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Preparation of Plastic Road using Single Used Waste Plastic

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Abstract -_Plastics are the non-biodegradable materials and means to degrade our environment. The waste plastic and its disposal is a major threat to the environment, which results in pollution and global warming. The utilization of plastic waste in bituminous mixes enhances its properties and also its strength. In addition, it will also be a solution to plastic disposal & various defects in pavement i.e., pot holes, corrugation, ruts, etc. the waste plastic used are poly-ethylene, poly-styrene, poly-propylene. There are two processes available for the mixing of plastic in bituminous mix such as wet process and dry process. The waste plastic is shredded & coated over aggregate & mixed with hot bitumen and resulted mix is used for pavement construction is known as the dry process. But in wet process waste plastic is ground and made into shredded form; various percentage of plastic is mixed with the bitumen and study the durability of the roads laid out with shredded plastic waste is much more compared with roads with asphalt with the ordinary mix which is the objective of the present study. The use of the innovative technology not only strengthened the road construction but also increased the road life as well as will help to improve the environment and also creating a source of income. It's economical and eco-friendly. In this project, we have discussed about the bitumen with plastic properties to be considered in design of pavement, pavement design, and process of construction flexible pavement.

Keywords: plastic waste, flexible pavement, strength, eradication of pot holes.

1.1 INTRODUCTION

India generates 1,88,000 tons of garbage every day. Plastic Waste in different forms is found to be almost 9% to 12% in municipal solid waste, which is toxic in nature. It is a common sight in both urban and rural areas to find empty plastic bags and other type of plastic packing material littering the roads as well as drains. Due to poor biodegradability, it creates stagnation of water and associated hygiene problems.

In order to contain this problem, experiments have been carried out to know whether this waste plastic can be reused productively. The experimentation at several institutes, private organisations indicate that the waste plastic, when added to hot aggregate bituminous mix will form a fine coat of plastic over the aggregate and such aggregate, when mixed with the binder is found to give higher strength to the road, higher resistance to the water and better performance of the road over a period of time.

Waste plastic such as carry bags, disposable cups and laminated pouches like chips, pan masala, aluminium foil and packaging material used for biscuits, chocolates, milk and grocery items can be used for surfacing roads.

A material that contains one or more organic polymers of large molecular weight, solid in its finished state and at some state while manufacturing or processing into finished articles, can be shaped by its flow, is called as 'Plastic'. Plastics are durable and degrade very slowly; the chemical bonds that make plastic so durable make it equally resistant to natural processes of degradation.

Plastics can be divided in to two major categories: thermoses and thermoplastics. A thermoset solidifies or "sets" irreversibly when heated. They are useful for their durability and strength, and are therefore used primarily in automobiles and construction applications. These plastics are polyethylene, polypropylene, polyamide, polyoxymethylene, polytetrafluorethylene, and polyethylene terephthalate.

A thermoplastic softens when exposed to heat and returns to original condition at room temperature. Thermoplastics can easily be shaped and moulded into products such as milk jugs, floor coverings, credit cards, and carpet fibres. These plastic types are known as phenolic, melamine, unsaturated polyester, epoxy resin, silicone, and polyurethane.

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According to recent studies, plastics can stay unchanged for as long as 4500 years on earth with increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household.

Plastic in different forms is found to be almost 5% in municipal solid waste, which is toxic in nature. It is a common sight in both urban and rural areas to find empty plastic bags and other type of plastic packing material littering the roads as well as drains. Due to its biodegradability, it creates stagnation of water and associated hygiene problems. In order to contain this problem experiments have been carried out whether this waste plastic can be reused productively.

The experimentation at several institutes indicated that the waste plastic, when added to hot aggregate will form a fine coat of plastic over the aggregate and such aggregate, when mixed with the binder is found to give higher strength, higher resistance to water and better performance over a period of time.

Waste plastic such as carry bags, disposable cups and laminated pouches like chips, pan masala, aluminium foil and packaging material used for biscuits, chocolates, milk and grocery items can be used for surfacing roads.

The disposal of waste plastic has become a serious problem globally due to their non-biodegradability. Plastic roads mainly use plastic carry-bags, disposable cups and PET bottlesthat are collected from garbage dumps as an important ingredient of the construction material.

When mixed with hot bitumen, plastic melt to form an oil coat over the aggregate and the mixture is laid on the road surface like a normal bitumen road.

Use of plastic along with the bitumen in construction of roads not only increases its life and smoothness but also makes it economically sound and environment friendly. Plastic waste is used as modifier of bitumen to improve some of bitumen properties Roads that are constructed using plastic waste are known as Plastic Roads and are found to perform better compared to those constructed with conventional bitumen.

Data on plastic consumption and generation of plastic waste

A material that contains one or more organic polymers of large molecular weight, solid in its finish state and at some state while manufacturing or processing into finished articles, can be shaped by its flow is termed as plastics. The plastic constitutes two major categories of plastics: (i) Thermoplastics and (ii) Thermoset plastics. The thermoplastics, constitutes 80% and thermoset constitutes approximately 20% of total postconsumer plastics waste generated. The following table describes the average municipal solid waste production from 0.21 to 0.50 Kg per capita per day in India.

