

## Reclamation of Potholes by Utilisation of Plastic

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### ABSTRACT

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The rate of accidents caused by potholes is increasing day by day. So, potholes must be repaired as soon as possible. This paper aims to repair potholes by using plastic. The introduction of plastic in bitumen modifies the characteristic of bitumen. Tests were done on aggregate and bitumen to check their quality. Marshall Test on bitumen were done on different percentage of bitumen and plastic. From the result it was observed that as the percentage of plastic is increased the stability value of Marshall test is also increased.

Keywords : Aggregate, Bitumen, Bitumen, Plastic, Potholes

### I. INTRODUCTION

As India is the developing country. India is having several bad roads wheather it is cities or villages potholes are common in both rural & urban area. Crores of rupees are paid by road agencies to repair pothole. It also requires large amount of time, labours and human efforts to repair potholes. (Nachivanekar et al.,2019)

India is the country where plastic materials are mostly used in road construction (Sasidharan et.al 2019) .By use of plastic to repair potholes the lifespan of road increases(Nachivanekar, et.al 2019)). Potholes not only cause harm to vehicles but because of potholes serious accidents are also happened. Because of heavy traffic load, water pressure elaborates in the wet materials which cause failure of material. Deficient in road maintenance also results in elaboration of surface crack, this crack permits the

water to step into the layers during rainfall. (Naveen et.al, 2018)

Potholes on the surface of asphalt pavements significantly reduce pavement condition, and potentially impair traffic safety. Potholes on the surface of asphalt pavements significantly reduce pavement condition, and potentially impair traffic safety. Potholes on the surface of asphalt pavements significantly reduce pavement condition, and potentially impair traffic safety. Different materials are used to repair potholes present in the pavement (Ballari,2019). Studies have shown that plastics may be used with bitumen so that it can result in better performance of pavement and also gives strength and resistance to deformation. (Mishra et.al 2016)

Plastics are generally used in every work due to their different varieties and characteristics. Plastics are inexpensive so they are used widely

(Deshmukh,2018). Disposal of plastic waste is common and serious problem. Disposal of plastic increase risk to person health and it also pollute the environment. Hence, it is needed to recycle the plastic.(Yadav,2017)

## II. MATERIALS AND METHOD

### 2.1 Study Area

Only Two Potholes were found at Naya Raipur from Muktangam Garden to Mantralaya Road the potholes are shown in Figure 2.1 and dimensions of potholes are shown in Table 2.1

**Table 2.1 : Dimensions of Potholes**

| Sr.no.    | Length (cm) | Depth (cm) | Area (cm <sup>2</sup> ) | Volume (cm <sup>3</sup> ) |
|-----------|-------------|------------|-------------------------|---------------------------|
| Pothole 1 | 52          | 8.89       | 2109.12                 | 18750                     |
| Pothole 2 | 60          | 10.16      | 2826                    | 28712                     |



**Figure 2.1 : Identified potholes**

For repairing of potholes test were done on aggregate and bitumen.

### 2.2 Test Done on Aggregate

The Aggregate used were of size 20mm and 10 mm.

#### 2.2.1 Impact Value Test

This test measures the resistance to sudden shock that is caused due to application of loads. This test is done on aggregate as per I.S. Code IS: 2386 Part 4. This test is used to determine toughness of aggregate. Impact Test is shown in Figure 2.2



**Figure 2.2 : Aggregate Impact Value Test**

#### 2.2.2 Los Angeles Test

This test is used to check the quality of aggregate. This test is used to determine hardness of aggregate. Los Angeles Abrasion Test is shown in Figure 2.3.

This test is done on aggregate as per I.S. Code IS: 2386 Part 4.



**Figure 2.3 : Los Angeles Abrasion Test**

#### 2.2.3 Moisture Content Test

This test is done on aggregate as per I.S. Code IS: 2386 Part 3. This test is done to determine water content of aggregate. Moisture content Test is shown in Figure 2.4



Figure 2.4 : Moisture Content Test

Table 2.2 - Results of Tests Performed on Aggregate

| S.no. | Test                 | Result | IS code       |
|-------|----------------------|--------|---------------|
| 1.    | Impact Test          | 11.4%  | IS 2386 Part4 |
| 2.    | Los Angeles Abrasion | 13%    | IS 2386 Part4 |
| 3.    | Moisture Content     | 1.2%   | IS 2386 Part3 |

Table 2.2 shows Results of Tests Performed on Aggregate.

2.3. Test on Bitumen-

Bitumen of grade V30, 5% Plastic was used

2.3.1 Penetration Test

This test is done to determine the hardness of bitumen by measuring its depth in millimetre to which a needle will penetrate vertically in five seconds. This test is done as per IS 1203.

2.3.2 Specific Gravity Test

This test is done as per IS 1202. This test is done to determine the Specific Gravity of bitumen.

