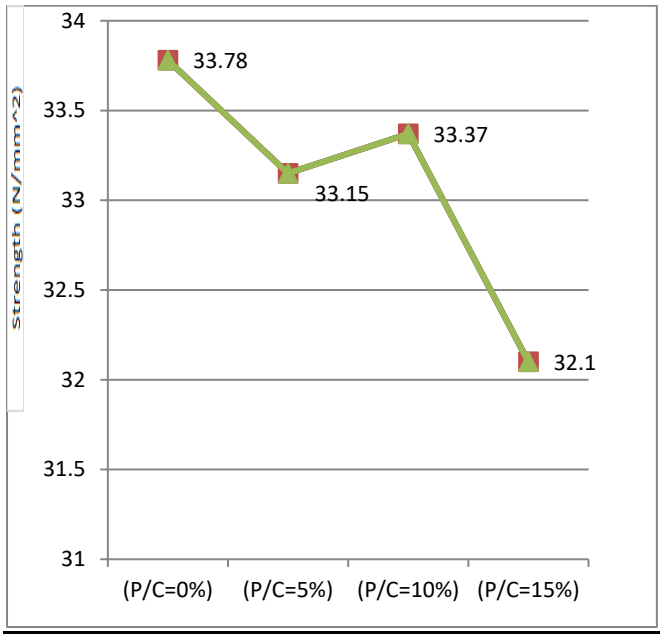
Graph 7: comparative study of M25 concrete having different P/C ratio at 7 days



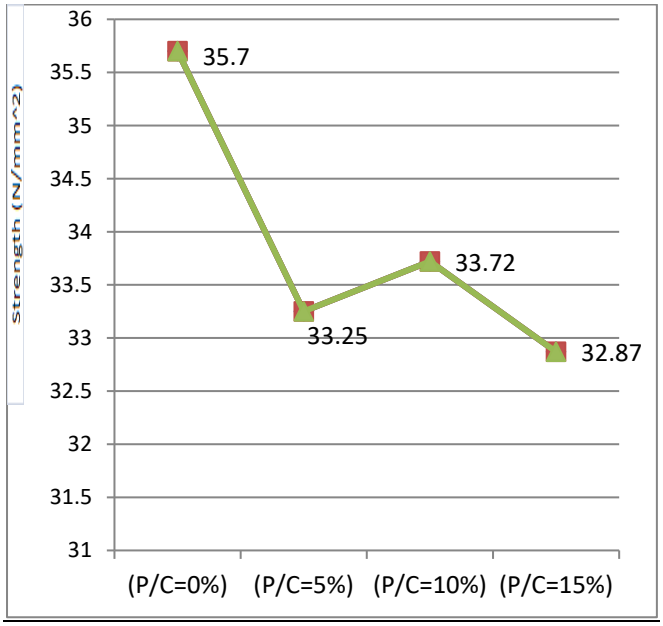
Graph 8: comparative study of M25 concrete having different P/C ratio at 14 days



Graph 9: comparative study of M25 concrete having different P/C ratio at 28 days



Graph 10: comparative study of M30 concrete having different P/C ratio at 7 days



Graph 11: comparative study of M30 concrete having different P/C ratio at 14 days

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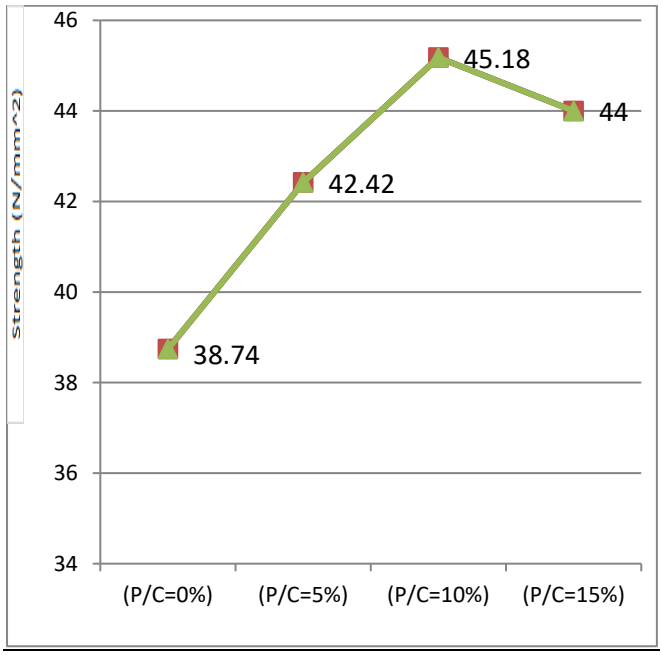

Graph 12: comparative study of M30 concrete having different P/C ratio at 28 days

CONCLUSION:

⇨ It can be observed that compressive strength of M15 concrete cube decreases at 7 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

⇨ It can be observed that compressive strength of M15 concrete cube decreases at 14 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

⇨ It can be observed that compressive strength of M15 concrete cube increases at 28 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

⇨ It can be observed that compressive strength of M20 concrete cube decreases at 7 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 5% .

⇨ It can be observed that compressive strength of M20 concrete cube decreases at 14 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

⇨ It can be observed that compressive strength of M20 concrete cube increases at 28 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

⇨ It can be observed that compressive strength of M25 concrete cube decreases at 7 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

⇨ It can be observed that compressive strength of M25 concrete cube decreases at 14 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

⇨ It can be observed that compressive strength of M25 concrete cube increases at 28 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

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⇨ It can be observed that compressive strength of M30 concrete cube decreases at 7 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

⇨ It can be observed that compressive strength of M30 concrete cube decreases at 14 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

⇨ .It can be observed that compressive strength of M30 concrete cube increases at 28 days after the addition of SBR polymer although on comparing different proportions used maximum value is observed when P/C is 10% .

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