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Enhancing the Strength of Pervious Concrete by Using Poly Vinyl Alcohol and Poly Vinyl Acetate

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Abstract: ***Earth gets water in the form of rain. The construction of pavements by using Bitumen and Concrete covers the soil surface which restricts the rain water from infiltration and ground recharge and also results in flooding. Pervious concrete is a special type of concrete which allows water to percolate through it, pervious concrete is a mixture of Cement and Aggregates, fine sand is not used for mix preparation, so also called as 'No Fine Concrete'. The percentage of voids in pervious concrete can vary from 15% to 40% due to which it allows rain water to infiltrate, increases ground water recharge and also decreases flooding possibilities. The main disadvantage of pervious concrete is its low strength which restricts its applications in areas where high load carrying capacity is required in this project poly vinyl alcohol (C_2H_2OH) and poly vinyl acetate ($C_4H_6O_2$) is used to check the effect on compressive strength of pervious concrete.***
Keywords: Pervious concrete, strength of concrete, Polymers, Poly Vinyl alcohol, Poly Vinyl acetate.

I. INTRODUCTION

Pervious concrete is a special type of concrete different from conventional concrete. It is a mixture of cement coarse aggregate and water in which filler material sand is not used. It has high permeability, the percentage of voids can vary from 15% - 40%. It is also known as 'No Fine Concrete, zero slump concrete, porous or permeable concrete. Also the Heat of evolution of pervious concrete is less than conventional concrete. The main disadvantage is its low compressive strength. Water or rain water gets saturated on impervious surfaces like parking areas, pedestrian sidewalks and this result in deterioration of pavement. Such problems cannot be totally eliminated but can be improved by using pervious concrete or by the applications of pervious concrete.

Poly vinyl alcohol is cream coloured granular powder, has high flexibility and tensile strength. Specific gravity of 1.19 to 1.26 and pH value is neutral. Poly vinyl acetate is it is a synthetic Resin made by polymerize Vinyl Acetate. It may enhance the strength properties of concrete. Poly vinyl alcohol and poly vinyl acetate both are polymers and poly vinyl acetate is insoluble in water. These polymers are available in powder form so first they were converted in gel then added in concrete mix. Coarse aggregates used are in the range of 4.75mm – 20mm and fine aggregates (churi) used are in the range of 2.75mm – 4.75mm also cement with 53 grade is used. Water used for mixing and curing.

II. EXPERIMENTAL WORK

The experimental work was carried out by using arbitrary mix proportion of 1:2:4 of cement: fine aggregate: coarse aggregate. Water cement ratio used was 0.4. The polymers i.e. poly vinyl alcohol and poly vinyl acetate were used in combination of different proportions from 0% to 0.75% by weight of cement. The methodology for preparing the mixture of pervious concrete is as same as conventional concrete, fine sand is not used. But the polymers were added. Both the polymers are available in powder form. Solution of poly vinyl alcohol is directly dissolved in warm water as it is soluble in water. Whereas poly vinyl acetate is insoluble in water, so for its gel formation acetone were used.

A. Preparation of chemicals

1) Gel Formation of Poly Vinyl Acetate:

a) 100 ml of Acetone was taken in Pycnometer.

b) Weighed amount of finely crushed Poly Vinyl Acetate is added in Acetone and kept it steady for 6-7hrs.

2) Gel Formation of Poly Vinyl Alcohol:

a) 200 ml of warm water (70-80 degree Celsius) was taken in Pycnometer.

b) Then Poly Vinyl Alcohol slowly added in warm water and kept continuously stirring until gel Formed.

B. Cube casting

In this project, 7 numbers of cubes were casted for each proportion and the one reference cube of 0% polymers were also casted. Each cube of size 15cm x 15cm x 15cm. Compaction were done by tamping rod. Submerged water curing was used. 7th and 28th day compressive strength was recorded.

