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UTILIZATION OF PLASTIC IN RIGID ROAD CONSTRUCTION

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ABSTRACT-- The percent study investigates the effective use of waste plastic as a modifier for bitumen roads. Solid waste management is the thrust area. The various waste materials, plastic waste and principle solid waste are of great concern these leads to disposal crisis and environmental pollution. On the other side, road traffic is increasing. The load bearing capacity of the roads should be increased. Our present work is helping to take care of both these aspects. Plastic waste consists of carry bags, bottles, cups, and disposals. Commonly soil, aggregates, sand, bitumen can be used in road construction. Natural materials are limited in nature, its quantity is increasing gradually. If our material can be utilized in highway construction, the pollution, and waste problems may be decreased. The use of the modern technology will not only strengthen the road construction but also increase the road life as well as will help to decrease the quantity of waste in environment.

Keywords: Bitumen and plastic.

I. INTRODUCTION

The rapid urbanization and industrialization all over the world has resulted in large deposition of waste materials. The world's annual consumption of plastic materials has increased from around 5 million tons in the 1950s to nearly 100 million tons in 2001 [1]. In Plastic waste various materials are present such as surplus, obsolete, broken, old plastic furniture, different household plastic materials, equipment, anti-static packaging materials and devices made of plastic. In natural environment these waste material are non-degradable.

Utilization of waste polymer material in making bitumen can be good solution to this environmental hazard. In the year 2005 in Dhaka city the solid waste generated is about 3315 tons in which 4.15% is plastic material [2]. The safe use of plastic waste is very important because plastics are not biodegradable. Approximately 11.3 million tons of solid waste is produced annually in Iraq. The aim of this research is to investigate the effect of two types of waste plastic on strength of bitumen.

II. OBJECTIVE

Basic intention is to efficiently utilize the waste plastic in constructive way so that it can be beneficial to society

- To compare the results of penetration, ductility, viscosity and softening point value of bitumen without plastic.
- To compare the results of penetration, ductility, viscosity and softening point value of bitumen with plastic.

Present status of plastic:

1. Plastics Scenario:

Plastics have become common man's friend. It finds its use in every field. The most used plastic materials for packing are carry bags, bottles, cups and foams. These materials are manufactured using polymers like Polyethylene, polypropylene and polystyrene. The tubes and wires are made out of poly vinyl chloride. These materials are mixed with Municipal Solid Waste (MSW). As the plastics are non- biodegradable, their disposal is a problem and they cause social problems contributing for environmental pollution [3].

2. Physical Properties:

- Different commercial plastic materials, that are in use were collected and the following test were carried out

i. Softening Point
ii. Thickness of the film.

- Most of Plastic get soften below 170°C except Poly-vinyl-chloride and Polyethylene terephthalate. The molten plastic can be used as a binder using proper technique [3].

Advantages and Disadvantages:

Plastic Roads have been tried and tested and have proved to be an ecofriendly, efficient way in the construction of road. Briefly, thin plastic is shredded in shredding machines and then mixed into bitumen to create a strong bond. This plastic is melted, not burned. The advantage of the gases residue are:

1. Longevity: up to 3 times that of the current methods of road construction
2. No cracking or potholes
3. Resistance to water
4. Reduced cost of maintenance
5. Reduced stress on bitumen which is not an unlimited resource either.
6. Best use of plastic waste. The only way of disposing thin plastic are incineration and landfilling because thin plastic is not recyclable.
7. Completely eco-friendly.
8. Inculcation of waste segregation culture. If every other country can do it, nothing should be stopping India from making a start somewhere [4].

However, there are some disadvantages

1. Reduced pavement life in comparison with other materials due to the increased likelihood of binder oxidation caused by the voided nature of the material
2. Possible clogging of pores and drainage paths while under construction and also during the service life of the road
3. The need for more salting during winter as snow and frost linger longer on PA
4. Increased construction costs due to the increased sensitivity of the material to temperature and adverse weather conditions
5. Increased maintenance costs incurred by many of the above factors and the fact that methods of repairing the pavement would be more complex than with other more traditional materials [5].

III. METHODOLOGY

There are two methods for conducting pavement evaluation.

(i) Structural evaluation and (ii) functional evaluation. The primary objective of pavement evaluation is to asses as to whether and to what extent the pavement fulfils the intended purpose so that the maintenance and strengthening jobs could be planned and budgeted in time. The studies, therefore, investigate the structural adequacy of pavements and other technical requirements for providing safe and comfortable traffic operations. Physical distress is identified by the type, severity and extent of various distress modes or types [3].

Test on Bitumen without plastic and with plastic:

- Penetration test
- Ductility test
- Viscosity test
- Softening point test

1. Penetration test without plastic

Penetration of a bituminous material is the distance in tenth of millimeter that a standard needle will penetrate vertically into sample under standard conditions oftemperature, load and time. Penetration test procedure can see appendix.

