

# Experimental investigation on water absorption flexible pavement using super absorbent polymers

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## Abstract:

The pavement specially affected by natural disaster like rain and storm run off . It affect the loss of strength and durability of pavement. Storm run off also cause accident by decreasing of skid resistance. It also affect sub grade of the soil . We decide to reduce the damage providing of water absorbent pavement using super absorbent polymer. By providing of super absorbent polymer it absorb the water content and increase the life time of pavement. we are adding chemical two different ratio sample1 5gm and sample2 25gm Finally we are concluded by adding chemical give less ratio its give better strength and water absorption capacity. It is calculate by California Bearing Ratio method. The absorb water is evaporated while rising of temperature within fifteen days.

## Key word:

Flexible pavement, Water absorption pavement, Super absorbent polymers (SAPs), California bearing ratio.

## I.INTRODUCTION

Indian road way can mainly classify into type depend upon usage and traffic system. The traffic system divided into two way heavy traffic area and light area. They heavy traffic road are national and state highways and it was designed in proper super elevation and gradient. Another one is light traffic area it is rural roads. In this rural road has more uneven surface and pin turn are there because of rural road are connect in all the village area. In rural area was highly used by vehicles like bicycle, two wheeler, van, tractor used harvesting period and animal drawn carts. So it is layout normal elevation and gradient. Because it is mainly affected by rain during rainy season the rain water store in uneven surface. It cause damages and decrease the life time of the pavement. Storm run off also cause accident by decreasing of skid resistance. This

type of failure cause a accident. It can be control by adding water absorption material by super absorption material. In this polymer has a special character water absorbing behavior. It absorb range from 350 to 1000 times of its own weight. It absorb the water converted into gel like structure. It does not react any other material. By this control damage and protect life time of the pavement.

## II. MATERIAL

### A. Bitumen

The bitumen viscosity grade is VG 30 grade is used for this experiment. The physical properties of the bitumen is shown in the table.

Table I:- Physical properties of bitumen

S.No	Physical properties	Test value
1	Ductility	100 cm
2	Penetration	57 mm
3	Viscosity	550 m <sup>2</sup> /s
4	Softening point	53 <sup>0</sup> C
5	Absolute viscosity	3121 p
6	Flash and fire point	306 <sup>0</sup> C

### B. Aggregate

The aggregate is used for experiment is tested. The physical properties of the aggregate was tested show on below the table.

Table II:- Physical properties of aggregate

S.No	Physical properties	Test value
1	Specific gravity	2.68
2	Water absorption	6.75%
3	Flakiness and elongation	31.76%
4	Impact test	39%
5	Abrasion test	9%

### C. Super absorbent polymer

The chemical composition of super absorbent polymer is  $[-CH_2-CH(CO_2Na)-]_n$ . It is cross linked with hydrogen molecules. So it is also called as hydrogel. This polymer has potential of absorption water up to 500 times its own weight.



Figure I:- Super absorbent polymer

### III.MIX PROPORTION OF WMM FOR CBR

#### A. Sieve and Combined Grading for WMM

To choosing the five different size of metal by sieving process the size metal is 45mm, 22.40mm, 13.2mm, 6.7mm, 2.36mm and below. To take metal each size 10000gm and take 2.36mm & below weight of

1000gm. It is sieved order of from top to bottom sieve size is 75mm, 53mm, 26.5mm, 9.5mm, 4.75mm, 2.36mm, 850 $\mu$ , 425 $\mu$ .CG is done by the experimental value of sieve gradient its give result about amount of metal required for taken for proctor density test.

Table III:- Combined gradient CG

Sieve size	45 Mm	22.4 Mm	13.2 mm	6.7 Mm	2.36 & Below Mm	CG
	10%	20%	26%	30%	14%	
75mm	10	20	26	30	14	100
53mm	8.61	20	26	30	14	98.61
26.5mm	0	16.71	26	30	14	86.71
9.5mm	0	0	9.97	30	14	53.97
4.75mm	0	0	0.08	11.45	14	25.52
2.36mm	0	0	0	1.13	12.67	13.80
850 $\mu$	0	0	0	0.23	9.52	9.75
425 $\mu$	0	0	0	0	3.57	3.57

#### B. Proctor density (PD)

Determination of water content – dry density relation using light /heavy compaction method. By using of proctor compaction test to calculate max dry density and optimum moisture content. It is give the result of amount metal required CBR and also show amount of water required as per IS2720-part-7/part-8. It shown below table for sample 1, sample 2.

