iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.35943

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

Utilization of Waste Plastic for Construction of Flexible Pavement

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Abstract: ***The major threat to the environment is the disposal of waste plastic and on the other side; the road traffic intensity is increasing. The load bearing capacity of roads are increasing. This study discusses the suitability of plastic waste for construction of roads. A material that contain more organic polymer of large molecular weight, solid in its finished state, can be shaped by its flow is called as "plastic". Generally plastic is used in various domestic and industrial applications. In the Current Period Use of plastic bags and bottles is very common. Use of plastics in road construction can reduce the cost of road construction and pollution index of environment to an appreciable extent. Use of this mix for road construction it helps to reduce or use plastic waste effectively. Use of waste plastic in construction material is becoming more and more acceptable due to the improved properties. Due to use of waste plastic the Cost of construction materials also decreases. When we use the waste plastic in flexible pavement it improves the abrasion & slip resistance of asphalt pavement. It is economical and eco-friendly.***
Keywords: Plastic, Flexible Pavement, Strength, Bitumen, Aggregate, Composite Material.

I. INTRODUCTION

In the Current Period the major threat to the environment is the disposal of waste plastic. Minimization of waste plastic material is important aspect of the modern development initiatives. In a highway, the pothole is the major problem. The Plastic pavement will be a better solution to the above stated problems. A material that contain more organic polymer of large molecular weight, solid in its finished state, can be shaped by its flow is called as "plastic". Generally various Plastic Product is used in various domestic and industrial applications. Use of various plastic bags and water bottles is very common. The Main thing of plastic durability of plastic is high and it degrades very slowly. And also plastic has high resistant to degradation. There are two major categories in which Plastic can be divided - thermoses & thermoplastics. The First one Thermo sets Which have high durability and strength because when heated it solidifies irreversibly. Hence in the future it can be used for road construction and other construction related activities. Waste Plastic is a non-degradable waste, and it causes greenhouse effect and global warming. The various experiments have been carried out whether the waste plastic can be reduce and reused productively. The various literatures indicated that the waste plastic when added to hot aggregates will form a fine coat of plastic over the mixture and such aggregates when mixed with Bitumen binder is found to have higher strength, higher resistance and better performance over a period of time. Along with bitumen, use of waste plastic increases its life and smoothness. Because of extremely humid climate, the plastic pavement is the greatest advantage in India. The Addition of plastic waste in construction of pavements reduces the plastic shrinkage and drying shrinkage. The abrasion & slip resistance of asphalt pavement improved by the use of waste plastic. It is economical and eco-friendly.

A. Research Objectives

1) Sufficient workability in order that there's no segregation under load.
2) Very High strength to survive heavy wheel loads & tyre pressures.
3) Coat the aggregates with the help of waste plastic materials.
4) To know or to check the properties of bituminous mix specimen.
5) To spot the optimum proportion of waste plastic to be added within the bitumen mix for getting the specified strength.
6) To match the experimented results with the traditional pavement details and perform the economic analysis.
7) For optimum utilization of plastic waste make the statistical model.

B. Scope

1) To eradicate potholes
2) To attenuate the worldwide warming, greenhouse gases and pollution.
3) The lifespan of the roads are often increased.
4) Eco-friendly in nature.

II. LITERATURE REVIEW

The quantum of plastic waste in municipal solid waste (MSW) is increasing because of increase in population, urbanization, development activities and changes in life style which leading widespread littering on the landscape. This literature is commissioned in 2012 by Amit Gawande. Thus disposal of waste plastic is become a serious issue globally due to their non-biodegradability and unaesthetic view. These are not disposed scientifically, in which there is possibility to create ground water pollution. Replace the conventional material with the plastic waste, to improve the mechanical characteristics for particular road mix. Bitumen is used as binder in conventional road making process. Such bitumen can be replaced with waste plastic pieces and bitumen mix is made which can be used as a flexible pavement top layer coat. This waste has modified bitumen mix shows better binding property, stability, density and more resistant to water. Decrement in waste material is so essential aspect of the modern growth and development initiatives now a day. Plastic is used in different domestic and industrial applications. Presently use of plastic bags and bottles is very ordinary. For ethanol like products plastic can be used as feedstock. It can be utilized for road construction and other construction related activities. The current review summarizes the research on use of waste plastic which is by Sunil J. Kulkarni in 2015. Another best literature of Sasane Neha B. named as “Application of waste plastic as an effective construction material in flexible pavement “issued in 2015.Polyethylene as one sort of polymers is used to find the potential prospects to enhance asphalt mixture properties. The objectives also include determining the best type of polyethylene to be utilized and its proper proportion too. There are two types of polyethylene were added to coat the aggregate, High-Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE). The results show that grinded HDPE polyethylene modifier provides better engineering properties. By the weight of bitumen content, recommended proportion of the modifier is 12%.It is found to maximize the stability, reduce the density and little bit increase the air voids and the mineral aggregate voids.

