



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 4, April 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512



9940 572 462



6381 907 438



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Patching Work using Plastic Waste

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ABSTRACT: Wrappers of betel nuts, chocolates, chips, hand bags, cold drink bottle and all other forms of plastic create significant environment and economic problem. They consume massive energy and other natural resources, depleting the environment in various ways. In manufacturing firms, construction industries and product delivery services, use of plastic is a priority to handle and pack things comfortably due to its light weight, cost effectiveness and strength. plastics cannot be banned as it will result in usage if natural resources like paper, wood at a great extent. It is made up of various chemical elements and is regarded as a highly pestilent material which does not easily degrade in the natural environment after its usage waste plastics are made up of Polyethylene, Polystyrene and Polypropylene. Temperature varying between 120 °C -160°C gives the softening point of these plastics. they do not produce any toxic gases during heating but the softened plastics have tendency to form a lamination or coating over the aggregate, when it is sprayed over the hot aggregate at 160°C. The main objective of this paper is to discuss the air voids with plastic and binds with aggregate to provide stability.

KEYWORDS: Municipal plastic waste, Aggregates, shredded plastic, stripping, Marshall, stability, Optimum Bitumen Content, Flexible pavement

1. INTRODUCTION

Today in this accelerated world 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 alternative material 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.

1.1 Why use of plastic

Polymers have number of vital properties which exploited alone all together make a significant and expanding contribution to construction needs

1. Durable the corroding needs
2. Good insulation for cold, heat and sound saving energy
3. It is economical and has a longer life.
4. Maintenance free
5. Hygienic and problem
6. Ease of processing
7. Light weight

Problem Statement

Our main problem is excessive plastic in our environment for which we are trying to give various techniques rather than our project to hell the mankind we have discussed it in next coming portion. Debate on the use and abuse of plastics vis-à-vis environmental protection can go on, without yielding results until practical steps are initiated at the grassroots level by everyone who is in a position to do something about it. The plastic wastes could be used after proper processing as AB additive would enhance the life of the roads and also solve environmental problems. The present

write-up highlights the developments in using plastics waste to make plastic roads.

The rapid rate of urbanization and development has led to increasing plastic waste generation. As plastic is non-biodegradable in nature, it remains in environment for several years and disposing plastic wastes at landfill are unsafe since toxic chemicals leach out into the soil, and under-ground water and pollute the water bodies. Due to littering habits, inadequate waste management system / infrastructure, plastic waste disposal continues to be a minor problem for the civic authorities, especially in the urban areas.

II. LITERATURE SURVEY

Prof. C.E.G. Justo States that addition of 8.0% by weight of processed plastic for the preparation of modified bitumen results in weaving of 0.4% bitumen by weight of the mix or about 9.6 kg bitumen per cubic meter (m^3) of BC mix. Modified Bitumen improves the stability or strength life and other desirable properties of bituminous concrete mix. **DR. R. Vasudevan** states that the polymer bitumen blend is a better binder compared to plain bitumen. Blend has increased softening point and decreased penetration value with suitable ductility. When it is used for road construction, it can withstand higher temperature and load. The polymer coated aggregate bitumen mix forms better material for flexible pavement construction as the mix shows higher Marshall stability value and suitable Marshall for easy disposal of waste plastics. Use of plastic bags in road help in many ways like easy disposal of waste, better road and prevention of pollution and so on.

According to **V.S. Punish (2001)**, some encouraging results were reported in the study that there is possibility to improve the performance of bituminous mixes of road pavements. Waste plastics (polythene carry bags, etc.) on heating soften at around 130°C . Thermo gravimetric analysis has shown that there is no gas evolution in the temperature range of $130-180^\circ\text{C}$. Softened plastics have a binding property. Hence, it can be used as a binder for road construction.

Subdermal & Rojas (2008) studied the Effective blending technique for the use of plastic waste into bitumen for road laying and polymer-bitumen mixtures of different composition were prepared and used for carrying out various tests.

Varma S.S (2008) Concluded that those plastics will increase the melting point of the bitumen. This technology not only strengthened the road construction but also increases the road life.

Dr. R. Vasudeva and S. Aljazeera (2007) stated that the polymer bitumen blend is a better binder compared to plain bitumen. Blend has increased Softening point and decreased penetration value with a suitable ductility.

