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# Experimental Study on Anti-Stripping Performance of Lime in Bituminous Mix

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**ABSTRACT**

Flexible pavement is the paving system most widely adopted all over the world. It has been recognized that there are many different types of factors affecting the performance and durability of pavement. Stripping and deformation are main factors affecting in pavement. These two factors can be reduced by hydrated lime and improve the properties of pavement. It has been found that hydrated lime stone of effect give additives because it widely available relatively cheap compared to others.

Hydrated lime is added in different percentages like 2, 4, 6, 8 and 10 where properties are investigated. The hydrated lime is use as a partial replacement by weight of bitumen. We are use CRMB60 grade of bitumen compares all the properties of bitumen with respect to specific at ionsbyIS15462-2004.Stripping value of with and without adding of hydrated lime can be determined by static immersion method. These mixtures are designed and tested on Marshall Stability procedure to evaluate permanent deform at ion at different percentages and different temperatures and the properties of bitumen with and without adding of hydrated lime. We compared all the properties like stability, deformation, plasticity, hardness, and softening temperature of bitumen and stripping value with and without adding of hydrated lime. Identify, Max. Stability and min. flow value at investigate above percentages.

Finally, we conclude that this experimental result shows addition of hydrated lime of about 8% in pavement mixture gives maximum stability, minimum flow valueand0%stripping. So, use of 8% hydrated lime in the construction of road gives durability, resisting high moisture damages in heavy rain fall area, resisting the deformation due to heavy loads or repetitive traffic loads.

**KEYWORDS:** Hydrated lime, Stripping, CRMB60 bitumen, Deformation, Moisture damage

## I.INTRODUCTION

Flexiblepavementwilltransmitwheelloadstressestothelowerlayersbygrain to grain transfer through the granular structure. Flexible pavement consists of four layers that are sub-grade with existing soil, sub base, base course, surface course or pavement course or wearing course. Mix design is the process of choosing optimum content of

stabilized various ingredients of the pavement. The general principle of mix design is that the mixture should provide satisfactory performance when constructed in the desired position of sub-grade. Design proportions of in gradients are generally based on analysis of the effect of various proportions on selected properties of mix. Before the design of pavement check the properties of aggregates. In this report mainly the hydrated lime is added in bitumen so the properties of bitumen are safe or not by different methods. The different types of factors affecting the performance and durability of pavement are stripping and deformation.

**Stripping**

Stripping is the loss of adhesion between the aggregates and bitumen in the presence of moisture. Stripping is caused due to heavy rain falls and moisture damage. It is mostly occurred in heavy rain fall areas. When stripping begins at the surface and progresses downward it is usually called ravelling. Stripping may result in ravelling, loss of stability, load carrying capacity of hot mix asphalt pavement. This type of failure is accumulated by water drop acting on the surface of pavement that is hydrophilic and hydrophobic surface contact.

**Hydrophilic surface** water drop is acting on surface of pavement; the water drop contact angle is 90° so water drop does not roll from the surface.

**Hydrophobic surface:** water drop is acting on the surface of pavement, the water drop contact angle is 180º so water drop easily roll from the surface.

**Deformation**

The accumulation of permanent strains that are produced by repetitive traffic loads or wheel loads can cause deformation. It is also known as rutting. This failure is in the form of wheel path. Two types of rutting that are mix rutting and sub-grade rutting, mix rutting occurs when the subgrade does not rut yet the pavement surface exhibits wheel path depressions as the result of compaction or mix design problems. Sub-grade rutting occurs when the subgrade exhibits wheel path depressions due to loading. In the presence of pavement reformat ion is developing map cracking or alligator cracking or fatigue cracking in narrow path or in the form of wheel path. Ruts are formed due to repeated application of loads along the same wheel path resulting longitudinal ruts. Wearing of the surface course along the wheel path resulting shallow ruts.

