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Resilient modulus of different asphalt mixtures of varying bitumen content by performing Creep test using UTM-5P

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Abstract: ***High traffic volume and high traffic load exert a major impacts on roadways .The traffic volume is increasing continuously with passage of time and modern era. This increase in volume cause adverse impacts on roadways and highways and this increase in volume demands a good construction of roadways and means of transportation but during the last few decade, the continuously increasing in traffic volume and poor construction of roadways and highways in combination with an inappropriate due to Govt Policies and regulations cause an continuous deterioration of road network in Pakistan. As the traffic volume increases which cause the increase in traffic load and poor quality of construction or any compromise on the construction quality are the main cause on pavement failure especially in the fatigue cracking. In this research to improve the asphalt binder properties LDPE (Plastics) and crumb rubber are used .The proportion of Additives is kept 0.2% and 0.4% by the weight of bitumen content. In this study the different asphalt mixture are tested for resistance to creep by subjecting all specimen to UTM- 5P at the control load rate. Improvement in resistance against permanent deformation is monitored in Plastic modified bitumen and then crumbed rubber modified mix.***

Keywords: LDPE (low density polyethylene), crumb rubber modified, UTM 5P (universal testing machine).

1. Introduction

Construction of high Way system and network of road in Pakistan is important for a balance economy. These provide means to carry agriculture produce industrial product and other day-to-day necessities of life. What are pavements? A pavement is a multilayer system that distributes the vehicular loads over a larger area. There are two types of roads present in our country known as rigid pavements and flexible pavements. Mostly in the rigid pavements the top surface of the pavements is made by concrete and in flexible pavements the top surface of the road is made by asphalt. Flexible pavement is the structure which distributes the traffic loading stresses to the soil (sub grade) at a magnitude that will not shear or distort the soil i.e., from 150 psi to 3 psi. The asphalt binder performance is greatly depend upon the visco-elasticity. Due to visco-elastic nature of asphalt binder temperature goes on increasing. The asphalt binder behavior depends on temperature and also on time on loading .At colder temperature asphalt is stiffer That's why for the effective interpretation of the results the test temperature must be specified .Under short loading time it is stiffer thus a high test temperature simulate slow loading rate while low test temperature simulate fast loading rate. Due to the visco elastic nature of asphalt binders it displays both viscous and elastic characteristics simultaneously. At high temperatures it become softer and at very high temperature (more than 100°C) it become so soft that it displayed viscous fluid characteristics. When temperature of asphalt binder falls it become stiffer and at lower temperature (less than 0°C) it acts as elastic solid and it deformed under load but on the removal of load it bonus back on its original shape. At moderate or intermediate temperature it has the characteristics of both viscous fluid and elastic solid. Creep test mostly involves the application of static load over a specified period of time and measurement of the resulting strain. This is considered to be the simplest way to investigate the permanent deformation characteristics of bituminous mixtures and is the most widely used test method for determining material properties because of its simplicity and the fact that many laboratories have the necessary equipment and expertise. This test is performed by the UTM-5P(Universal Testing Machine).

2. Literature Review

SerkanTapkın (2009) studied the effect of polypropylene fibers on asphalt performance and observed an obvious increase in marshall stability and decrease inflow values for the fiber-reinforced mixes.

Muhammad T. Awwad and LinaShbeeb (2007) used polyethylene as an additive to develop properties of asphalt concrete mixtures and to resolve the type andproportion of polyethylene which is the most suitable for use in asphalt mixes.

M Perl and A Sides investigated the stress-strain behavior of sand-asphalt mixture subjected to either uniaxial compressive oruniaxial tensile cyclic loading. Based on the test results, they considered that the total axialstrain consists of the elastic, the plastic the viscoelastic and the viscoplastic straincomponents, and presented a comprehensive model.

3. Aims and Objectives

a) To determine resilient modulus by varying bitumen content.

b) To evaluate the resilient modulus of different asphalt mixtures by using Polymer and crumbed rubber as a additives.

4. Testing Program

Sieve analysis is performed manually according to NHA Class-A gradation. The gradation is shown in Table 1.1.After sieve analysis aggregates and binder is mixed and heated in the range of 140o C to 160o C. Mixing of binder and aggregates is done by two methods, First add bitumen and plastic, Crumbed rubber with % of 0.2,0.4 then mix with aggregates, Secondly add bitumen and aggregate then mix plastic, Crumbed rubber with 0.2%& 0.4 %. Compaction hammer and mould are cleaned well and mould assemblage is heated in oven to a temperature about 1500C. Grease is applied thoroughly to the mouldand then mix is placed in mould.Each mold has a weight of 1280gm. We will cast 40 molds(cylinders) using varying percentage of bitumen with 0.2%& 0.4% plastic waste (LDPE) or crumb rubber in replace of bitumen with varying percentage of aggregates 96.5% ,96%, 95.5%, 95% and 94.5%. Mould is assembled .Mix is placed in 3 layers andeach layer being tamped with spatula by 25 times. Then 75blows are applied through compactor. Similar numbers of blows are also applied on theother side of mould. Then allowed the specimen to cool and then de-mould it.After the preparation of moulds these specimens are placed in UTM 5-P machine and Creep test is performed to find resilient modulus. This test conforms the requirements of the design according to British standardsInstitute .Initially the test applied astatic conditioning stress to specimen and measures the resultant accumulating strain.

