

Study and Evaluation of Disintegration of Pavement Surface

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Abstract— This paper aims at the study of potholes on the bituminous road surface and introducing the antistripping material to the bitumen to increase the durability of the road. Antistripping agents can eliminate the possibility of some instabilities in asphalt, such as crumbling and formation of holes. The idea is to introduce some of anti-stripping agent in the bituminous while contraction of the road to increase the life of the road from potholes and cracking. In this paper, the antistripping material 'bitugrip' is used to improve the adhesion properties of bitumen and aggregates. The stripping value decreases while increasing the percentage of bitugrip to the bitumen. An additional laboratory study was conducted to characterize the performance properties of the antistripping material. Overall, the addition of bitugrip has a positive influence on the adhesion properties between the aggregates and the bitumen and can be used to increase the durability of roads, thereby reduce the maintenance cost of the roads.

Key words: Bitumen, Potholes, Bitugrip

I. INTRODUCTION

In recent years, a lot of research has been done in the area of automated vehicles and automated highway systems. All this research has a common goal: to make driving safer and easier. It is important to find out solutions to reduce number of accidents. One of the major reason for road accidents is potholes according to the survey conducted by Automobile Association. Vehicles tend to lose balance when they come across a larger pothole. Potholes on the roads are due to many reasons like rains, oil spills, road accidents or inevitable wear and tear make the road difficult to drive upon. Unexpected hurdles on roads may cause more accidents. Also because of the bad road conditions, fuel consumption of the vehicle increases causing wastage of precious fuel. The antistripping material is used to ensure better adhesion between bitumen and the aggregates. Perfect adhesion between the binder and the stone elements, prevents water from filtering between the two materials, causing premature aging between the bituminous mixture and leading to the formation of the instabilities that decrease the pavement's performance. The deteriorations that characterize road pavements are multiple and each one has well defined cause attributable to the bituminous mixture made and/or to the design and/or the simple end of useful life. One of the main triggers of pavement deterioration is the weakening or the detachment of the bitumen film adhering to the surface of the aggregate (stripping). In detail, the factors that affects stripping are- Chemical/physical characteristics of the materials used (bitumen and aggregates);

- Characteristics of the asphalt concrete, with particular reference to the aggregates and the type of mixture produced (dense graded, porous, SMA, etc.)
- Production methodology, hot (HMA), warm (WMA) possible use of water (salts, zeolites, wet sands, etc.)
- Conditions of use of the pavement such as environmental

- Ones, the loads, the de-icing method, etc.
- As soon as the bitumen film separates, the pavement immediately starts to deteriorate
- Typical deterioration caused by stripping are-
- Surface crumbling, further intensified if the bitumen content was less than optimal,
- Disaggregation and pothole formation,
- Cracking and rutting

II. KEYWORDS OF THE PROPOSED EXPERIMENT

Here, we are discussing the major keywords used in the experiment.

A. Potholes

Potholes are bowl shaped holes or pits of various sizes found on pavement surface. These holes usually contain ravelled edges. As water seeps or penetrates through incipient cracks in the surface of pavement during rainy season, it softens the supporting layers. The seeped water retained freezes, expands and pushes up the asphalt layer during winters. The criterion adopted for the measurement of potholes is described in terms of dept.(in mm)and severity levels specified as(ODOT 200;SHRP,1993):The weak portion of the asphalt starts breaking up and raveling under wheel loads during dry season.

- 1) LOW-The hole depth, including delamination of patch, not exceeding 25mm (1").
- 2) MODERATE-The hole depth ranges between 25mm (1") and 50mm (2").
- 3) HIGH-Depth>50mm (2").The pit extends beyond the top layer of the wearing course but the seldom deeper than 150 or 200mm (CSIR, 2010).

The number of potholes at each severity level is recorded up to a maximum of 44 per 161m (0.1 mile) of pavement section. A long pothole or a string of potholes extending over 3.66m (12ft) in length shall be counted as separate potholes (ODOT, 2010).

B. Bitugrip

It is the product of HINCOAL (Hindustan Colas Private Limited).It prevents bitumen against the stripping action of water. The premature failure of flexible pavement is a widespread problem. The important factor contributing to this is improper adhesion between bitumen and aggregates mostly due to non-availability of good quality of aggregates and improper drainage system. Hincopal bitugrip is specially designed solution to tackle such problem by enhancing the adhesion of bitumen and ensuring the stability of bituminous pavement. Hincopal bitugrip is very effective while paving roads in high rainfall area and the areas with bad quality of aggregates and improper drainage system. It prevents bitumen against stripping action of water.