**Hydrated lime**

The two of the main factors causing the development of distresses, such as fatigue cracking, moisture damage and permanent deformation, in pavements using additives has been found to be one of the effective techniques to improve pavement durability. Recently, the use of hydrated lime, as mineral filler and anti-stripping material has raised more and more interest. Hydrated lime has a wide range of particle size distribution and proportion. Hydrated lime in hot mix asphalt (HMA) creates multiple benefits. A considerable amount of in format ion exists in the current literature on hydrated lime's ability to control water sensitivity and its well - accepted ability as an antistrip to inhibit moisture damage. However, recent studies demonstrate that lime also generates other effects in HMA. Specifically, lime acts as an active filler, anti-oxidant, and as an additive that reacts with clay fines in HMA.

These mechanisms create multiple benefits for pavements. The ability of lime to improve the resistance of HMA mixtures to moisture damage, reduce oxidative aging, improve the mechanical properties, and improve resistance to fatigue and rutting, has led to observed improvements in the field performance of lime – treated HMA pavements Several highway agencies have proven the effectiveness of lime with cold-in- place recycled mixtures. Hydrated lime is an additive that increases pavement life and performance through multiple mechanisms.

A number of additives to reduce moisture sensitivity and stripping are used in the United States. Hydrated Lime is widely used as an anti-strip additive. Others include liquid additives (e.g., amines, diamines, and polymers), Portland cement, fly ash, and flue dust. Pavement contractors usually prefer liquid antistrip additives as they are relatively easy to use. The filler effect of the lime in the asphalt reduces the potential of the asphalt to deform at high temperatures, especially during its early life when it is most susceptible to rutting. The hydrated lime filler actually stiffens the asphalt film and reinforces it. Furthermore, the lime makes the HMA less sensitive to moisture effects by improving the aggregate-asphalt bond. Hydrated lime is not simply an inert filler but reacts with the bitumen. In all cases, asphalt formula to rust now have in mind that besides binder and aggregate, there is an additional lever to be played with in order to fine-tune mixture properties: hydrated lime. It makes It a promising additive in the search of more sustainable and more durable asphalt pavements. Finally, the use of hydrated lime in hot mix asphalt pavement can reduce the main failures in cold regions in anywhere. This hydrated lime is added in bitumen, the properties of bitumen such as plasticity, hardness, sp. gravity, softening point etc. stability and flow value of bituminous mixture is determined by Marshall mix design with and without adding of hydrated lime, plotting the curves and also comparing the values of that bituminous mix.

**Objectives**

The main objectives of this project is

- To reduce stripping
- To improve stability and durability.
- To reduce rutting (permanent deformation).
- It improves water retention.
- To improve plasticity of pavement

## II. RESULTS AND DISCUSSION

| S. No | Test Name | Obtained Value% | Permissible Limit |
|---|---|---|---|
| 1. | Impact Test | 19 | 30 |
| 2. | Crushing Test | 12 | 30 |
| 3. | Abrasion Test | 18 | 30 |
| 4. | Sp. Gravity Test | 2.8 | 2.5-3.0 |
| 5. | Water Absorption Test | 1.8 | 2 |
| 6. | Shape Test (flakiness) | 14 | 15 |
| 7. | Shape Test(elongation) | 11 | 15 |

**Discussion:** The above aggregate results show within the permissible limits. Hence it is suitable for road Construction

**Results for bitumen (USE CRMB60 AS PER IS15462- 2004):**

**Table 1: Results for bitumen without addition of hydrated lime**

| S. No | Test Name | Obtained Value | Permissible Value |
|---|---|---|---|
| 1 | Ductility Test (cm) | 48 | 50 |
| 2 | Penetration Test (mm) | 5.2 | <50 |
| 3. | Softening Point Test | 59 | 60 |

**Discussion:** The above results shows the Ductility, Penetration, Softening point are within the limits.

**Table 2: Results for bitumen with 2% addition of hydrated lime**

| S. No | Test Name | Obtained Value |
|---|---|---|
| 1. | Ductility Test(cm) | 51 |
| 2 | Penetration Test(mm) | 5.07 |
| 3. | Softening point test | 58 |

**Discussion:** The comparison of this test results shows the properties of bitumen improved by 2% addition of hydrated lime than the plain bitumen.