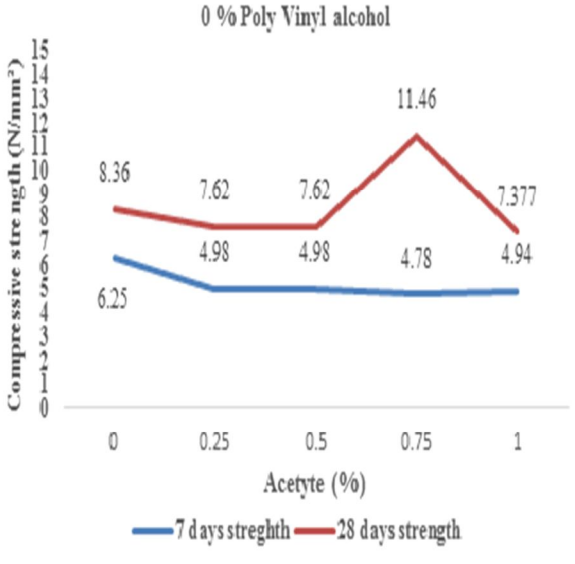
III. RESULT AND DISSCUSION

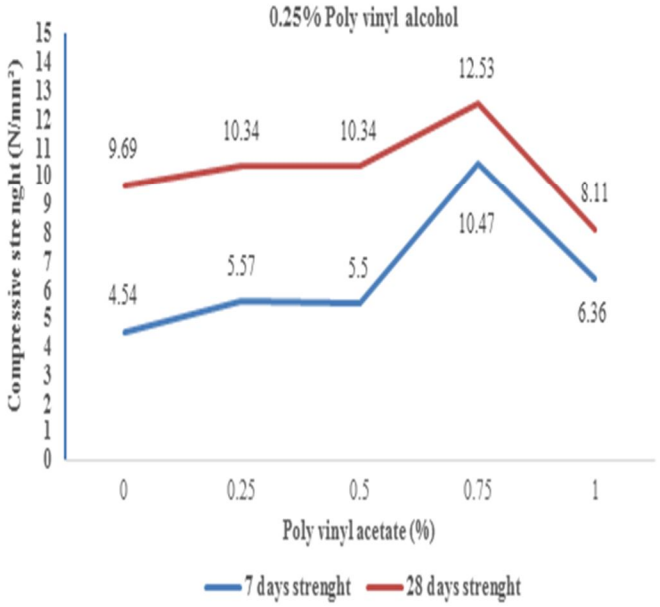
The results are shown in table given below. The compressive strength of reference cube was recorded, which is found lower than the compressive strength of cubes which were casted by adding polymers. The table shows as the % of polymer increase in mixture the compressive strength were also found to be increasing.

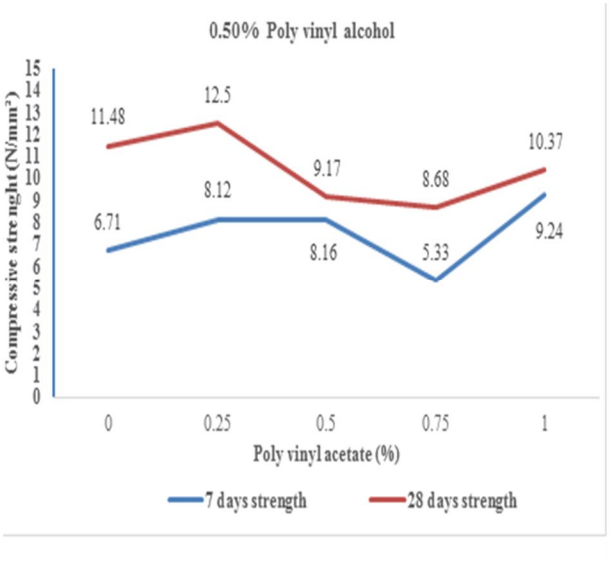
Sr.no.	Poly vinyl Alcohol (%)	Poly vinyl Acetate (%)	Compressive Strength(N/mm^2)			Sr. no.	Poly vinyl Alcohol (%)	Poly vinyl Acetate (%)	Compressive Strength(N/mm^2)	
			7th day	28th day					7th day	28th day
1	0	0	6.25	8.36		11	0.50	0	6.71	11.48
2	0	0.25	4.98	7.62		12	0.50	0.25	8.12	12.5
3	0	.50	4.98	7.66		13	0.50	0.50	8.16	9.17
4	0	0.75	4.78	11.46		14	0.50	0.75	5.33	8.68
5	0	1.0	4.94	7.377		15	0.50	1.0	9.24	10.37
6	0.25	0	4.54	9.69		16	0.75	0	6.3	11.044
7	0.25	0.25	5.57	10.34		17	0.75	0.25	5.99	10.54
8	0.25	0.50	5.5	10.39		18	0.75	0.50	7.56	12.3
9	0.25	0.75	10.47	12.53		19	0.75	0.75	9.82	13.6
10	0.25	1.0	6.36	8.11		20	0.75	1.0	6.71	10.38

