Use of Waste Plastic Material in Bituminous Concrete Mixes

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Abstract— The quantum of plastic waste in 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 become a serious problem globally due to their non-biodegradability and unacceptable view. Since these are not disposed scientifically & possibility to create ground soil-pollution and water-pollution. This waste plastic partially replaced the conventional material to improve desired mechanical characteristics& suitability for particular road mix. In the present paper developed techniques to use plastic waste for construction purpose of roads and flexible pavements has reviewed. In conventional road making process bitumen is used as binder for mixes. Such bitumen can be modified with waste plastic pieces and bitumen mix is made which can be used as a top layer coating of flexible pavement. This waste plastic modified bitumen mix show better binding property, stability, density, adheshive property and more resistant to water.

Keywords: Plastic Wastes, Non-Biodegradability, Mechanical Properties, Bitumen Mix

I. INTRODUCTION

The threat of disposal of plastic will not solve until the practical steps are not initiated at the ground level. It is possible to improve the performance of bituminous mixed used in the surface course of roads. Study reports in the used of re-cycled plastic, mainly polyethylene, in the manufacture of blended indicated reduced permanent deformation in the form of rutting and reduced low – temperature cracking of the pavement surfacing. The field tests withstand the stress and proved that plastic wastes used after proper processing as an additive would enhance the life of the roads and also solve environmental problems and issues regarding pollution little bit. Plastic is a very versatile material. Due to the industrial revolution ,and its large scale production of plastic seemed to be a cheaper and more effective raw material today, every vital sector of the economy starting from agriculture to packaging, automobile, electronics, electrical, building construction, communication sectors has been drastically revolutionized by the applications of plastics. Plastic is a non-biodegradable material and researchers are found that the material can remain on earth for approximately 4500 years without degradation. Several studies have proven the health hazard caused by improper disposal of plastic waste. The health hazard includes reproductive problems in human and animal, genetical abnormalities etc., Looking forward the scenario of present generation a complete ban on the use of plastic cannot be hold, although the waste plastic taking the face of evil for the present and future generation. . We cannot ban use of plastic but we can reuse the plastic waste.

II. IMPORTANCE OF STUDY

Utilization of waste recycled packaging plastics having great importance, particularly for bitumen conservation and for bitumen modification to find its utility in bituminous mixes for laying flexible pavements and surface coating. Utilization of waste recycled packaging plastics is of great importance, particularly for bitumen conservation and for bitumen modification to find its utility in bituminous mixes for laying flexible pavements.

SPECIFIC GRAVITY	0.92
SOFTENING POINT	58.22 C
YOUNG MODULUS	104.50 MPa
STRAIN AT BREAK	1372%
STRAIN AT PEAK	1286.4%
DISPLACEMENT AT BREAK	149.14mm
DISPLACEMENT AT PEAK	134.18mm
LOAD AT PEAK	0.0162KN

Table 1: Physical Properties of Waste Plastic

III. MATERIAL SELECTION

A. *Selected Waste Plastic*

Now a days in India it is most common to see these polyethylene (here in after referred as "Polythene") materials used for packaging of drinking water in small pouches. The materials used for the purpose of this research were Waste Plastic, Bitumen (VG 10), and Aggregates. Waste plastic materials were collected from the canteens of residential hostels. The collected waste plastics were sorted, de-dusted, washed when necessary and sun-dried for few days until all the samples were dry. The dried samples of the waste plastic materials were shredded into sizes between 0.6mm to 2.36mm in the shredding machine to enhance its surface area of contact with the bitumen during mixing.Normally, polymer use in bituminous concrete could be in form of aggregate or binder modifier. The modified bitumen was ready by heating bitumen with shredded plastic materials of sizes between 0.6mm to 2.36mm. Five proportion of plastic content (1.0, 2.0,3.0, 4.0 and 5%) were considered.

B. *Selected Bitumin Grade*

The selected bitumen penetration grade for this study was 60/70 usually used as a Paving Grade Bitumen suitable for construction of flexible pavements with superior properties.

C. *Aggregates and Mineral Fillers*

Aggregates constitutes the granular part in bituminous concrete mixtures which contributes up to 90–95% of the mixture weight and contributes to most of the load bearing & strength characteristics of the mixture. Hence, the quality and physical properties of the aggregates should be controlled to ensure a good pavement texture. The aggregates of different grades were sieved through different IS Sieves and they were

kept inside different containers with proper marking. Aggregates used for mix were of two types: Coarse Aggregate and Fine Aggregate. mineral fillers may be cement or fly ash.

IV. SAMPLE PREPARATION

A. Waste Polythene-Bitumin Blend

The collected polythene wastes were washed, cleaned and dried. The polythenes were then shredded into very tiny and small pieces. The required quantities of polythene to be added with specified amount of bitumen for preparation of different percentage of polyethylene-bitumen blend were weighted and added in required percentage by weight of bitumen to the hot bitumen and the mixture was stirred well for about 30 minutes under temperature around of 170- 180°C.

B. Marshal Mould

The aggregates of different grades were sieved through different IS Sieves and they were kept inside different containers with proper marking. The mixing of materials required for moulds preparation was done as: Required quantities of coarse aggregates, fine aggregates & mineral fillers were collected in an iron pan. This was kept in an oven at temperature 160 °C for 2 hours. This is because the aggregate and prepared blends are to be mixed in heated state so preheating is required. The prepared blend was also heated up to its melting point prior to the mixing .The Aggregates in the pan kept in oven were taken and heated on a controlled gas heating for a few minutes maintaining the temperature. Now blend (60 gm.), i.e. 5% was added to this mix and the whole mixers was mixed uniformly and homogenously. This was continued for 15-20 minutes till they were properly mixed. Then the mix was transferred to the Marshall sampling mould. The mix in the mould was then compacted by the Marshall Hammer.75 numbers of blows were given on each side of the sample so a subtotal of 150 no. of blows was given per sample. Then these samples with moulds were kept separately and marked accordingly to the percentage of polythene added by weight of bitumen.

V. PHYSICAL VALUES OF POLYETHENE MODIFIED BITUMIN

The values for physical properties of Polythene Modified Bitumen tested through experiment are given in table 2 Below:

properties	(P0) PLASTIC 0%	(P1)PLASTIC 1%	(P2)PLASTIC 2%	(P3)PLASTIC 3%	(P4)PLASTIC 4%	(P5)PLASTIC 5%
Softening point(c)	47.50	50	51.4	53	55	55.90
Penetration value(mm)	65	55	50	48.50	46	44
Ductility(cm)	100	100	90	85	78	56
Flashpoint & firepoint(C)	>280	>350	>350	>350	>350	>350

Table 2: Physical Properties of Modified Blend

VI. MARSHAL STABILITY & MARSHAL FLOW VALUE

The effect of polyethylene admixture on the volumetric properties of both modified and conventional bituminous mixes are shown.

SAMPLE	MARSHAL STABILITY VALUE(KN)	MARSHAL FLOW VALUE(mm)
P0	14.3	2.31
P1	14.2	2.28
P2	14.4	2.25
P3	15.2	2.22
P4	17.6	2.20
P5	15.3	2.17

Table 3:

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