International Journal of Scientific & Technical Development
(A Peer-Reviewed Bi-Annual Journal) ISSN: 2348-4047

WASTE PLASTIC USE IN BITUMINOUS PAVEMENT

***Zeyan Bin Amin**
Research Scholar , Department of Civil Engineering, Desh Bhagat University Mandi Gobindgarh

Abstract
Now days, the population growth, industrialization, consumerism and technological development have led to uncontrollable accumulation of waste Proper waste disposal is of great importance in both rural and urban areas. Many of the wastes produced today will remain in the environment for many years leading to various environmental concerns Plastic which is toxic in nature is found to be nearly 5% in Municipal Solid Waste (MSW) A major problem nowadays is the disposal of plastic wastes. These wastes are non biodegradable in nature causing environmental pollution and hygiene problems. The experimentation at several institutes indicated that waste plastic can be utilized in Asphalting of roads The use of these wastes in road construction is based on Economic, Technical and Ecological criteria. Taking an example of INDIA (Authors native land) several million metric tons plastic wastes are produced every year. However disposal of waste plastic (WP) in large quantities constitutes an environmental problem, as they considered non-biodegradable materials. Hence, there is a real need to find useful applications for these growing quantities of wastes. Therefore it is necessary to utilize the wastes effectively with technical development in cache field. If these wastes can be suitably utilized in road construction, the disposal and pollution problems can be minimized to a large extent Once the plastic waste is separated from municipal solid waste, the organic matter can be converted into manure and used. In road making process bitumen is used as binder The bitumen can be modified with plastic waste pieces forming a mix which can be used as a top layer of flexible pavement, showing better binding property, stability, density and which is more resistant to water. In this study bitumen and aggregates are coated with various percentage of waste plastic (0%, 4%, 8%, and 12 %) replacement. And various laboratory tests are done on these samples It has been observed that, the optimum replacement of waste plastic to bitumen without changing the properties is 12%.

INTRODUCTION

Now-a-days disposal of different wastes produced from different Industries is a great problem These materials pose environmental pollution in the nearby locality because many of them are non-biodegradable. Traditionally soil, stone aggregates, sand, bitumen, cement etc are used for road construction: Natural materials being exhaustible in nature, its quantity is declining gradually, Also, cost of extracting good quality of natural material is increasing Concerned about this, the scientists are looking for alternative materials for highway construction, and industrial wastes product is one such category. If these materials can be suitably utilized in highway construction, the pollution and disposal problems may be partly reduced. In the absence of other outlets, these solid wastes have occupied several acres of land around plants throughout the country. Keeping in mind the need for bulk use of these solid wastes in India, it was thought expedient to test these materials and to develop specifications to enhance the use of these industrial wastes in road making in which higher economic returns may be possible. The possible use of these materials should be developed for construction of low volume roads in different parts of our country. The necessary specifications should be formulated and attempts are to be made to maximize the use of solid wastes in different layers of the road pavement Post construction pavement performance studies are to be done for these waste materials for construction of low volume roads with twofold benefits. (a) it will help clear valuable land of huge dumps of wastes, (b) it will also help to preserve the natural reserves of aggregates, thus protecting the environment. Plastics are user friendly but not eco-friendly as they are non biodegradable generally, it is disposed by way of land filling or incineration of materials which are hazardous Plastic is versatile material and a friend to common man becomes a problem to the environment after its use. The better binding property of plastics in its molten state has helped in finding out a method of safe disposal of waste plastics. Road surface with neat bitumen can cause bleeding in hot climate, may develop cracks in cold climate, possess fewer loads bearing capacity and can cause serious damages because of higher axle load in present conditions due to rapid infrastructure development.