Population range (Millions)	Average per capita value
0.1-0.5	**0.21**
0.5-1.0	**0.25**
1.0-2.0	**0.27**
2.0-5.0	**0.35**
>5	**0.50**

Table-1

Plastic consumption in India

Year	consumption (Tones)
1996	61,000
2001	4,00,000

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2006	7,00,000
2011	13500000

Table-2

Population growth and Impact on overall waste Generation and Future Predictions until 20041:

year	Population (Millions)	Per Capita	Total Waste generation Thousand Tones/Years
2001	197.3	0.439	31.63
2011	260.1	0.498	47.3
2021	342.8	0.569	71.15
2031	451.8	0.649	107.01
2036	518.6	0.693	131.24
2041	595.4	0.741	160.96

Table-3

1.2 WHY USE OF PLASTIC

i. Disposal of waste plastic is a major problem.

ii. It is non-biodegradable.

iii. Burning of these waste plastic bags causes environmental pollution.

iv. It mainly consists of low-density polyethylene.

v. To find its utility in bituminous mixes for road construction

vi. Laboratory performance studies were conducted on bituminous mixes,studies proved that waste plastic enhances the property of the mix.

vii. Improvement in properties of bituminous mix provides the solution for disposal in an useful way.

viii. Durable & corrosion resistant.

ix. Good insulation for cold, heat & sound saving energy and reducing noise pollution.

x. It is economical and has a longer life.

xi. Maintenance free.

xii. Hygienic & problems.

xiii. Edge of processing/ installation.

xiv. Light weight.

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Fig-1

1.3 NEED OF STUDY

I. Disposal of waste plastic is a major problem.
II. It is non-biodegradable.
III. It mainly consists of low-density polyethylene
IV. To find its utility in bituminous mixes for road construction.
V. Burning of these waste plastic bags causes environmental pollution.
VI. Laboratory performance studies were conducted on bituminous mixes.
VII. Studies proved that waste plastic enhances the property of the mix.
VIII. Improvement in properties of bituminous mix provides the solution for disposal in an useful way.
IX. Plastic is durable and provides protection from contaminants and the elements. It reduces food waste by preserving food and increasing its shelf life. It protects food against pests, microbes and humidity. Without this protection, food is more likely to get damaged and become unusable.

Fig-2

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1.4. WASTE PLASTIC

Plastic products have become an integral part of our daily life as a result of which the polymer is produced at a massive scale worldwide. On an average, production of plastic globally crosses 150 million tonnes per year. Its broad range of application is in packaging films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household and industrial products, and building materials.

It is estimated that approximately 70% of plastic packaging products are converted into plastic waste in a short span. Approximately 9.4 million TPA plastic waste is generated in the country, which amounts to 26,000 TPD2 . Of this, about 60% is recycled, most of it by the informal sector. While the recycling rate in India is considerably higher than the global average of 20%3 there is still over 9,400 tonnes of plastic waste which is either landfilled or ends up polluting streams or groundwater resources. While some kinds of plastic do not decompose at all, others could take up to 450 years to break down. The figure captures per capita plastic consumption in FY 2014-15.

Plastics are not inherently bad, and they have many redeeming ecological features. Many of the techniques we utilize in our designs involve targeted use of plastic products. Their durability and low maintenance reduce material replacement, their light weight reduces shipping energy, their formulation into glue products allows for the creation of engineered lumber and sheet products from recycled wood, and their formulation into superior insulation and sealant products improves the energy performance of our structures.

The recycling of a virgin plastic material can be done 2-3 times only, because after every recycling, the plastic material deteriorates due to thermal pressure and its life span is reduced. Hence recycling is not a safe and permanent solution for plastic waste disposal.

2.1. MATERIALS USED

2.1.1. AGGREGATE

The aggregates are bound together either by bituminous materials or by cement. In a few cases, the rock dust itself when mixed with water forms slurry which acts as a binding medium.

The aggregates may be classified into natural and artificial aggregates. The naturalaggregates again are classified as coarse aggregates consisting of crushed rock aggregates or gravels and fine aggregates or sand.

The blast furnace slag obtained as by-product from blast furnaces is the one extensively used as road construction material. Stone aggregate used for road work should be hard, tough, durable and hydrophobic for bituminous surface.

Gravel should he well graded (6.4mm to 38mm) and should have at fineness modulus of not less than 5.75. Sand should be sharp, well graded, clean of all silts, clay and organic matter.

The quantity of aggregates used in first coat of surface dressing should be 0.15 m3 per 10m2 area of 12mm nominal size. On the other hand, the quantity of aggregate used in second coat of surface dressing should be 0.15 m3 per 10 m2 areas and of 10mm nominal size..