Table 2.3- Results of Tests Performed on Bitumen-

| S.no | Test                  | Result | IS Code |
|------|-----------------------|--------|---------|
| 1.   | Penetration Test      | 69 mm  | IS1203  |
| 2.   | Specific Gravity Test | 1.015  | IS 1202 |

Table 2.3 shows Results of Tests Performed on Bitumen

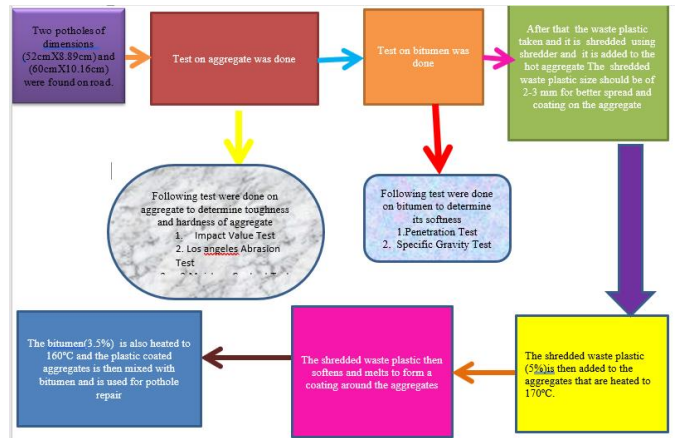


Figure 2.5 - Flow chart of Pothole Repair Process

Steps to repair potholes-

1. Firstly the waste plastic is cut into pieces using shredder and then it is put in warm aggregate.
2. The plastic piece size should be of 2-3 mm for better spread of plastic so that the plastic get coated on the aggregate.
3. After that the pieces of plastic is put in the aggregates and are heated at 170°C.
4. Now the plastic piece gets soften and it melt to form coat on all sides of aggregates.
5. After that bitumen is heated at 160°C and the plastic coated aggregates are added with the bitumen and they are used to repair pothole.



Fig 2.6 Repaired Potholes

3 Marshall Test

Marshall Test was done to check the stability of material .Marshall Test is done as per ASTM D6927 – 06. This test was done on 4%,4.5%,5%,5.5% and 6% of bitumen and 5%,6%,7%,8% and 9% of plastic. Marshall test apparatus is shown in fig 2.6

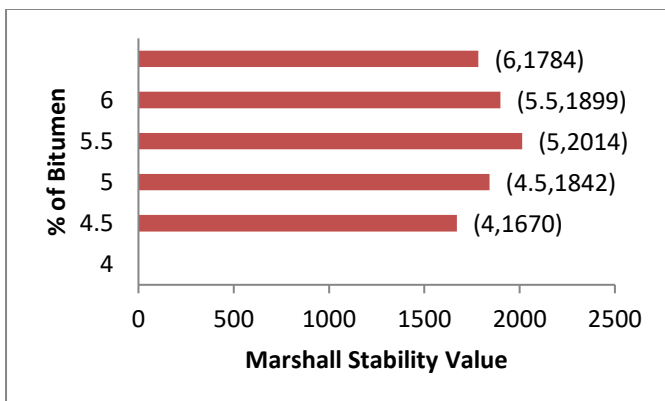


**Fig 3.1** Marshall Test Apparatus

**Table 3.1-** Result of Marshall stability test for different % of bitumen

| S.NO | Bitumen Content (Percentage) | Specific gravity maximum (Theoretical) | Bulk specific gravity | % of Air voids | Voids % filled with bitumen | Test Value of Marshall Stability Test (Kg) | Flow Test Value (mm) |
|------|------------------------------|--|-----------------------|----------------|-----------------------------|--|----------------------|
| 1.   | 4                            | 2.34                                   | 2.222                 | 5.43           | 71.70                       | 1670                                       | 6.82                 |
| 2.   | 4.5                          | 2.37                                   | 2.268                 | 4.69           | 73.62                       | 1842                                       | 4.22                 |
| 3.   | 5                            | 2.41                                   | 2.308                 | 4.02           | 75.4                        | 2014                                       | 3.25                 |
| 4.   | 5.5                          | 2.40                                   | 2.298                 | 3.82           | 77.8                        | 1899                                       | 3.4                  |
| 5.   | 6                            | 2.38                                   | 2.318                 | 3.77           | 78.88                       | 1784                                       | 4.10                 |

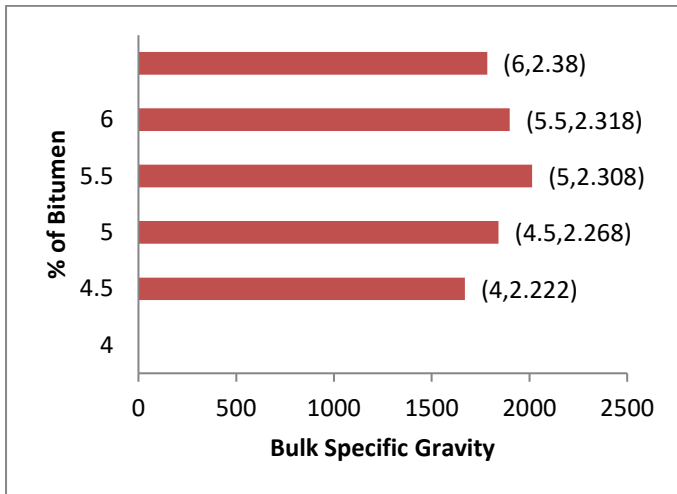
Table 3.1 Shows that Marshall Stability value of different percentage of bitumen and from the table it can be seen that the stability value of 5% bitumen is maximum.