Mohr. Imtiyaz (2002) concluded that the mix prepared with modifiers shows: -Higher resistance to permanent deformation at higher temperature. **Sabina (2001)** studied the comparative permanent deformation at higher temperature. **Sabina (2001)** studied the comparative performance of properties of bituminous mixes containing plastic / polymer (pp) (8% and 15% by WT. of bitumen) with conventional bituminous concrete mix (prepared with 60/70 penetration grade bitumen). Improvement in properties like Marshall stability, retained stability, indirect tensile strength and rutting was observed in plastic modified bituminous concrete.

2.1 Case study

Plastic is everywhere in today's lifestyle. The leading problem is what to do with the plastic waste. Use of plastic waste which is non-biodegradable is quickly increasing and investigators have found that the material can remain on earth for 4500 years unchanged and without degradation. This hazard of disposal of plastic will not solve itself and confident practical steps have to be initiated at the ground level. On the other hand the road traffic is growing with time hence there rises a need to increase the load bearing capacity.

III. METHODOLOGY

Waste plastic bags were collected from roads, garbage trucks, dumpsites and compost plants rag-pickers, 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. collected plastic waste. Was sorted as per the required thinness. Collected plastic was cut into fine pieces 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°C - 170°C which is its melting temperature. Pieces were added slowly to the hot bitumen of temperature around 169°C - 170°C . The mixture was stirred manually for about 20-30 minutes. In that time period temperature was kept constant about 160°C - 170°C . Polymer-bitumen mixtures of different composition were prepared and used for carrying out tests i.e. Penetration test, Ductility test, flash point test & fire point test,

stripping test, Ring and ball test and Marshall Stability value test

1. Dry process

2. WET process

3.1 Material used and the tests conducted

The materials used for carrying out the present research are:

1. Aggregates
2. Bitumen
3. Plastic waste

3.1.1 Aggregate

People have used sand and stone for foundations for thousands of years, which used aggregate to build its vast network of road and aqueducts. The invention of concrete, hatchways essential to architecture utilizing arches, create an immediate, permanent demand for construction aggregates. In these areas, natural sandals travel are mined for use as aggregates. In these areas, natural. Sand and gravel are mined for use as aggregate. Where neither The aggregate used for road work should be hard, tough, and durable. Gravel should be well graded (6.4mm to 38mm) and should have a fineness modulus of not less than 5.75. The quantity of aggregates used in first coat of surface dressing should be 0.15 m³ per 10 m² area of 12mm nominal size, the quantity of aggregate used in second coat of surface dressing should be 0.15 m³ per 10 m² area of 10mm nominal size

The American society for Testing and Materials publishes an exhaustive listing of the specification include specific type of coarse. And fine aggregate designed for such used as additives to asphalt and construction. Concrete mixes, as well other construction. Uses.

3.1.1.1 Test Conducted On Aggregate

1. Sieve Analysis of Aggregates
2. Specific Gravity & water Absorption Test
3. Aggregate IMPAC Value Test
4. Aggregate Crushing Value

3.1.2 Bitumen

Bitumen is very well known as the binders in asphalt construction. It is one of the most important highway construction materials. The important quality of bitumen which has made bitumen a popular binding material is its excellent binding property and gets softness when heated

3.1.2.1 Test conducted on bitumen

1. Penetration test
2. Softening point
3. Ductility test
4. Flash point and fire point.

IV. RESULT AND DISCUSSION

4.1 Aggregate impact value test

4.1.1 Scope

The aggregate impact value gives a relative measure of the resistance of an aggregate to sudden shock or impact. The particular purpose which an aggregate is meant to serve requires the aggregate to have a particular strength which is usually stated in the specification. This test provides a method for measuring this strength.

4.1.2 Result

Calculate the mean of the two values determined in (a) or (b) of 7.6.6.2 to the nearest whole number. Report the mean as the aggregate impact value, unless the individual results differ by more than 0.15 times the mean value. In this case repeat the test on two further specimens, calculate the median of the four results to the nearest whole number.

