

REVIEW PAPER ON STRIPPING AND STABILITY OF AGGREGATE

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ABSTRACT

The stripping value of aggregate is defined as the ratio of uncovered area observed visually to the total area of aggregates, expressed as percentage. Proper adhesion between aggregate and bitumen is one of the principal fundamental properties for good performance of bituminous pavement. This adhesion can be reduced by presence of water which may be caused by de-bonding of bitumen from aggregate. The phenomenon is known as 'stripping'. Bituminous roads are greatly susceptible to moisture damage. Nowadays proper drainage facilities are lacking on the roads which is one of the main reasons for road damage due to stripping. Adequate drainage must be provided for prevention of damage of roads due to stripping as complete failure of the pavement can take place.

Stripping is a complex problem comprising many variables, including the type and use of mix, aggregate and bitumen characteristics, environment, traffic, construction practice and use of anti-stripping additives.

Keywords:- bituminous pavement, adequate drainage, stripping, potholes and culminate

1. INTRODUCTION

Contact of water with bituminous pavement is one of the main factors for stripping. The moisture affects physical properties and mechanical behavior of bitumen paving mixtures as aggregates that have a dry surface adhere better to bitumen and have a higher stripping resistance than wet aggregate. The water can be in the form of ground water, surface water or rain water. Presence of water on the road, if not properly managed, may cause deterioration of road more rapidly as it reduce the potency of bond between bitumen and aggregate which provides strength to the mix and ultimately leads to failure of pavement. For prevention of such damage, adequate drainage must be provided.

The physical and chemical characteristics of aggregates have a significant effect on the bonding between aggregate and bitumen. In addition, aggregate surface texture, aggregate porosity and pore pressure are also known to affect stripping. A deficiency in properties of aggregates reduced the strength of bond and leads bitumen-aggregate mixture towards stripping. Stripping may further cause rutting, raveling, bleeding, cracking and formation of potholes and culminate with complete failure of pavement.

Hence, to prevent pavement from these failure, we need to thoroughly investigate various factors which affect the stripping of aggregates. This study presents various influencing factors, their effect and possible remedies to the problem. The stability test provides the performance prediction measure for the Marshall Mix design method. The stability portion of the test measure the maximum load supported by the test specimen. Load is applied to the specimen till failure, and maximum load is designed as stability.

2. LITERATURE REVIEW

Covington et al (1977) demonstrated that asphalt-aggregate adhesion is strongly influence by the PH of water, which changes with the temperature. The pH cause shift in angle of contact and significantly affect the wetting properties of bitumen. Weak acids affect some aggregate mineral like alkali feldspars. Adhesion affects capillarity while cohesion affects surface tension. Since most aggregate surface have electrostatic charges, water molecule attach to them with stronger forces than bitumen polar to satisfied unbalance surface charges. Calcareous aggregate give free calcium ions forming strong water resistant bonds with bitumen. Siliceous aggregates (with SiO₂) form weak bonds with bitumen, which are hydrolytically unstable.

Kennedy et al (1983) explained that stripping is the loss of adhesion between the asphalt binder and aggregate due to the action of the water. Loss of integrity of the hot mix asphalt through weakening of the bond between the aggregate and bitumen is known as stripping. When a weakening of the bond occurs, loss of strength of the hot mix asphalt can be sudden. Stripping usually begins at the bottom of the bituminous layer, then travel upward. A typical situation is a gradual loss of strength over a period of years, which causes rutting and showing to develop in the wheel path. Many times, stripping is difficult to identify because surface indicators may take years to show. Also many surface indicators are possible and may include: rutting, showing, corrugations and cracking. There are many ways in which

moisture can enter the asphalt pavement layers: capillary action from the water table, run off from the road surface and seepage from surrounding areas.

Ensley et al (1984) suggested that stripping is the displacement of the asphalt binder film from the aggregate surface, which is explained using the chemical reaction of adhesion. It mentioned adhesion as being poorly understood due to bitumen internal complexity and the variety of aggregate surface. Initially, interaction between the bitumen polar and active aggregates surface takes place. Several mechanisms have been used to explain the adhesion between the component materials.