**Fig 3.2** - Different percentage of Bitumen and Marshall Stability Value

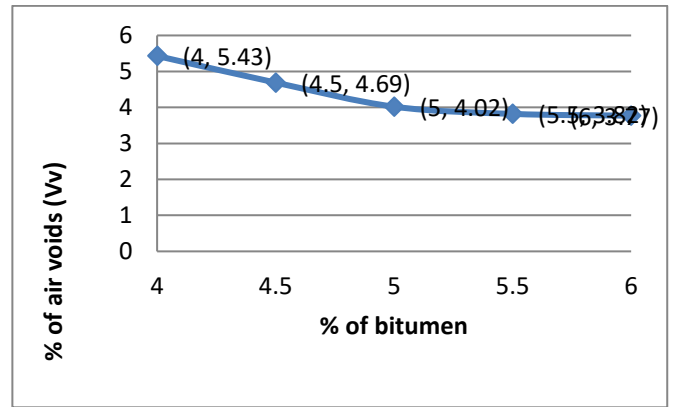
From figure 3. 2. it can be seen that stability value of 5% bitumen stability value is maximum as compared to 4% ,4.5%,5.5%and 6% .





**Fig 3.3** Different percentage of Bitumen and Bulk specific gravity

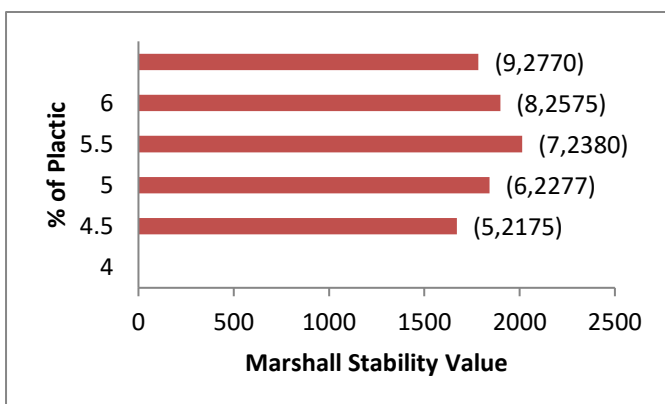
The 3.3 figure shows that when 6% bitumen has maximum bulk specific gravity as compared to 4% ,4.5%,5.5%and 5%.



**Fig 3.4** - Different % of Bitumen and % of Air voids  
From figure 3.4 it can be seen that that 4% bitumen has maximum value as compared to 4.5%,5% ,5.5% and 6%

Table 3.2 – Result of Marshall Stability test for Different percentage of plastic

| S.No. | percentage of plastic | specific gravity maximum (Theoretical) | Bulk specific gravity | % of Air voids (Vv) | voids % that is filled with bitumen (VFB) | Test Value of Marshall Stability Test (Kg) | Flow Test Value (mm) |
|-------|-----------------------|--|-----------------------|---------------------|---|--|----------------------|
| 1     | 5                     | 2.44                                   | 2.29                  | 4.50                | 74.5                                      | 2175                                       | 3.2                  |
| 2     | 6                     | 2.47                                   | 2.34                  | 4.42                | 77.13                                     | 2277                                       | 3.18                 |
| 3     | 7                     | 2.45                                   | 2.35                  | 4.34                | 79.76                                     | 2380                                       | 3.16                 |
| 4     | 8                     | 2.43                                   | 23.3                  | 4.26                | 82.93                                     | 2575                                       | 2.8                  |
| 5     | 9                     | 2.41                                   | 2.3                   | 4.18                | 85.02                                     | 2770                                       | 2.3                  |



**Fig 3.5**-Different percentage of Waste Plastic vs. Marshall Stability Value

From figure 3.5 it can be seen that as the percentage of plastic is increased the stability value also increases. Hence 9% plastic has maximum stability value.

### III.CONCLUSION

Potholes have been repaired by using plastic. It can be concluded that the stability of potholes filled with plastic is more as compared to bitumen. The potholes that are filled with plastics provides more strength and durability. Marshall stability test was also done on different percentage of plastic and bitumen and it

can be concluded that as the percent of plastic increases the stability value also increases.

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