Main objectives of present work are

- To identify the optimum proportion of waste plastic to be added in the bitumen mix forgetting the required strength
- To compare the experimented results with the conventional pavement details and perform the economic analysis
- To prepare statistical model for optimum utilization of plastic waste. 4. To improve the volumetric properties of BC mix design
- To utilize waste plastic in bituminous mixes

LITERATURE REVIEW

The literature studies has been carried out based on present work and mentioned as follow:

Gawande et al. 2012 studied that the quantum of plastic waste in municipal solid waste (MSW) is increasing due to increase in population, urbanization, development activities and changes in life style, which leading widespread littering on the landscape. Thus disposal of waste plastic is a menace and become a serious problem globally due to their non-biodegradability and un-aesthetic view. Since these are not disposed scientifically & possibility to create ground and water pollution. This waste plastic partially replaced the conventional material to improve desired mechanical characteristics for particular road mix. In this paper developed techniques to use plastic waste for construction purpose
of roads and flexible pavements had reviewed. In conventional road making process bitumen was used as binder. Such bitumen can be modified with waste plastic pieces and bitumen mix was made, which can be used as a top layer coat of flexible pavement.This waste plastic modified bitumen mix show better binding property, stability, density and more resistant to water.

Paul et al.2012 studied that the Flexible pavements with bituminous surfacing are widely used in India. Exponential increase in traffic, overloading of commercial vehicles and significant variations in daily and seasonal temperatures have shown some limitations of conventional bitumen performance. Early developments of distress symptoms like cracking, rutting, pumping, bleeding, poor skid resistance, undulations, shoving and potholing of bituminous surfacing have been reported for flexible pavements.

A bituminous mixture needs to be flexible enough at low service temperatures to prevent pavement cracking and to be stiff enough at high service temperature to prevent rutting. Bitumen modified with polymer offers a combination of performance related benefits as the physical properties of the bitumen was improved without changing the chemical nature of it. The experimental study carried out conventional bitumen and polymer modified binder. It has been shown that rutting resistance, indirect tensile strength and resilient modulus of the bituminous concrete mix with polymer modified bitumen was significantly improved.

Vamshi et al.2015 studied that the bottles, containers and packing strips etc. is increasing day by day. As a result amount of waste plastic also increases. This leads to various environmental problems. Many of the wastes produced today will remain in the environment for many years leading to various environmental concerns. Therefore it is necessary to utilize the wastes effectively with technical development in each field. Many by-products were being produced using the plastic wastes. Plastic waste, consisting of carry bags, cups and other utilized plastic can be used as a coating over aggregate and this coated stone can be used for road construction. The mix polymer coated aggregate and tyre modified bitumen have shown higher strength. Use of this mix for road construction helps to use plastics waste. Once the plastic waste is separated from municipal solid waste, the organic matter can be converted into manure and used.

Besides, the mixtures containing waste plastic showed significantly greater fatigue resistance than the conventional mixture

Tapase et al.2014 studied that the growth in various types of industries together with population growth has resulted in enormous increase in production of various types of waste materials world over creating a problem of its disposal in eco-friendly way. To deal with the problem, study on use of plastic waste as partial replacement to bitumen in flexible pavement was considered. The work consists of an experimental approach towards waste management and finding alternative to conventional materials in flexible pavements. To simulate with the field conditions Marshall Stability method was considered to carryout experimental work. The objective of work was to investigate the effect of plastic Waste in flexible pavement and to suggest the optimum percentage of bitumen that can be replaced by plastic waste for the improvement of roads. Number of laboratory tests has been carried out by replacing bitumen by plastic waste. The results obtained in laboratory investigation indicate major gain in strength with substantial saving in cost.

Santosh et al.2013 evaluated that the plastics are user friendly but not eco friendly because they
are non biodegradable and generally it is disposed by way of land filling or incineration of materials which are hazardous. The better way of disposal of waste plastic may be using it in molten state for bituminous road. From practical experiences of asphalt binder with polymer additives offer several benefits to enhance various engineering properties many modifiers such as styrene based polymers, polyethylene based polymers, poly chloroprene, Gilsonite and various oils have been used in asphalt. An attempt had been made to use waste cement bags which were made of Poly-Propylene (PP) using different percentage of Poly-Propylene (PP) in the CRMB- 60 grade bitumen.