Volume of cylinder in cc = 2250

Weight of cylinder in gms = 5740

Sample number: 1 replacing of 5gm

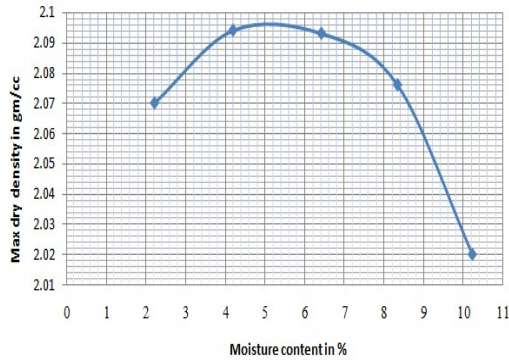
Table IV:-Proctor density (PD)

S.No	Wt of cylinder + compacted wet soil in gm	Wt of compacted wet soil in gm	Avg moisture content %	Dry density in gm/cc
1	10500	4760	2.21	2.070
2	10650	4910	4.19	2.094
3	10750	5010	6.42	2.093
4	10800	5060	8.34	2.0576
5	10750	5010	10.23	2.020

Maximum dry density =2.098 gms/cc

Optimum moisture content= 5%

Graph I:- To find the amount cc and amount of metal required



98% of max dry density =2.052 gm/cc

Soil required for CBR test =4626 gm

Requirement of water = 223cc

O M C =5.0%

I M C =0.19%

Diff =4.81%

Sample number:2 replacing of 25gm

Volume of cylinder in cc =2250

Weight of cylinder in gm =5740

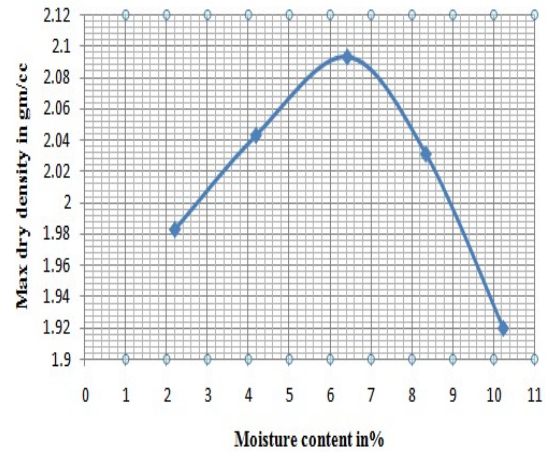
Table V:- Proctor density (PD)

S.No	Wt of cylinder + compacted wet soil in gm	Wt of compacted wet soil in gm	Avg moisture content %	Dry density in gm/cc
1	10300	4630	2.47	1.983
2	10530	4805	2.57	2.043
3	107	4955	6.03	2.093
4	10755	5015	8.24	2.031
5	10700	4960	10.03	1.920

Maximum dry density = 2.094 gms/cc

Optimum moisture content= 6.50%

Graph II :- To find the amount cc and amount of metal required



98% of max dry density =2.052 gm/cc

Soil required for CBR test =4617 gm

Requirement of water = 291cc

O M C =6.50%

I M C =0.19%

Diff =6.31%

C. California bearing ratio test

In this CBR test is conducted for to find mechanical strength pavement. In this test by using proctor density test amount metal & soil required for CBR and amount water quantity required CBR mould. The sample is prepared and cured in water for four days. After four days it is placed over CBR machine the plunger are penetrated and show the mechanical strength. The diameter of the plunger is 50mm and it is penetration in each 0.5mm to find division. It is done by as per code book IS:2720-part16.



Figure II:- CBR Testing apparatus

Sample number:1 replacing of 5gm

Table VI:-California Bearing Ratio test

Providing ring factor : 1 division = 7.24

Penetration Mm	Std load Kg	Dial gauge Division	Load Kg	Crct Load Kg	CBR %
0		0	0		
0.5		4	25.34	217.2	
1		6	39.82	470.6	
1.5		8	57.92	767.4	
2		13	90.5	1100	103.5
2.5	1370	17	123.0	1411	9
4		40	289.6	2389	146.21
5	2055	65	470.6	3004	22.9