5. Results and Discussions

Fig 1.1 shows the values of resilient modulus of different asphalt mixtures by varying bitumen content and additives of 0.2% by weight of bitumen.

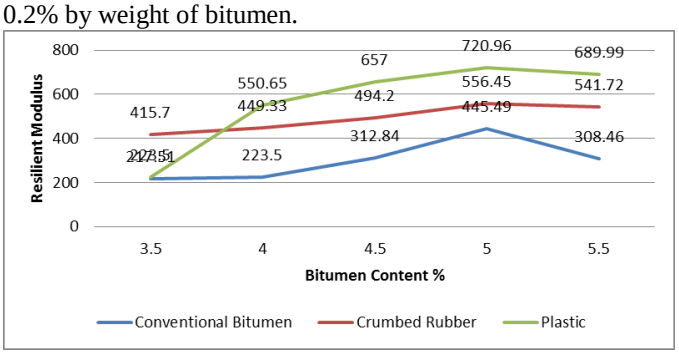
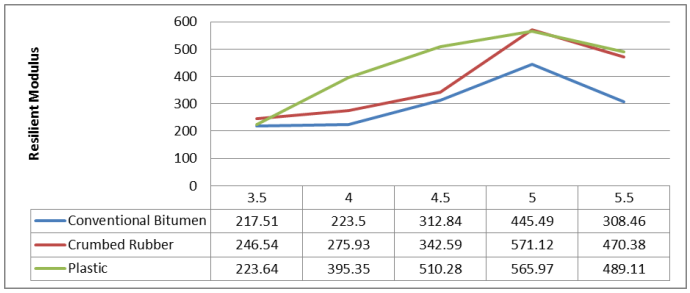


Fig 1.1

It is clear from the graph that resilient modulus of asphalt mixture having plastics as an additive is greater than that of asphalt mixture having crumb rubber as an additive and conventional bitumen mixture. Increase in Bitumen content in linear manner showing the resilient modulus is increasing but after a certain point it will start decreasing. As we increases the bitumen content gradually up to 5% resilient modulus relatively increases but on further increment in the bitumen content results in decrease of resilient modulus.Use of bitumen greater than optimum value (5%) cause flow and rutting.



	3.5	4	4.5	5	5.5
Conventional Bitumen	217.51	223.5	312.84	445.49	308.46
Crumbed Rubber	246.54	275.93	342.59	571.12	470.38
Plastic	223.64	395.35	510.28	565.97	489.11

Fig 1.2

Fig 1.2 shows the values of resilient modulus of different asphalt mixtures by varying bitumen content and additives of 0.4% by weight of bitumen. It is clear from the graph that resilient modulus of asphalt mixture having plastics as an additive is greater than that of asphalt mixture having crumb rubber as an additive and conventional bitumen mixture. Increase in Bitumen content in linear manner showing the resilient modulus is increasing but after a certain point it will start decreasing.As we increases the bitumen content gradually up to 5% resilient modulus relatively increases but on further increment in the bitumen content results in decrease of resilient modulus.Use of bitumen greater than optimum value (5%) cause flow and rutting.

6. Conclusions

a) Resilient Modulus is higher in case of LDPE and Crumb rubber modified bitumen as compared to conventional bitumen.
b) Resilient Modulus is higher in case of 0.2% additives than that of 0.4% additives.
c) As we increases the bitumen content gradually up to 5% resilient modulus relatively increases but on further increment in the bitumen content results in decrease of resilient modulus.
d) Use of bitumen greater than optimum value (5%) cause flow and rutting.
It is accomplished in general that it is a simple ecological process not only to help savecost of bitumen but also improves performance of roads, solves problem of plastic waste discarding and can be reused. This process can be practically more effective if segregation is done at the source, as a substitute of going through the exclusion of plastics.

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Author Profile

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Muhammad Hussain received the B.S. and M.S. degrees in Civil Engineering (Transportation Engg.) from University of Engg. & Technology, Taxila in 2011 and 2014, respectively. During 2012-2014, he served as a Lecturer in Civil Engineering Department, Swedish College of Engineering & Technology, Wah Cantt.