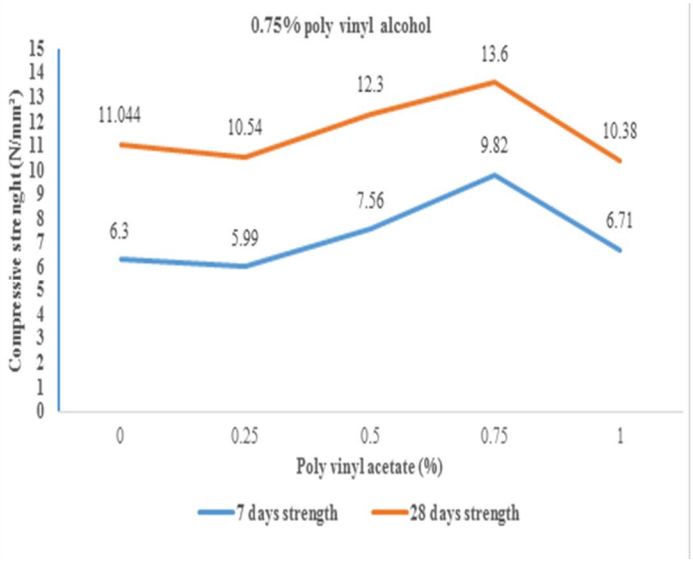
Compressive Strength Results

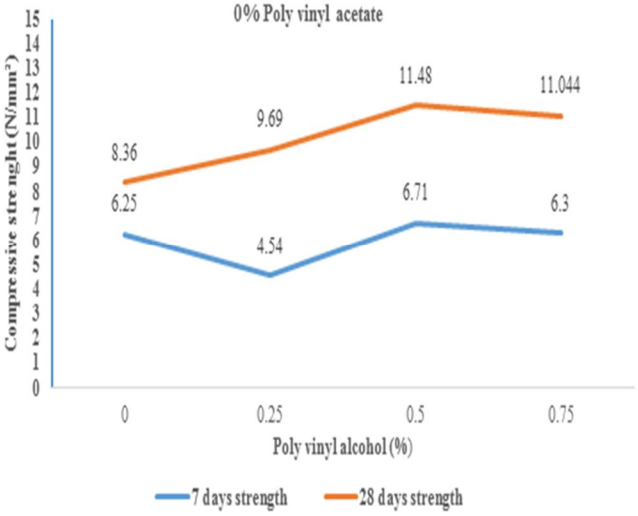
IV. GRAPHS

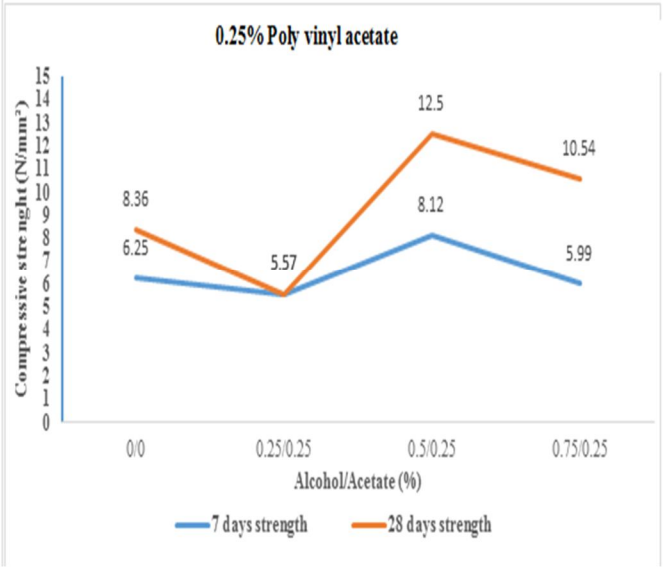


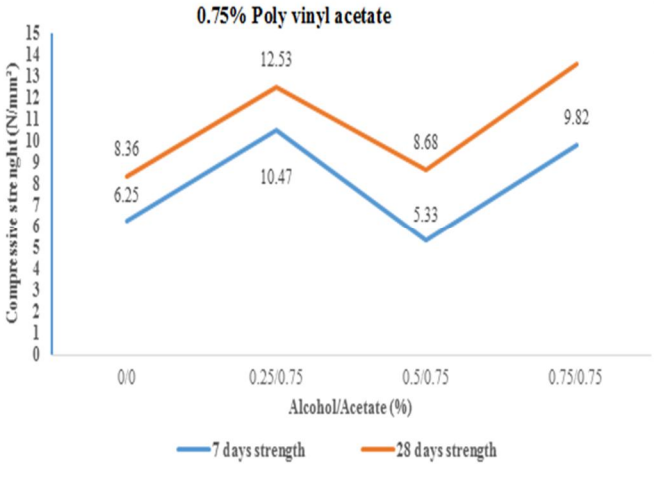


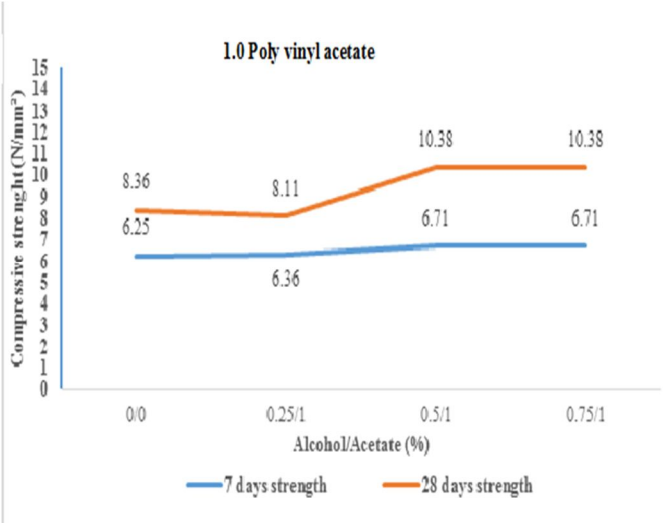

0.50% Poly vinyl alcohol
Compressive strenght (N/mm²)
11.48
12.5
9.17
8.68
10.37
6.71
8.12
8.16
5.33
9.24
0
0.25
0.5
0.75
1
Poly vinyl acetate (%)
7 days strength
28 days strength


0.75% poly vinyl alcohol
Compressive strenght (N/mm²)
11.044
10.54
12.3
13.6
10.38
6.3
5.99
7.56
9.82
6.71
0
0.25
0.5
0.75
1
Poly vinyl acetate (%)
7 days strength
28 days strength


0% Poly vinyl acetate
Compressive strenght (N/mm²)
8.36
9.69
11.48
11.044
6.25
4.54
6.71
6.3
0
0.25
0.5
0.75
Poly vinyl alcohol (%)
7 days strength
28 days strength


0.25% Poly vinyl acetate
Compressive strenght (N/mm²)
8.36
12.5
10.54
6.25
5.57
8.12
5.99
0/0
0.25/0.25
0.5/0.25
0.75/0.25
Alcohol/Acetate (%)
7 days strength
28 days strength


0.75% Poly vinyl acetate
Compressive strenght (N/mm²)
8.36
12.53
8.68
9.82
6.25
10.47
5.33
0/0
0.25/0.75
0.5/0.75
0.75/0.75
Alcohol/Acetate (%)
7 days strength
28 days strength


1.0 Poly vinyl acetate
Compressive strenght (N/mm²)
8.36
8.11
10.38
10.38
6.25
6.36
6.71
6.71
0/0
0.25/1
0.5/1
0.75/1
Alcohol/Acetate (%)
7 days strength
28 days strength

V. CONCLUSION

A. Pervious concrete plays significant role in reducing storm water runoff as it allows water to percolate through it and recharge natural ground water.
B. Pervious concrete as can also use as an ideal solution for flood control and also in sustainable land management.
C. Compressive strength of pervious concrete is found to be increasing with increase in proportion of polymers.
D. These polymers can be used at a place where moderate compressive strength is required, e.g. footpaths, etc.
E. From the results it is observed that combination of 0.25% of poly vinyl alcohol and 0.75% of poly vinyl acetate the strength was found to be highest.
F. Therefore, these can use in construction where low load carrying capacity is required.