C. Advantages of Antistripping Agents

- Enhance the service life of the pavement,
- Excellent adhesion promoter onto all type of aggregates,
- Slow down age hardening of bitumen,
- Low dosage required,
- Stable at high process temperature of hot mix temperature.

D. Adhesion

The adhesion of bituminous binders involves physical properties of different origin. The adhesion is influenced by the characteristics of both the bitumen (hydrophobic material) and the aggregate used in the mixture (basically hydrophilic material). Other factors are the environmental conditions (humidity and temperature) surface characteristics of the pavement (roughness, porosity and coating) and vehicular movements upon the pavement. Adhesion can be defined generally as the molecular force of attraction between two bodies of different nature in contact with each other. In the context of the asphalt concrete, the contact is liquid (bitumen) and solid (aggregates). With the mixing between aggregates with bitumen, the latter covers the aggregates. This is to say, the aggregates are made “wet” by the binder. The bituminous binder creates a superficial film around the aggregate in order to obtain a hydrophobic surface, actually impermeable to the particle of water.

III. EXPERIMENTAL PROGRAM AND METHODOLOGY

A. Materials and Preparation of Asphalt Binders

An asphalt binder of 60/70 penetration grade obtained present investigation. The properties of the supplied material is in liquid.

| Properties of Bitumen IS 73 : 1992 | | | |
|--|-----------|----------|----------|
| Characteristics | 80/100 | 60/70 | 30/40 |
| Specific gravity at 27°C | 0.99 | 0.99 | 0.99 |
| Softening Point °C | 35 to 50 | 40 to 55 | 50 to 65 |
| Penetration at 25°C, 100gm, 5 secs., 1/10 mm | 80 to 100 | 60 to 70 | 30 to 40 |
| Ductility at 27°C, in cm min. | 75 | 75 | 50 |

The HINCOAL Bitugrip has been used to decrease the stripping value. To prepare the sample, 5% by wt. of bitumen is taken and was heated to 160° and blended with bitugrip. The bitugrip was blended with the bitumen binder at different concentrations (0.5, 1 to 3%) and the stripping test is carried out on the prepared samples to determine the effect of bitugrip on the properties of bitumen binders.

B. Experimental Method

In this study, the hot melting method has been used for mixing the base bitumen with antistripping agent, bitumen and bitugrip. In hot melting method, the antistripping agent have been introduced to the neat binder at the elevated temperature

(160° for bitumen) 5% by wt. of bitumen has been utilized for all 200gm of aggregates samples, while the bitugrip was varied from 0.5% to 3% by wt. Based on the bitumen. In every sample 200gm of clean and dry aggregates passing through 20mm sieve and retained on 12.5mm sieves is taken and the aggregates are heated at 150°C. After that 5% by wt. of bitumen binder was taken and heated at 160°C. The aggregates and the binder are mixed till they are completely coated and then the mixture is transferred into a 500ml beaker and allow to cool at room temperature for about 2 hours. The distilled water is poured into the beaker to fully immerse the coated aggregates. The beaker is then covered and has been kept in a water bath for about 24 hours at a temperature maintained as 40°C. It should be taken care that the level of water bath is at least half the height of the beaker. After 24 hours the beaker is taken out, and the stripping value is taken out. The bitugrip is added percentage wise to the bitumen as shown in table 1.