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2.1.2. BITUMEN

Bitumen is used as binders in pavements constructions. Bitumen may be derived from the residue left by the refinery from naturally occurring asphalt.

As per definition given by the American Society of Testing Materials bitumen has been defined as "Mixtures of hydrocarbons of natural or pyrogenous origin, or combination of both, frequently accompanied by their non-metallic derivatives, which may be gaseous, liquid, semi-solid or solid, and which are completely soluble in carbon di-sulphide."

Bitumen found in natural state known as asphalt contains large quantities of solid mineral matter. When petroleum crude is refined in a refinery, they are separated by fractional distillation in the order of decreasing volatility.

On distillation of the residual bituminous residue, straight run bitumen is obtained. This bitumen is known as penetration grade bitumen or steam used for water proofing of structures is known as industrial grades.

The grade of straight run refined petroleum bitumen. The grades of bitumen used for pavement construction is known as paving grades and that bitumen is chosen depending upon the climatic conditions of the region in which surface.

2.1.3. WASTE PLASTIC

Plastics are durable and degrade very slowly; the chemical bonds that make plastic so durable make it equally resistant to natural processes of degradation.

Since the 1950s, one billion tons of plastic have been discarded and may persist for hundreds or even thousands of years. Perhaps the biggest environmental threat from plastic comes from nurdles, which are the raw material from which all plastics are made.

They are tiny pre-plastic pellets that kill large numbers of fish and birds that mistake them for food. Prior to the ban on the use of CFCs int extrusion of polystyrene (and general use, except in life-critical fire suppression systems; see Montreal Protocol), the production of polystyrene contributed to the depletion of the ozone layer; however, non-CFCs are currently used in the extrusion process.

Thermoplastics can be remoulded and reused, and thermoset plastics can be ground up and used as filler, although the purity of the material tends to degrade with each reuse cycle. There are methods by which plastics can be broken back down to a feedstock state.

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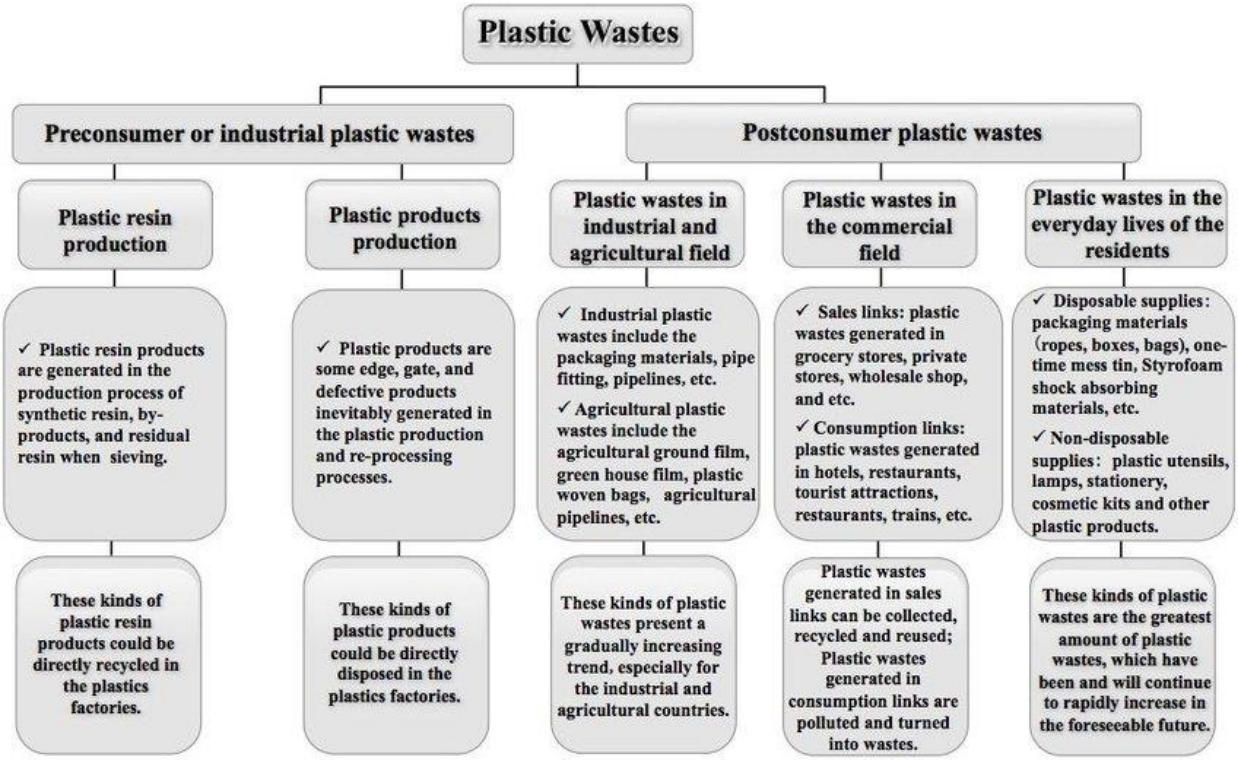

FIG-3

3.1. COLLECTION OF WASTE PLASTIC

One of the things all of us can do to protect and improve our environment is: recycling. Today a plastic bottle may contain juice or water or soda … but what can it become after you use it?
Let's take a look at some of the everyday plastics that you use and what they can become.