4.2 Flash and fire point test

4.2.1 scope

An alternative to the penetration test for checking the consistency of bitumen is the ring and ball softening point test. The scope of this test is to provide a method for determine the consistency of semi-solid and bituminous materials in which the side or major constituent is either bitumen or the tar.

4.2.2 Standard value test

□ For Flash point: 1750

C.

□ For Fire point: 1750

C + 50

C.

The Flash and Fire point are determined to the standard values of fuels like petrol and diesel and therefore they are transported accordingly, and stored underground

4.2.3 patchwork procedure

If the construction of Road need not be done and previous Road has to be maintained using Patching Work than following steps are involved:

□ The Road Patches are counted and the volume of those patches is calculated to estimate the materials quantity required.

□ Second the materials are dumped on the site and are ordered as per requirement.

□ Plastics waste (bags, cups, thermocol) made out of PE, PP and PS cut into a size between 2.36mm and 4.75mm using shredding machine, (PVC waste should be eliminated).

□ The aggregate mix is heated to 165°C (as per the HRS specification) and transferred to mixing chamber.

□ Similarly the bitumen is to be heated up to a maximum of 160°C (HRS Specification) to have good binding and to prevent weak bonding. (Monitoring the temperature is very important).

□ 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 110°C to 120°C. The roller used is 8-ton capacity or just a rammer

4.2.3 Characteristics of procedure

□ Easy process without any new machinery

□ Simple process without any industry involvement

□ In situ process use of lesser % of bitumen and thus savings on bitumen resource Use of plastics waste for a safe and eco-friendly process

□ Both Mini Hot Mix Plant and Central Mixing Plant can be used only aggregate is polymer coated and bitumen

V. CONCLUSION

The population growth, industrialization and technological development have led to uncontrollable accumulation of waste and hence it is necessary for environmental engineers to use wastes materials effectively. Use of plastic for modifying bitumen for road construction is an idea which will save environment as well as cost of construction of road. Let us hope that in near future we will have durable and eco-friendly roads which will reduce the earth from all type of plastic waste. Plastic coating on aggregates is used for the better performance of roads. This helps to have a better binding of bitumen with plastic waste coated aggregate due to increased bonding and increased area of contact between polymers and bitumen. The polymer coating also reduces the voids. This prevents the moisture absorption and oxidation of bitumen by entrapped air. This has resulted in reducing rutting, ravelling and there is no pothole formation.

□ Aggregate Impact value of control specimen was 5.43%. It reduced to 4.91% for PP8 and 4.26% for PP10. Reduction in value was 10% for PP8 and 22% for PP10. This shows that the toughness of the aggregate was increased to face the impacts.

□ Crushing Value was reduced from 19.2% to 13.33% and 9.82% for PP8 and PP10 respectively. Value reduced by 30% for PP8 and 48% for PP10. Low aggregate crushing value indicates strong aggregates, as the crushed fraction is low.



- Specific Gravity of the aggregate increases from 2.45 for control specimen to 2.7 for PP8 and 2.85 for PP10 due to plastic coating.
- Stripping Value was reduced from 8% for control specimen to nil for PP8 and PP10. This shows that coated aggregate are more suitable for bituminous construction than plain aggregates.
- Water Absorption is also reduced to nil for PP8 and PP10 from 1.7% for control specimen.
- Los Angeles Abrasion Value of the control specimen was found to be 13.42%. Coating of polymer over aggregate for PP8 increased abrasion value by 19.97% and 29.88% for PP10. This indicates the hardness of the aggregate.

In short we can conclude that, using plastic waste in mix will help reduction in need of bitumen by around 10%, increase the strength and performance of road, avoid use of anti-stripping agent, avoid disposal of plastic waste by incineration and land filling and ultimately develop a technology, which is eco-friendly. Increased traffic conditions will and are reducing the life span of roads. Plastic roads are means of prevention and ultimately will be the cure. It will save millions of dollars in future and reduce the amount of resources used for construction. The generation of waste plastics is increasing day by day. The major polymers, namely polyethylene, polypropylene, and polystyrene show adhesion property in their molten state. Plastics will incise the melting point of the bitumen. Hence, the use of waste plastic 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 also increased the road life as well as creating a source of income. Plastic roads would be a boon for India's hot and extremely humid climate, where temperatures frequently cross 500 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 that will raise the earth from all type of

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