“Optimum quantity of bitumen in roads” is the Fransis Hveem (1942), he was a project engineer of California Department of Highways, has developed the Hveem stabilometer in 1927. He did not have any previous experience on pointing, the required mix of its colour, therefore he decided to compute the various mixture parameters to find the optimum quantity of bitumen next literature of Vallerga and Lovering in 1985 in which He had used the surface area calculation concept, (which was already in utility, at that time of the cement concrete mix design), to estimate the extent of bitumen actually required.

III. BASIC PROCESS

A. Segregation Process

1) Plastic Waste collected from other sources must be separated from Other Waste.
2) Thickness maximum of 60 mm Micron.

B. Cleaning Process

1) Plastic Waste gets Cleaned and Dried.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

C. Shredding Process

1) The Plastic Waste is going to be shredded or dig small Pieces.
2) The various sorts of plastic waste are mixed together.

D. Collection Process

The Plastic Retaining in 2.36 mm length and 2 mm width is collected.

E. Mixing of shredded waste plastic, aggregate and bitumen

The mixture mix is heated to 140-175°C and including of waste plastic. When it will be the aggregate properly Coated mix ready then bitumen should be mix in the Bitumen mix.

1) Test on Aggregate
a) Aggregate crushing test
b) Los Angeles abrasion test
c) Impact test
d) Shape Test

2) Test on Bitumen
a) Penetration test
b) Softening point test
c) Marshall Stability test.
d) Viscosity test

IV. METHODOLOGY

There are two type of method process:

A. Dry Process

1) In dry Process the aggregate is heated up to 170^0 c in the Mini Hot Mix Plant.
2) The Shredded Plastics Will be added in Equal Proportions.
3) Immediately the hot bitumen 60/ 70 or 80/100 grade (160^0) is added.
4) The Mixture is Transferred to the Road the Road is laid.
5) This Method is Very simple and Economical.

B. Wet Process

1) Waste Plastic by dirt mixing with Hot Bitumen at 160^0 C.
2) Mechanical Stirrer is needed.
3) Addition of Stabilizer and proper cooling.
4) In this wet process require a lot of investment and required bigger Plants.
5) As Compare Dry Process this Process is not commonly use.

V. RESULT

A. The Aggregate crushing value reduces from 23.34 to 13.98 for normal and plastic coated aggregate. The value was reduced by 40%. The strength is higher when the aggregate crushing value is lower.
B. The plastic coated aggregate impact value was reduced by 9% than the normal aggregate. It's the higher toughness of plastic coated aggregates.
C. The value of Los Angeles abrasion indicates the hardness of the aggregates. The abrasion value plastic coated aggregates.
D. Were 21% less than the normal aggregates.
E. As compare the bitumen mix with the plastic the penetration value of bitumen is higher.
F. The softens bitumen 10oC less than the bitumen replaced with plastic.
G. As compare the normal bitumen the stability of modified bitumen is higher. (10% bitumen replaced by plastic).

A. Advantages and Disadvantages of Plastic road.

1) Advantages of Plastic Road

Plastic Reduce the strength and Performance of the road.

a) Use Higher Percentage of Plastic Waste.
b) Increase the Strength and Performance of the road.
c) 100 % improvement in fatigue life of road.
d) Reduced penetration and Ductility, a higher Softening Point, Less rutting and cold cracking.
e) Use higher percentage of plastic waste.
f) Smoke absorbent absorbed the gases released during traffic condition.

2) Disadvantages of Plastic Road

a) Toxic present within the co-mingled plastic wastes would start leaching.
b) The presence of chlorine will definitely release hydrogen chloride gas.
c) The components of the road once it has been laid are not inert.

VI. CONCLUSION

A. By increasing the percentage of waste plastic into the mix the Marshall Stability value are increased and maximum stability is found for the mix containing 12% plastic by weight of the bitumen. At 14% plastic content the steadiness value has decreased and hence the optimum plastic content is found as 12%.
B. The flow value goes continuous increasing with the addition of plastic content within the mix.