Milk Jugs & Other Plastic Containers:

Bottles and containers used for milk, shampoo, laundry detergent and household cleaners are lightweight and tough – but they usually are made from a different type of plastic than beverage bottles.
What can they become? When they are recycled, they can make new bottles and containers, plastic lumber, picnic tables, lawn furniture, playground equipment, recycling bins and more.

Plastic Bags and Wraps:

We use plastic bags to carry home groceries. They keep our bread and other food fresh. They even let us carry goldfish home from the pet store.
Today there are thousands of grocery and retail stores to collect these bags for recycling, including most Target, Walmart, Lowes, Safeway stores and more. And remember that at all these places, we also can recycle lots of the plastic wraps that protect the things we buy (even bubble wrap!).

Bottles:

Plastic bottles for soft drinks, juice and water are a handy way to conquer thirst …and they don't shatter if you drop them.

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What can they become? When plastic bottles are recycled, they can be made into lots of things: t-shirts, sweaters, fleece jackets, insulation for jackets and sleeping bags, carpeting and more bottles.

FIG-4

Waste plastic is collected from roads, garbage trucks, dumpsites or compost plants, or from school collection programs, or by purchase from rag-pickers or waste-buyers at Rs 5-6 per kg.

FIG-5

CLEANING AND SHREDDING OF WASTE PLASTIC:

Waste plastic litter in the form of thin-film carry-bags, use-and-throw cups, PET bottles, etc, these are sorted, de-dusted, washed if necessary.

Plastic waste which is cleaned is cut into a size between 1.18mm using shredding machine as shown below.

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Fig 7: Cleaning process

Fig 8: Shredding machine

4.3 MIXING OF SHREDDED WASTE PLASTIC, AGGREGATE AND BITUMIN IN CENTRAL MIXING PLANT:

The aggregate mix is heated to 165°c (as per the HRS specification) in central mixing plant. Similarly, the bitumen is to be heated up to a maximum of 160°c.

The 8% of waste plastic to the weight of bitumen are added in the conveyor belt or special mechanical device is developed which will spray the plastics inside the chamber to coat the plastics effectively.

Central mixing plant helps to have better control of temperature and better mixing of this material thus helping to have a uniform coating and heated bitumen is also sprayed.

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Fig 9: Central mixing plant

4.4 LAYING OF BITUMENOUS MIX:

The plastics waste coated aggregate is mixed with hot bitumen and the resulted mix is used for road construction. The road laying temperature is between 1100c to 1200c. The roller used is 8-ton capacity.

Fig.10: Paver Machine

TESTS CONDUCTED ON MATERIALS

TESTS OF AGGREGATE

- **CRUSHING TESTS**

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The **crushing value test of aggregate** provides the resistance of an aggregate sample to crushing under gradually applied compressive load. Generally, the test is conducted on aggregate passing **12.5 mm and retained on a** 10 mm sieve.

The strength of coarse aggregates is determined by the aggregates crushing test. The aggregate crushing value test provides resistance of an aggregate to crushing under a gradually applied compressive load. To construct a high quality of pavement, aggregate possessing low aggregate crushing value should be preferred.

Crushing strength of aggregate can be found by the following formula,

"Aggregate crushing value is determined by taking a percentage of weight crushed aggregate sample passing through 2.36 mm IS Sieve divided by weight of aggregate sample taken for test"

Aggregate crushing value formula is given below,

Aggregate crushing value = (W3 / W) or W3 / (W2 – W1)

W1 = Empty weight of cylindrical Measure.

W2 = Weight of Aggregate with Cylindrical Measure

W = W2 –W1 = Weight of Aggregate Sample

W3 = Weight of crushed aggregate sample passed through 2.36 mm IS Sieve.

Types of Roads / Pavements	**Aggregate Crushing Value Limit**
Flexible Pavements	
Soling	50
Water bound macadam	40
Bituminous macadam	40
Bituminous surface dressing or thin premix carpet	30
Dense mix carpet	30
Rigid Pavements	
Other than wearing course	45

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Surface or Wearing course	30

Aggregate Crushing Value=25.123%

5.1 IMPACT VALUE TEST OF AGGREGATE

The aggregate impact test is carried out to evaluate the resistance to impact of aggregates. Aggregates passing 20 mm sieve and retained on 12.5 mm sieve is filled in a cylindrical steel cup of internal die 10.2 mm and depth 5 cm which is attached to a metal base of testing machine.