The values of bitumen is obtained at test as follows,

Content	Trial 1	Trial 2	Trial 3
Initial reading	200	294	380
Final reading	294	380	465
Mean values	94	86	85

Table: 1 Penetration test values for bitumen without plastic

Mean value of penetration of bitumen is 88.33mm. Therefore the grade of bitumen for the above obtain value is 80/100.

Content	Trial 1	Trial 2	Trial 3
Initial reading	200	360	463
Final reading	360	463	517
Mean values	160	103	54

Table: 2 Penetration test values with plastic

Mean value of penetration of bitumen is 105.67mm. Therefore the grade of bitumen for the above obtain value is 80/100.

2. Ductility test for without plastic:

The ductility of a bituminous material is the distance to which it will elongate before breaking when a briquette specimen of the material of the form pulled apart at a specified speed and at a specified temperature. This distance is measured in centimeters. Penetration test procedure can see appendix.

In this test the values of bitumen is obtain are:

Content	Trial 1	Trial 2	Trial 3
Initial reading	0	0	0
Final reading	76.8	75.7	76.6
Ductility=FR-IR	76.8	75.7	76.6

Table: 3 Ductility test values for bitumen without plastic

Content	Trial 1	Trial 2	Trial 3
Initial reading	0	0	0
Final reading	76.3	78.6	82.6
Ductility=FR-IR	76.3	78.6	82.6

Table: 4 Ductility test values for bitumen with plastic

The Ductility value of bitumen is 79.17cm. The value is >75cm and is related with given recommended value in IS-73.

3. Viscosity test without plastic:

The property of a fluid by which it resists flow due to internal friction, and one of the methods by which it is measured, is by determining the time taken by 50cc of the material to flow from a cup through a specified orifice under standard conditions of test and in specified temperature. Penetration test procedure can see appendix.

Content	Trial 1	Trial 2
Test temperature	60°C	60°C
Time taken to flow 50cc of the binder	971	1025

Table: 5 Viscosity test value for bitumen without plastic

The viscosity value of bitumen is 998 sec.
Viscosity test with plastic:
The property of a fluid by which it resists flow due to internal friction, and one of the methods by which it is measured, is by determining the time taken by 50cc of the material to flow from a cup through a specified orifice under standard conditions of test and at specified temperature. Penetration test procedure can see appendix.
The values of bitumen is obtain at test as follows,

Content	Trial 1	Trial 2
Test temperature	60°C	60°C
Time taken to flow 50cc of the binder	1034	1076

Table 6: Viscosity test value for bitumen with plastic

The viscosity value of bitumen is 1055 sec.

4. Softening point test without plastic:
The temperature at which the substance attains a particular degree of softening under specified condition of test. Penetration test procedure can see appendix.

Content	Trial 1	Trial 2
Temperature when the ball touches bottom, °C	38.6	40.2

Table 7: Softening point test value without plastic

The softening point of bitumen is 39.4°C. This obtain value is within the recommended value on IS-73.

Softening point test with plastic:
The values of bitumen is obtain at test as follows,

Content	Trial 1	Trial 2
Temperature when the ball touches bottom, °C	45	47

Table 8: Softening point test value with plastic

The softening point of bitumen is 46°C. This obtain value is within the recommended value on IS-73.

S.No.	Test	Test result for Bitumen without Plastic	Test result for Bitumen with Plastic	Recommended Value	Unit
1	Penetration Value	88.3	105.67	80-100	Mm
2	Ductility Value	76.4	79.17	>75	Cm
3	Viscosity Value	998	1055	800-1200	Sec
4	Softening Value	39.4	46	40	°C

Table 9:Comparison of test result

This comparison of test result can confirm that the strength of bitumen mixed with plastic is greater than the strength of bitumen mix of plastic.

IV. CONCLUSION

Based on the present work the following conclusion can be drawn:

- Waste plastic modified bituminous binders provide better resistance against permanent deformations according to their high stability and it contributes to recirculation of plastic waste as well as to protection of the environment.
- Melting point of bitumen can be increased by mixing plastic. Then use of the innovative technology not only strengthened the road construction but also increased the:-

i. Penetration value for bitumen with plastic is 105.67mm and is greater than the penetration value for bitumen without plastic is 86.67mm and thus are within the limit of recommended value is 80-100mm
ii. Ductility value for bitumen with plastic 79.17cm and is greater than the ductility value for bitumen.
iii. Viscosity value for bitumen with plastic is 1055sec and is greater than the viscosity value for bitumen without plastic is 998sec and thus is within the limit of recommended value is 800-1200sec.
iv. Softening value for bitumen with plastic is 46°C and is greater than the ductility value for bitumen without plastic is 39.4°C and thus road life as well as will help to improve the environment and also improve the environment and also creating a source of income.

The above results show that the consumption of waste plastics in bituminous mixtures show improved property of the mixtures.

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