Volume of the mould in cc =3094

Weight of the mould in gm =7318

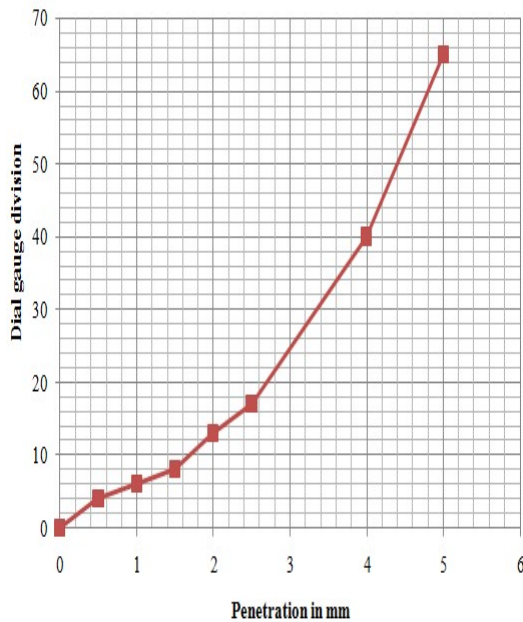
Mould + compacted wet soil in gm =4982

Weight of the wet soil in gm =12300

Weight density of sample compacted =1.61 gm/cc

Dry density of sample compacted =1.52 gm/cc

Graph III:- California Bearing Ratio test



Sample number:2 replacing of 25gm

Table VII:- California Bearing Ratio test

Providing ring factor : 1 division = 7.24

Penetration Mm	Std load Kg	Dial gauge Division	Load Kg	Crct Load Kg	CBR %
0		0	0		
0.5		2	10.86	217.2	
1		3	18.1	470.6	
1.5		4	25.34	767.4	
2		4	28.96	1100	103.5
2.5	1370	5	36.2	1411	2.6
4		8	57.92	2389	146.2
5	2055	10	68.78	3004	3.3

Volume of the mould in cc =3094

Weight of the mould in gm =7318

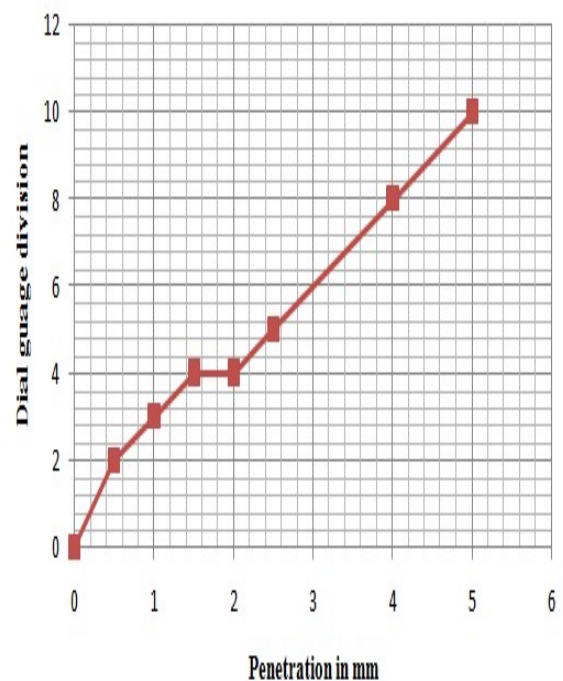
Mould + compacted wet soil in gm =4982

Weight of the wet soil in gm =12300

Weight density of sample compacted =1.61 gm/cc

Dry density of sample compacted =1.52 gm/cc

Graph IV:- California Bearing Ratio test



## IV.CONCLUSION

Finally concluded every year providing new pavement project having large amount of estimate cost. But it is get affected by rain cause different type of damages. It can be reduce by absorbing the stagnant water in the pavement. Now it is done by this project using super absorbent polymer it is effectively absorb the water. This chemical is added in two different ratio the first sample replace 2.36mm & below metal in 5gm is cured in water for four days. It give high strength and water absorption capacity give safe strength in WMM layer. Another second sample is tested replacing of 25gm and cured in water for four days its give less strength compared to first sample reading it also come safe. Finally we are concluded by adding chemical give less ratio its give better strength and water absorption capacity. It is calculate by California Bearing Ratio method. By this way we can reducing damage of pavement and accident in the road surface. The absorb water is evaporated while rising of temperature within fifteen days. It is done by as per code book IS:2720-part16,and IRC 37-2012.

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