The material is filled in 3 layers where each layer is tamped for 25 number of blows. Metal hammer of weight 13.5 to 14 Kg is arranged to drop with a free fall of 38.0 cm by vertical guides and the test specimen is subjected to 15 number of blows. The crushed aggregate is allowed to pass through 2,36 mm IS sieve. And the impact value is measured as percentage of aggregates passing sieve (W1) to the total weight of the sample (W1).

Aggregate impact value = W1/W2*100

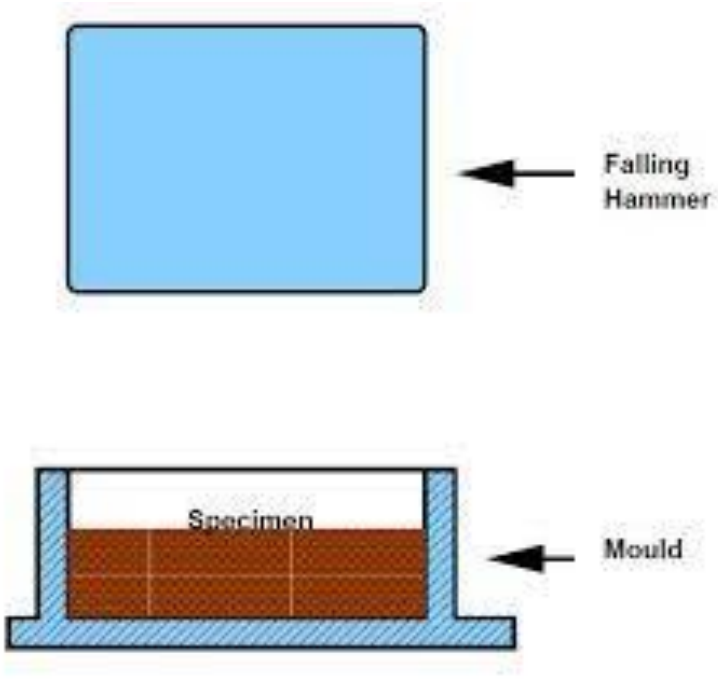

Fig 11: Impact test setup

Aggregates to be used for wearing course, the impact value shouldn't exceed 30 percent. For bituminous macadam the maximum permissible value is 35 percent. For Water bound macadam base courses the maximum permissible value defined by IRC is 40 percent.

Aggregate used: Passed through 20mm sieve and retained on 12.5mm sieve

IMPACT TEST VALUE: -21.83%

5.2 LOS ANGELES ABRASION TEST OF AGGREGATE

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Abrasion test is carried out to test the hardness property of aggregates and to decide whether they are suitable for different pavement construction works. Los Angeles abrasion test is a preferred one for carrying out the hardness property and has been standardized in India (IS:2386 part-IV).

The principle of Los Angeles abrasion test is to find the percentage wear due to relative rubbing action between the aggregate and steel balls used as abrasive charge. Los Angeles machine consists of circular drum of internal diameter 700 mm and length 520 mm mounted on horizontal axis enabling it to be rotated

An abrasive charge consisting of cast iron spherical balls of 48 mm diameters and weight 340-445 g is placed in the cylinder along with the aggregates. The number of the abrasive spheres varies according to the grading of the sample. The quantity of aggregates to be used depends upon the gradation and

usually ranges from 5-10 kg. The cylinder is then locked and rotated at the speed of 30-33 rpm for a total of 500-1000 revolutions depending upon the gradation of aggregates. After specified revolutions, the material is sieved through 1.7 mm sieve and passed fraction is expressed as percentage total weight of the sample. This value is called Los Angeles abrasion value.

A maximum value of 40 percent is allowed for WBM base course in Indian conditions. For bituminous concrete, a maximum value of 35 is specified.

Description	Sample	
	1	2
Weight of dry sample(gm) 'A'	536	560
Weight of sample retained on 2.36mm sieve 'B'	102	106
Impact value (B/A*100)	19%	18.9%

TABLE

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Abrasion test value =34.44%

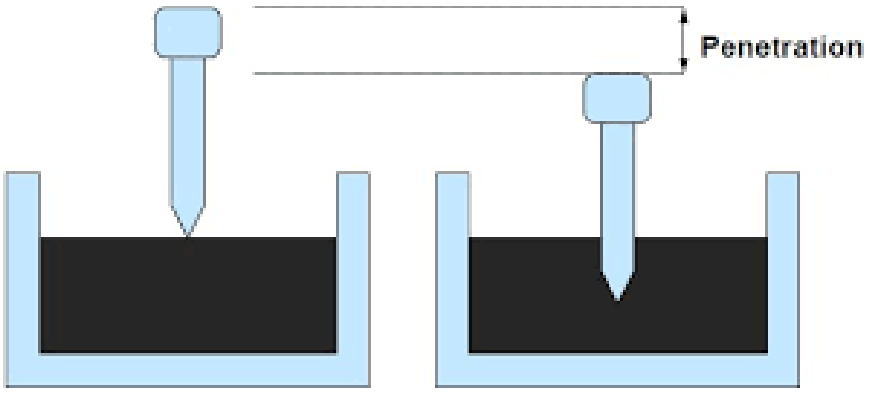
TEST OF BITUMEN

PENETRATION TEST

It measures the hardness or softness of bitumen by measuring the depth in tenths of a millimetre to which a standard loaded needle will penetrate vertically in 5 seconds. BIS had standardised the equipment and test procedure. The penetrometer consists of a needle assembly with a total weight of 100g and a device for releasing and locking in any position.