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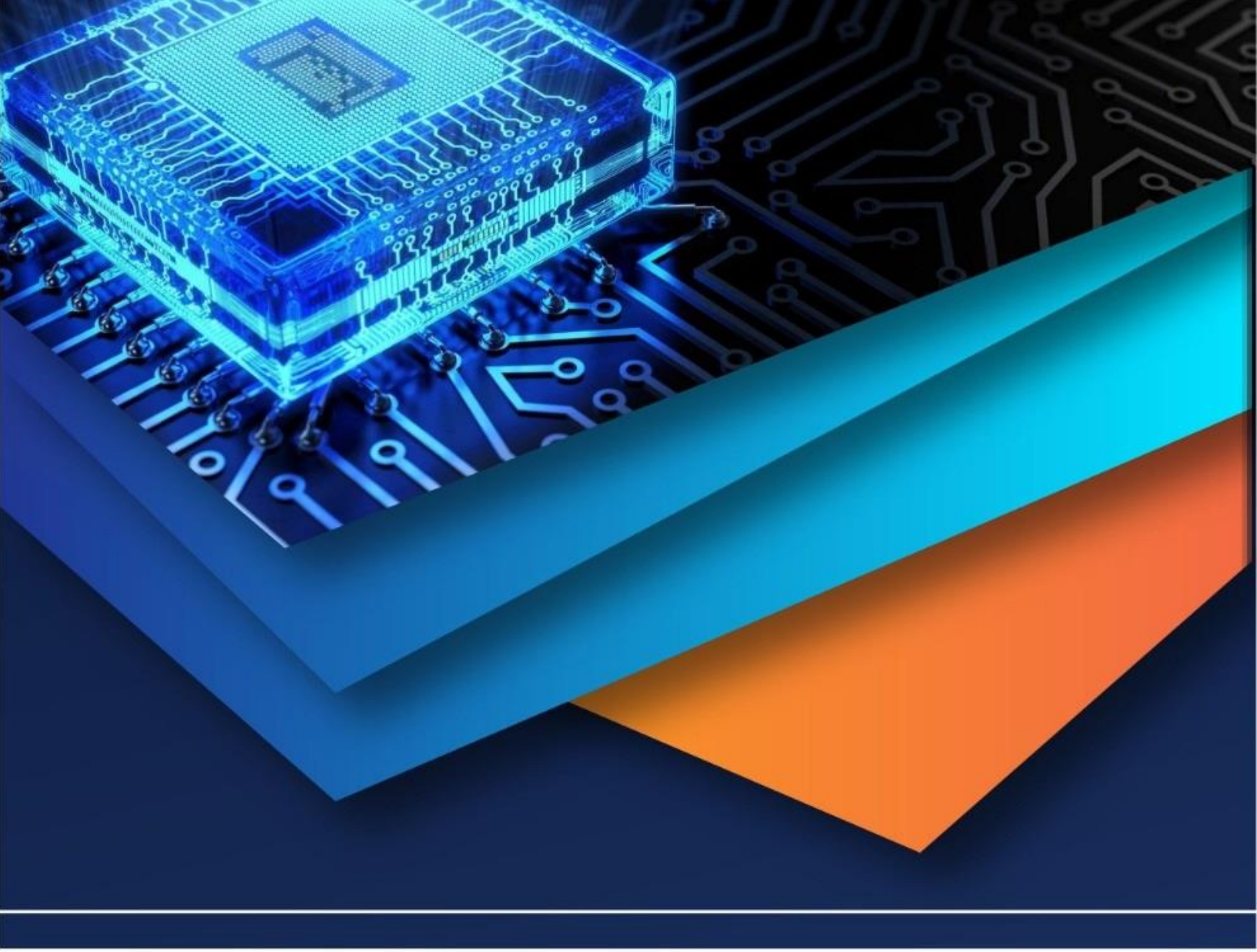

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