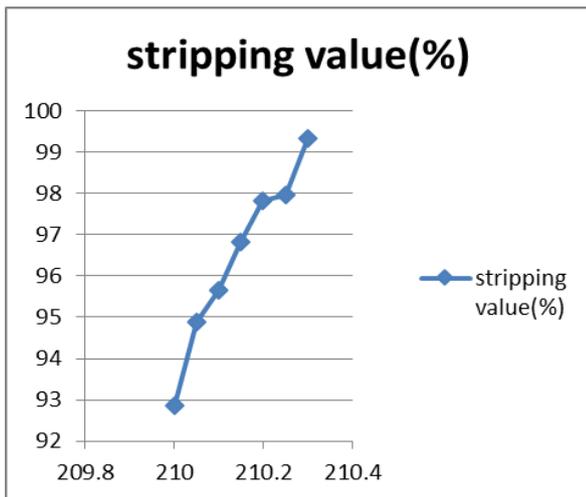
| S. N | wt. of dry aggregates (gm) | % of bitumen (%) | bitugrip used (%) |
|------|----------------------------|------------------|-------------------|
| 1 | 200 | 5 | 0 |
| 2 | 200 | 5 | 0.5 |
| 3 | 200 | 5 | 1 |
| 4 | 200 | 5 | 1.5 |
| 5 | 200 | 5 | 2 |
| 6 | 200 | 5 | 2.5 |
| 7 | 200 | 5 | 3 |

Table 1: percentage of bitumen and bitugrip

In every sample and it has been clearly observed that the stripping value decreases on increasing the addition of bitugrip to the sample. The stripping value is calculated as the ratio of the uncovered area to the total area of the aggregates. The weight of sample is taken as “wt. of dry aggregates + wt. of bitumen + wt. of bitugrip”. The addition of 3% of bitugrip to the sample shows very less stripping value as shown in Table 2

| wt. of sample (gm) | value after stripping (gm) | temp. of water bath (°C) | stripping value (%) |
|--------------------|----------------------------|--------------------------|---------------------|
| 210 | 210 | 40 | 92.85 |
| 210.05 | 199.3 | 40 | 94.88 |
| 210.1 | 201 | 40 | 95.66 |
| 210.15 | 203.5 | 40 | 96.83 |
| 210.2 | 205.6 | 40 | 97.81 |
| 210.25 | 206 | 40 | 97.97 |
| 210.3 | 208.9 | 40 | 99.33 |

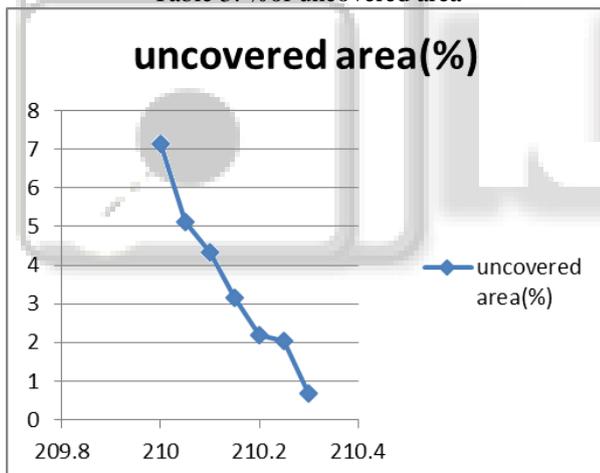
Table 2: Stripping value



The percentage of the uncovered area left as shown in table3.

| Wt. of sample (gm) | Stripping value (%) | Uncovered area (%) |
|--------------------|---------------------|--------------------|
| 210 | 92.85 | 7.15 |
| 210.05 | 94.88 | 5.12 |
| 210.1 | 95.66 | 4.34 |
| 210.15 | 96.83 | 3.17 |
| 210.2 | 97.81 | 2.19 |
| 210.25 | 97.97 | 2.03 |
| 210.3 | 99.33 | 0.67 |

Table 3: % of uncovered area



The percentage of uncovered area of aggregates decreases on addition of bitugrip.

IV. CONCLUSION

Every time there is a separation of the bitumen layer from the stone surface, there is the interposition of water and a direct reduction in performances of the asphalt concrete. Various studies have shown that binder and mixture. Stripping test is carried out to address the effectiveness of bitugrip on the binder properties. Further; an experimental investigation is carried out to characterize the performance of the binder mixed with the bitugrip. Based on the study findings, the following conclusions have been drawn.

- If it is not possible to alter the nature of the aggregate constituting the bituminous mixtures, the only controllable factor is the bitumen, through the use of antistripping agents.

- Bitugrip is a chemical mixture containing active functional groups that improves the adhesion of the bitumen film on the surface of the aggregates.
- When it is mixed with the binder it lowers the surface tension of the bitumen.
- As the bitugrip is of low cost, therefore, it is expected to reduce the life cycle cost of the bituminous pavements.
- Using bitugrip increases the durability of the road as proved it the study.

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