The bitumen is softened to a pouring consistency, stirred thoroughly and poured into containers at a depth at least 15 mm in excess of the expected penetration. The test should be conducted at a specified temperature of 25° C. It may be noted that penetration value is largely influenced by any inaccuracy with regards to pouring temperature, size of the needle.

weight placed on the needle and the test temperature. A grade of 40/50 bitumen means the penetration value is in the range 40 to 50 at standard test conditions. In hot climates, a lower penetration grade is preferred. The Figure 0.1 shows a schematic Penetration Test setup.



Actual test temperature =25c

Penetrometer dial reading	Test 1	Test 2	Test 3
(a) Initial	200	264	333
(b) Final	264	333	407
Penetration Value	64	69	74

Mean penetration value =69

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STRIPPING VALUE TEST OF BITUMEN MIX

Bitumen adheres well to all normal types of road aggregates provided they are dry and free from dust. In the absence of water there is practically no adhesion problem of bituminous construction. Adhesion problem occurs when the aggregate is wet and cold. This problem can be dealt with by removing moisture from the aggregate by drying and increasing the mixing temperature. Further, the presence of water causes stripping of binder from the coated aggregates. This problems occur when bitumen mixture is permeable to water. Several laboratory tests are conducted to arbitrarily determine the adhesion of bitumen binder to an aggregate in the presence of water. Static immersion test is one specified by IRC and is quite simple. The principle of the test is by immersing aggregate fully coated with binder in water maintained at 40°C temperature for 24 hours. IRC has specified maximum stripping value of aggregates should not exceed 5%.

Type of aggregate	Time	Stripping%
Plain Bitumen Coated Aggregate	24hr	5%
Polymer coated aggregate	72hr	Nil

5.6 MARSHALL TEST

Marshal test is extensively used in routine test programs for the paving jobs. The stability of the mix is defined as a maximum load carried by a compacted specimen at a standard test temperature of 600 °C. The flow is measured as the deformation in units of 0.25 mm between no load and maximum load carried by the specimen during stability test (flow value may also be measured by deformation units of 0.1 mm). This test attempts to get the optimum binder content for the aggregate mix type and traffic intensity. This is the test which helps us to draw Marshall Stability vs. % bitumen.

The sample needed is From Marshall stability graph, select proportions of coarse aggregates, fine aggregates and filler in such a way, so as to fulfill the required specification. The total weight of the mix should be 1200g.

Procedure to determine Marshall Stability of bituminous mixture:

A. Heat the weighed aggregates and the bitumen separately upto 170°C and 163"

respectively.

B. Mix them thoroughly, transfer the mixed material to the compaction mould arranged on the compaction pedestal.
C. Give 75 blows on the top side of the specimen mix with a standard hammer (45cm, 4.86kg). Reverse the specimen and give 75 blows again. Take the mould with the specimen and cool it for a few minutes.
D. Remove the specimen from the mould by gentle pushing. Mark the specimen and cure it at room temperature, overnight.
E. A series of specimens are prepared by a similar method with varying quantities of bitumen content, with an increment of 0.5% (3 specimens) or 1 bitumen content.
F. Before testing of the mould, keep the mould in the water bath having a temperature of 60°C for half an hour.
G. Check the stability of the mould on the Marshall stability apparatus.