**Table 3: Results for bitumen with 4% addition of Hydrated lime**

| S. No | Test Name | Obtained Value |
|---|---|---|
| 1. | Ductility Test(cm) | 52.5 |
| 2 | Penetration Test(mm) | 4.9 |
| 3. | Softening point test | 60 |

**Discussion:** The comparison of this test results shows the properties of bitumen improved by 4% addition of hydrated lime than the plain bitumen.

**Table 4: Results for bitumen with 6% addition of Hydrated lime**

| S. No | Test Name | Obtained Value |
|---|---|---|
| 1. | Ductility Test(cm) | 55 |
| 2 | Penetration Test(mm) | 4.8 |
| 3. | Softening point test | 55 |

**Discussion:** The comparison of this test results shows the properties of bitumen improved by 6% addition of hydrated lime than the addition of 4% hydrated lime.

**Table 8.2.5: Results for bitumen with 8% addition of Hydrated lime**

| S. No | Test Name | Obtained Value |
|---|---|---|
| 1. | Ductility Test(cm) | 58 |
| 2 | Penetration Test(mm) | 4.42 |
| 3. | Softening point test | 57 |

**Discussion:** The comparison of this test results shows the properties of bitumen improved by 8% addition of hydrated lime than the addition of 6% hydrated lime.

**Table 8.2.6: Results for bitumen with 10% addition of Hydrated lime**

| S. No | Test Name | Obtained Value |
|---|---|---|
| 1. | Ductility Test(cm) | 59 |
| 2 | Penetration Test(mm) | 4.2 |
| 3. | Softening point test | 58 |

**Discussion:** The comparison of this test results shows the properties of bitumen improved by 10% addition of hydrated lime than the addition of 8% hydrated lime bitumen

## IV. CONCLUSION

Hydrated lime is the anti-stripping agent for the design of flexible pavement. This type of agent is used to improve the properties of bitumen such that stability, flow value, plasticity, hardness. This helps to have a better binding of bitumen with hydrated lime and also reduces the air voids. This type of agent used for the construction of pavement mixture to prevent the moisture damage. This is also may result in reducing the rutting, raveling and stripping value of asphalt pavement. The hydrated lime is used to improve the durability of pavement. These roads can with stand
any areas to face the any problems of pavement mainly reformat ion and striping. This type of agent is used for the construction of flexible pavement to imp rove the quality and life span. Finally, the hydrated lime is adding and we conclude the mix proportion of pavement mixture based on the properties of mix. This may result shows
This aggregate result gives the properties of aggregates are within the permissible limits as per recommendations such as toughness, crushing strength, Sp. gravity, water absorption, shape, hardness. So, this type of aggregates are suitable for road construction. This bitumen results shows the properties of bitumen with and without adding of hydrated lime. We conclude that plasticity and hardness is improved in bitumen compared to without adding of hydrated lime but softening point value does not improve as per recommendations.
This result shows stripping value of bitumen mixture is 4% without adding of hydrated lime. After adding of hydrated lime, the stripping value is reduced to 0% with 6% adding of hydrated lime. We conclude that the mix proportion is taken as 6 or 8 or10%.
This resultshowsaddingof8%hydratedlimegivesmaximumstability value and flow value is minimum compared to other percentages. We conclude that the mix proportion of pavement mixture is taken as 8%. Finally, we conclude that the mix proportion of 8% hydrated lime in pavement mixture gives better results than the other percentages. This result gives maximum stability, minimum flow value and stripping value is zero. So, 8% mix proportion is taken for the construction of road in any areas it will also reduce the maintenance cost for construction.

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