Hicks, G. R. (1991) reported in their study that Rheological properties of a bitumen binder have a major influence on bonding between bitumen and aggregate. During mixing, placing and compacting the mix, the viscosity of the bitumen is the key issues of concern. During mixing of asphalt and aggregates, an asphalt binder with high viscosity may not effectively wet the aggregate surface. But during the service period, high viscosity can be beneficial against stripping because high viscosity bitumen usually carry high concentration of polar functionalities that provide more resistance against stripping. The viscosity of bitumen is the most common factor affecting a bitumen stripping properties. High viscosity bitumen resist pulling along an air-water interface and pulling of the bitumen film increases with decreased viscosity. Low viscosity bitumen has higher "wetting power" and is therefore more desirable from stand point of coating

TESTS TO DETERMINE STRIPPING

Test As Per Indian Standard

"Method of test for determination of stripping value of road aggregates (IS: 6241-1971)" is the

Standard describing the stripping test for the coarse aggregate.

Procedure of testing the value of stripping is given below.

Test Procedure

The step wise procedure for preparation of sample and its testing under standard conditions is as per "Method of Test for Determination of Stripping Value of Road Aggregates (IS: 6241-1971) code which is as follows:-

Take 200g of aggregate passing 20mm IS sieve and retained on 12.5mm sieve. Dry, clean and mix aggregate with 5% bitumen binder by weight of aggregate, bitumen binder is heated to 160°C (110°C in the case of tar binder). The aggregate are also to be heated prior to mixing to a temperature of 150°C and 100°C, when these are to be mixed with bitumen and tar respectively.

The mixture is transferred to a 500 ml beaker after complete coating and allowed to cool at room temperature for about 2 hours. Distilled water is then added in the beaker to immerse the coated aggregate. The beaker is covered and kept in a water bath maintained at 40°C, taking care that the level of water in the water-bath comes up to at least half the height of the beaker. After the expiry of 24 hours the beaker is taken out, cooled at room temp. The extent of stripping is estimated visually while the specimen is still under water. The permissible value of stripping is 5 percent.

Test Under Varying Condition

In this study, testing is performed on the aggregate-bitumen sample by undertaking various field conditions in to consideration. Most of the time it is envisioned that the laboratory test condition and field condition vary a large extent leads to stripping of aggregates on the road even when laboratory tests indicates nil stripping value. It is mainly because of difference of temperature, contact time of water with coated aggregates, pH value of water, alternate wetting and drying conditions, traffic, vehicle load and tyre friction in the field which are different from the lab conditions. To determine the effect of these variables on stripping, experiment have been carried out in the highway engineering lab national institute of technology Kurukshetra. The effect of traffic load and tyre friction has been simulated by applying light pressure with small tyres by the observer.

3. CONCLUSIONS

The present study on the topic "A Study on stripping and stability characteristics of aggregates of Haryana" has been carried out with a view to determining and analyzing various factors influencing stripping and stability of bituminous mix of aggregates. Tests have been carried out on two types of aggregates obtained from Yamuna Nagar and Tosham quarries with three types of bitumen VG10, VG30 and CRMB55 under varying condition of temperature, effect of traffic load and tyre friction, contact time with water. wet dry cycles, altered temperature cycle and alkaline and acidic water. Lime as an additive is used to determine its effect on stripping.

It is observed that the stripping of aggregates get affected by all these varying conditions. It is recommended that the standard stripping test conducted in lab to evaluate stripping of aggregates needs to simulate the field conditions better to pred

4. REFERENCES

- [1] AR. Tarrer and Vinay Wagh, (1991), "The effect of the physical and chemical characteristics of the aggregate on bonding", SHRP-A/UIR-91-507, pp. 1- 19, 1991.
- [2] Amir Mehrara and Ali Khodaii,(2013) "A review of state of the art on stripping phenomenon in asphalt concrete", Elsevier, Construction of Building Materials, Vol. 38, 2013, pp. 423-442.
- [3] ASTM D 3625-96(2007), "Effect of water on bituminous-coated aggregate using boiling water". Vol.04.03, pp. 1-2, 2007.
- [4] California test 302 (2002, "Method of test for film stripping", Transportation Lab, pp. 1-6, 2002.
- [5] Code of practice for maintenance of bituminous surfaces of highways
- [2] IRC: 82- 1982, the Indian Road Congress, New Delhi, 1982
- [3] Ensley, E.K., Petersen, J. C. Robertson, R.E.(1984) "Asphalt aggregate bonding energy measurement by micro calorimetric method". Thermochemica Acta, 77, Elsevier science, Amsterdam, pp. 95-107.