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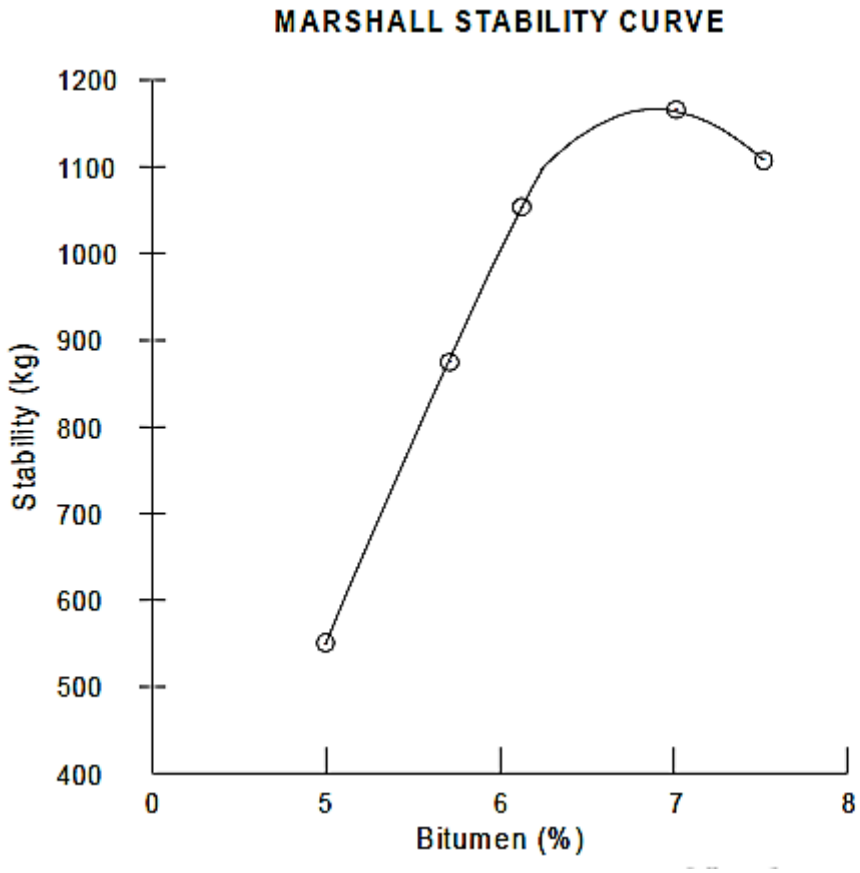

METHODOLOGY

Waste plastic bags were collected from roads, garbage trucks, dumpsites and compost plants, waste-buyers at Rs.5-6 per kg. Household plastic was also collected for the project work. like empty milk bags, used plastic bags etc. The collected Plastic waste was sorted as per the required thickness. Generally, polyethylene of 60 micron or below is used for the further process Less micron plastic is easily mixable in the bitumen at higher temperature (160 c 170°c).It is clean by de-dusting or washing if required. Collected Plastic was cut into fine pieces as far as possible. The plastic pieces were sieved through 4.75mm sieve and retaining at 2.36mm sieve was collected. Firstly, Bitumen was heated up to the temperature about 160-170°c which is its melting temp. Pieces were added slowly to the hot hitumen of temperature around 160-170°c. The mixture was stirred manually for about 20-30 minutes. In that time period temperature was kept constant about 160-170°c. Polymer bitumen mixtures of different compositions were prepared and used for carrying out tests i.e. Penetration test, Ductility test..

FIELD TRIALS

There are two types of field trials

1. Dry Process

2. Wet Process

6.1 DRY PROCESS-:

For the flexible pavement, hot stone aggregate (170) is mixed with hot bitumen (160° C) and the mix is used for road laying. The aggregate is chosen on the basis of its strength. porosity and moisture absorption capacity as per IS coding. The bitumen is chosen on the basis of its binding property, penetration value and viscoelastic property. The aggregate. when coated with plastics improved its quality with respect to voids, moisture absorption and soundness. The coating of plastic decreases the porosity and helps to improve the quality of the aggregate and its performance in the flexible pavement. It is to be noted here that stones with 2% porosity only allowed by the specification.

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- Plastic waste like bags, bottles, etc are cut into size between 2.36mm and 4.75mm using shredding machine.
- The aggregate mix is heated to 170' and then it is transferred to mixing chamber.
- Similarly the bitumen is to be heated up to a maximum of 160°.
- At the mixing chamber, the shredded plastics waste is added over the hot aggregate.
- The plastics waste coated aggregate is mixed with hot bitumen.

Advantages of Dry Process:

1. Plastic is coated over stones - improving surface property of aggregates.
2. Coating is easy & temperature required is same as road laying temp.
3. Use of waste plastic more than 15% is possible.
4. Flexible films of all types of plastics can be used.
5. Doubles the binding property of aggregates.
6. No new equipment is required. g. Bitumen bonding is strong than normal.
7. The coated aggregates show increased strength.
8. As replacing bitumen to 15% higher cost efficiency is possible.
9. No degradation of roads even after 5-6 yrs after construction. k. Can be practiced in all type of climatic conditions.
10. No evolution of any toxic gases as maximum temperature is 180º C.

Disadvantages of Dry Process

1. The process is applicable to plastic waste material only.

6.2 WET PROCESS-:

Waste plastic is ground and made into powder: 6 to 8% plastic is mixed with the bitumen. Plastic increases the melting point of the bitumen and makes the road retain its flexibility during winters resulting in its long life. Use of shredded plastic waste acts as a strong "hinding agent" for tar making the asphalt last long. By mixing plastic with bitumen the ability of the bitumen to withstand high temperature increases. The plastic waste is melted and mixed with bitumen in a particular ratio. Normally, blending takes place when temperature reaches 45.5° C but when plastic is mixed, it remains stable even at 55° C. The vigorous tests at the laboratory level proved that the bituminous concrete mixes prepared.

using the treated bitumen binder fulfilled all the specified Marshall mix design criteria for surface course of road pavement. There was a substantial increase in Marshall Stability value of the mix, of the order of two to three times higher value in comparison with the untreated or ordinary bitumen. Another important observation was that the bituminous mixes prepared using the treated binder could withstand adverse soaking conditions under water for longer duration.