C. The half of air voids within the mix decreases continuously and VFB continuously increases with the addition of the plastic waste within the mix.

D. From the above test results it will be often concluded that addition of plastic waste to the semi dense bituminous concrete mix significantly improves the performance within the mix .The strength and voids parameter also satisfied the need of MORTH specification. The optimum plastic content was obtained as 12% by weight of the bitumen Content.

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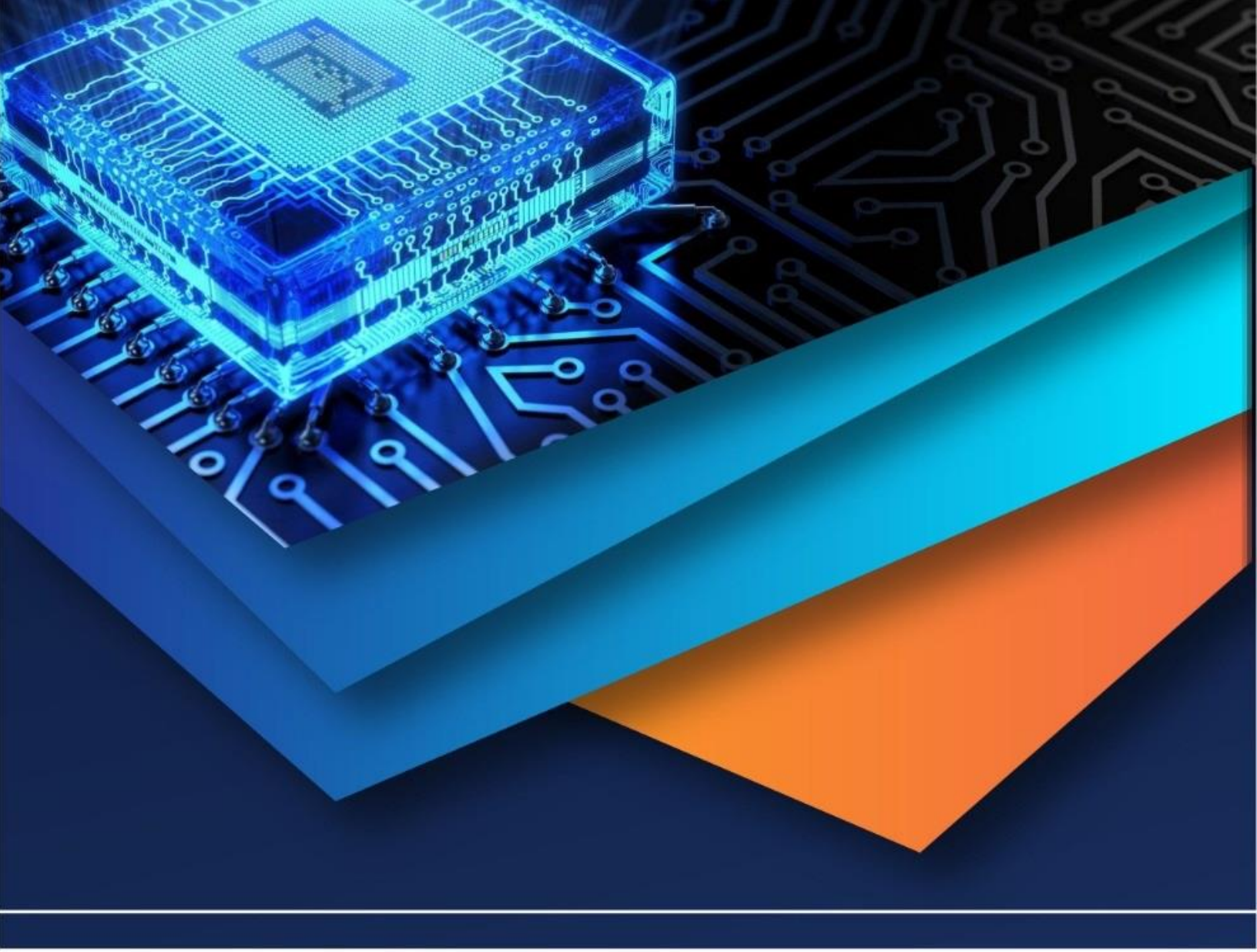

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