METHODLOGY

Basic raw materials used In mix design: The following materials are used are aggregates, Bituminous Binder, Mineral Filler, Polythene Aggregate from the major portion of pavement structure and they form the prime materials used in pavement construction. Aggregate is a collective term for the mineral materials such as sand, gravel, and crushed stone that are used with a binding medium (such as water, bitumen, Portland cement, lime, etc.) to form compound materials (such as bituminous concrete and Portland cement concrete). By volume, aggregate generally accounts for 92 to 96 percent of Bituminous concrete and about 70 to 80 percent of Portland cement concrete. Aggregate is also used for base and sub-base courses for both flexible and rigid pavements. Aggregates can either be natural or manufactured. Natural aggregates are generally extracted from larger rock formations through an open excavation (quarry). Extracted rock is typically reduced to usable sizes by mechanical crushing. Manufactured aggregate is often a bye product of other manufacturing industries. Hence, the quality and physical properties of the aggregates should be controlled to ensure a good pavement.

Table1: Penetration test on Bitumen

Bitumen	%of plastic	Penetration value in mm
Pure bitumen	0	62
With plastic	6	68
	12	72
	18	64

DUCTILITY TEST This test is done to determine the ductility of bitumen. The principle of this test is that the ductility of a bituminous material is measured by distance in cm to which it will elongate before breaking.

Table 2: Ductility Test on Bitumen

Bitumen	%of plastic	Ductility value
Pure bitumen	0	83
With plastic	6	87
	12	95
	18	75

MARSHAL STABILITY TEST The deformation of specimen of bituminous mixture is measured when the same load is applied. This test procedure is used in designing and evaluating bituminous paving mixes. The marshal stability of mix is defined as a maximum load carried by a compacted specimen.

Table 3: Marshal Stability Test

Sr. No	MI X	BINDER CONTENT	PLASTIC WASTE (%)	MARSHAL L STABILIT Y KN	FLOW	Marshal l Density g/cc	Percentag eAir voids %	Percentag e voids filled with bitumen VFG %
1	MI	4%	0%	11.38911	3.25981	2.17354	5.942583	62.97923
	X 1				5	8		
2	MI	5%		1226986	3.51290	2.24137	4.980836	66.27954
	X 2				7	6		
3	MI	6%		13.04938	3.58377	2.54306	4.373417	67.6766
	X 3				2	1		
4	MI	7%		12.16863	3.76599	2.14722	3.604019	73.43696
	X 4				8	6		
5	MI	4%	4%	12.44197	3.32055	2.26972	5.719862	61.60241
	X 5				7	2		
6	MI	5%		13.04938	3.56352	2.36893	4.677126	63.64739
	X 6				5	4		
7	MI	6%		14.01113	3.79636	2.40436	4.282304	65.75311
	X 7				9	7		

CONCLUSIONS

The results of this research together with that of previous researches are found to be encouraging for the future researchers who are interested to work in this field. In consideration of frequent submergence problems, high summer temperature and poor pavement construction practice and above all environmental hazards due to waste plastic, the use of waste plastic in road construction may bring

economical benefits in the many ways. After conducting laboratory tests on bitumen binder and mixtures with different polymer content and after analyzing the