- Waste plastics by direct mixing with hot bitumen at 160°C.
- Mechanical stirrer is needed.
- Addition of stabilizers and proper cooling.
- Since the wet process require a lot of investment and bigger plants.
- Not commonly used.

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ADVANTAGES OF WET PROCESS

I. This Process can be utilized for recycling of any type, size, shape of waste material (Plastics, Rubber etc.)

DISADVANTAGES OF WET PROCESS

a.Time consuming- more energy for blending.

b. Powerful mechanical is required.

c. Additional cooling is required as improper addition of bitumen may cause air pockets in roads.

d. Maximum % of waste plastic can be added around 8%.

Comparison between ordinary bituminous roads and waste plastic bituminous roads

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S.N	properties	Bituminous Roads	
		With Plastic	Without Plastic
1	Marshal stability value	More	Less
2	Softening point	Less	More
3	Penetrating value	More	Less
4	Tensile strength	High	Low
5	Tensile strength	Better	Good
6	Stripping(potholes)	No	More
7	Seepage water	No	Yes
8	Durability of roads	Better	Good
9	Cost of pavements	Less	Normal
10	Maintenance cost	Almost nil	More
11	Rutting	Low	More
12	Eco-friendly	Yes	No

ADVANTAGE OF PLASTIC ROAD :

- Stronger road with increased Marshall Stability Value.
- Better resistance towards rain water and water stagnation.
- No stripping and no potholes.
- Increase binding and better bonding of the mix.
- Reduction in pores aggregate and hence less rutting and raveling.
- No effect of radiation like UV.
- The strength of the road is increased by 100%.
- The load withstanding property increases. It helps to satisfy today's need of increased road transport.
- For 1km X 3.75m road. I ton of plastic (10 lakh carry bags) is used and 1 ton of bitumen is saved.
- Value addition to the waste plastics (cost per kilogram increases from Rs 4 to Rs12).
- The cost of road construction also decreased.
- The maintenance cost of road is almost nil.
- Disposal of waste plastic will no longer be a problem.
- The use of waste plastics on the road has helped to provide better place for burying the plastic waste without causing disposal problem.

DISADVANTAGES OF PLASTIC ROADS :

- Cleaning process- Toxics present in the co-mingled plastic waste would start leaching.
- During the road laying process in the presence of chlorine will release noxious HCI gas.
- After the road laying. It is opined that the first rain will trigger leaching. As the plastics will merely form a sticky layer, (mechanical abrasion).
- The components of the road, once it has been laid, are not inert.

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CASE STUDIES IN INDIA

Laboratory studies were carried out at the Centre for Transportation Engineering of Bangalore University, in which the plastic was used as an additive with heated bitumen n different proportions (ranging from zero to 12% by weight of bitumen) The results of the laboratory investigations indicated that, the addition of processed plastic of about 8,8% by weight of bitumen, helps in substantially improving the stability, strength, fatigue life and other desirable properties of bituminous concrete mix, even under adverse water-logging conditions. The additions of 8.0% by weight of processed plastic for the preparation of modified bitumen results in a saving of 0.4% bitumen by weight of the mix or about 9.6% bitumen per cubic meter of BC mix. In Tamil Nadu, length of roads around 1000 m in various stretches were constructed usingwaste plastic as an additive in bituminous mix under the scheme "1000 Km Plastic Tar Road", and found that, the performance of all the road stretches are satisfactory. The construction of rods using waste plastic in the above states is based on the guidelines developed by Bangalore University. CRRI and College of Engineering. Madurai, However, standard specifications are not available on the use of waste plastic in Bituminous Road Construction.

CONCLUSION

The generation of waste plastics is increasing day by day. The major polymers namely polyethylene, polypropylene, polystyrene show adhesion property in their molten state Plastics will increase the melting point of the bitumen.

The waste plastic bitumen mix forms better material for pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for pavement is one of the best methods for easy disposal of waste plastics.

The use of the innovative technology not only strengthened the road construction but alsoincreased the road life as well as will help to improve the environment and also creating asource of income.

roads would be a boon for India's hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with big potholes. It is hoped that in near future we will have strong. durable and eco friendly roads which will relieve the earth from all type of plastic-waste.

REFERENCES

[1] USE OF PLASTIC WASTE IN FLEXIBLE PAVEMENTS, Miss Apurva J Chavan, Volume 2, Issue 4, April 2013. Use of Plastic Waste in Road Construction, Shweta N. Rokdey, Sevagram P. L. Naktode,
[2] Sevagram M. R. Nikhan PLASTIC WASTE: IT'S USE IN CONSTRUCTION OF ROADS. Kurmadasu
[3] Chandramouli, AllipilliSaty aveni, Vol. No. 5, Issue 01, Feb