data and comparing the results, the following conclusions are drawn :The result shows that with increase of waste plastic in bitumen increases the properties of aggregate and bitumen. The optimum use of plastic can be 12% of bitumen based on Marshal Stability test. The modified bitumen shows good result when compared to standard results For all modified binders prepared, the penetration values decrease as waste plastic ratio Increases whilst, softening point values increase as waste plastic ratio increase. The coating of aggregates with waste plastic reduces the absorption of moisture. By using waste commodity plastics in binder modification carries the advantage of a cheap, technologically effective means of enhancing conventional binder performance and offers an alternative way to manage plastic waste. This has added more value in minimizing the disposal of plastic waste is the eco-friendly technique. The use of modified bitumen with the addition of processed plastic of about 12 % by weight of bitumen helps in substantially improving the Marshall stability, strength,Fatigue life and other desirable properties of bituminous concrete mix, resulting which improves the longevity and pavement performance with marginal saving in bitumen usage. The waste plastic bitumen mix forms better material for pavement construction as theMix shows higher Marshall Stability value and suitable Marshall Coefficient.The use of waste
plastics for pavement is one of the best methods for easy disposal of waste plastics.There is small decrease in the specific gravity values with the increase of plastic content in the aggregates. This helps to have better binding of bitumen with the plastic-waste coated aggregate due to increased bonding and increased area of contact between plastic-waste and bitumen.The plastic-waste coating also reduces the voids. This prevents the moisture absorption and oxidation of bitumen by entrapped air. This has resulted in reduced rutting, raveling.and there is not pothole formation.On the basis of the experimental results obtained, it is found that mixes prepared with biomedical plastic waste has shown better properties compared to the conventional bituminous mixes.Los Angeles abrasion value of plastic coated aggregates was found to reduce by 4 percent indicating that these aggregates have superior abrasion resistance compared to normal aggregates.

The use of waste plastics on the road has helped to provide better place for burying the plastic waste without causing disposal problem. At the same time, a better road is also Constructed

REFERENCES

1. Poweth, M, J., George, S., Paul, J., (2013) "Study On Use Of Plastic Waste In Road Construction", International Journal Of Innovative Research In Science, Engineering And Technology, ISSN 2319-8753 Vol. 2, Issue 3, PP 633 -638

2. Ojha, D. Kumar, D., (2014) "A Proposed Design Of Flexible Pavement Using Waste Plastic", International Journal Of Engineering And Management Research, ISSN No. 2250-0758. Volume-4, Issue-5, PP 21-26.

3. Sutar, A, S., Wasare, S, D., (2014) "Experimental Investigation On Use Of Low Density Polyethylene (LDPE) In Bituminous Road Construction", Journal Of Information, Knowledge And Research In Civil Engineering ISSN: 0975-6744. Volume 3, Issue 2, PP 183-190

4. Shedame, P. P., Pitale, N, H, (2014) "Experimental Study Of Bituminous Concrete Containing Plastic Waste Material", Journal Of Mechanical And Civil Engineering E-ISSN: 2278-1684.P-ISSN: 2320- 334X, Volume 11, Issue 3 PP 37-45.

5. Vamshi A. (2013) "Use Of Waste Plastic In Construction Of Bituminous Road",International Journal Of Innovative Research In Science, Engineering ISSN: 23250224 123 Vol. 2, PP 2205-2208,

6. Rokdey, S, H. (2015) "Use of Plastic Waste in Road Construction" International Journal of Computer Applications ISSN 0975-888, Volume 8, Issue 5 PP 129-135

7. Sahu, A, K., (2016) "Application of Waste Plastic Materials in Road Construction" SNC-ESR International Journal of Engineering and Management Research, ISSN No.: 1250-1720. Volume-8, Issue-4, PP 121-12

8 Chavan, A, J. (2013) "Use Of Plastic Waste In Flexible Pavements", Journal of Mechanical And Civil Engineering ISSN 2319-4847, Volume 2, Issue 4 PP 85-102

9. Sharma, H, K,. (2015) "Utilization of Waste Plastic in Construction of Pavement" International Journal of Engineering and Management ISSN: 2348-6406 Volume 12, Issue 16 PP 800-806.

10. Menaria, Y, (2015) "Use of Waste Plastic in Flexible Pavements-Green Roads" Open Journal of Civil Engineering, ISSN 299-311, Volume 4, Issue 7 PP 105-109