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Use and Impact of Waste Plastic on the Performance of Bituminous Mix

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Abstract: *Various percentages of polythene are used for preparation of mixes with a selected aggregate grading as given in the IRC Code. The role of polythene in the mix is studied for various engineering properties by preparing Marshall Samples of BC mixtures with and without polymer. Marshall Properties such as stability, flow value, unit weight, air voids are used to determine optimum polythene content for the given grade of bitumen (80/100).*

Keywords: Bituminous Concrete (BC), Marshall Stability, Flow value

I. INTRODUCTION

Bituminous binders are widely used by paving industry. A pavement has different layers. The main constituents of bituminous concrete (BC) are aggregate and bitumen. Generally, all the hard surfaced pavement types are categorized into 2 groups, i.e. flexible and rigid.

i. Flexible Pavement:

If the surface course of a pavement is bitumen then it is called "flexible" since the total pavement structure can bend or deflect due to traffic loads.

ii. Rigid Pavement :

If the surface course of a pavement is PCC then it is called "rigid" since the total pavement structure can't bend or deflect due to traffic loads. Such pavements are much stiffer than the flexible pavements due to the high modulus of elasticity of the Plain Cement Concrete material. Importantly, we can use reinforcing steel in the rigid pavements, to decrease or eliminate the joints.

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 surfacing course of roads. Studied reported 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 withstood 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. Plastic is a very versatile material. Due to the industrial revolution and its large scale production plastic seemed to be a cheaper and effective raw material. Today, every vital sector of the economy starting from agriculture to packaging, automobile, electronics, electrical, building construction, communication sectors has been virtually revolutionized by the applications of plastics. Plastic is a non-biodegradable material and researchers are found that the material can remain on earth for 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, genital abnormalities etc., Looking forward the scenario of present life style a complete ban on the use of plastic cannot be put, although the waste plastic taking the face of devil for the present and future generation. We cannot ban use of plastic but we can reuse the plastic waste.

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Scope

The scope of this research work of application of wastes in road construction is done for the city of Pune based on the observed waste generation from the dumping sites. The survey work is done for the dumping sites in the city. RAP generation is done on the case study undertaken at construction site

Problem statement

One of the major problems of Indian Roads is formation of Potholes which usually occurs when vehicular loads induce shear stresses that exceed the shear strength of the materials contained in the pavement structure. This depends on vehicular loads and the viscoelastic properties of the bitumen binder .Bitumen binders are required to have high stiffness at high temperatures to resist rutting. While talking to Environmental Pollution in recent years, numerous waste materials result from manufacturing operations ,service industries and households in which several millions of plastics are produced and plastics are not being readily biodegradable will persist in the environment in a more or less unchanged state of a considerable time. The need of the hour is to use the waste plastic in some beneficial purpose. In this study an attempt was made to find solution to overcome above discussed problems.

Aim

The bituminous mix design aims to estimate the proportions of bitumen, filler material, fine aggregates, coarse aggregates & polythene to produce a mix which should have

- Sufficient workability so that there is no segregation under load
- Enough strength to survive heavy wheel loads & tyre pressures.
- Sufficient durability
- Should be economical

II. LITERATURE SURVEY

A. Rajneesh Kumar et.al. (2020), researcher studied the main concern about the plastic waste is its non-biodegradability. Based on recent researches plastic waste when combined with bitumen provides it with desired physical properties. Bitumen is mainly applied to the construction of flexible pavements when it's combined with plastic-made waste it gets better the water resistivity, stability and capacity of the mix. Laboratory test have demonstrated it may be being used as a binder material within the bitumen mix for construction of flexible pavements. Plastic waste percentage in bitumen must be checked out. Marshal stability evaluation is essentially the most widely used technique to connect with area conditions. The samples used are created with bitumen concrete commonly known as Asphalt where plastic material and also bitumen are maintained at different percentages in every one of the test. The tests show results that are positive and also provide a scope of more practical implementations. The fundamental goal of the test is finding out the maximum percent of plastic-made waste that will overrule the bitumen information in the mix for the design of flexible pavements. The fundamental goal behind this particular analysis is replacing bitumen by non-biodegradable and conventional information and that will be the plastic waste.

B. Dr. J.S. Sudarsan et.al (2020), states that the increased plastic is likewise impacting the world's smallest creature, like plankton. When these creatures are poisoned by plastic-made ingestion, this can bring about difficulty for the bigger creatures that hinge on them for food items. Aside from this particular plastic waste is improving pollution in ways that are many. Groundwater pollution, land pollution, air pollution is several of the pollutions they're deteriorating the environment. To be able to get over all of this problem 's use of plastic as a construction material within the bituminous roads will help us to reduce the plastic waste across the globe with a bit of percentage. This particular method is going to allow the pavements to withstand higher temperature through reducing the development of cracks. Plastic roads are going to prove to be a boon for India's humid and hot weather, in which temperatures frequently exceed 50°C and heavy rains are able to lead to severe damage, resulting huge potholes. It's claimed that 33,400km road are been building through the use of plastic all across India. This first step taken up by all of the states is helping lower the plastic waste in their respective state and area. In the present scenario, the growing traffic volume of business vehicles as well as the substantial distinction between cyclical and daily weather temperature placed us in an exceptionally critical situation to think about a little replacement for the spontaneity of the pavement characteristics and

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quality by using several needed alternatives of which shall meet the strength in addition to building cost aspects. In this paper, the primary goal is highlighting the diverse sort of tasks by what the plastic road is laid and also by considering among the task a spot of plastic road is been laid in the institute of ours. Apart from that this particular paper also highlight the effect of by using clear plastic with bitumen and also the final results which are acquired by executing several check on both road that is been performed in the laboratory. The standard bitumen plus plastic bitumen sample are as opposed with one another on the foundation of test values.

C. Anuj Bhardwaj et.al (2020), studied Bituminous mixes are most often employed for road pavements. With the increased traffic volume, the bituminous road pavements are likely to provide much more toughness. The bituminous pavements provide satisfactory strength if created correctly. The utilization of waste polyethylene for highway building as an alternative of specific number of asphalt is able to boost the strength of the flexible pavement and also it'll additionally be helpful for the environment. Polyethylene has much stronger binding properties than may be utilized in flexible pavement up to a small percent. The rise in the interest in sustainable growth and lowering the unwanted side effects on the earth has improved the usage of waste materials. Plastic is non-degradable waste and also the application of plastic waste are only able to lessen the damaging consequences of waste plastic on the environment. The polyethylene could be worn as a binder substance for the building of flexible pavements. The polyethylene is able to be changed by asphalt as much as a small percent at that we have optimum strength.

D. Ashish Moon et.al (2020), author examined Bituminous Concrete (BC) is an integrated information which is popular in development projects like roadblocks, parking lots etc, airports. It is composed of bitumen or asphalt (used as a bond) along with a combination of nutrients combined together in levels thinking about the environment, on account of the unnecessary utilization of polythenes in daily business, environmental pollution is quite high. Since polythenes don't decay easily, the demand for the existing is using the garbage dump for some helpful purposes. Various proportions of polythene are being used to prepare the selected mixing and positioning as offered in the IRC Code. The role of polythene in blending is examined in several engineering structures by preparing Marshall Samples of BC composites formulated with polymer-free polymer. Marshall's properties like balance, unit weight, value flow, voids are being used to get the complete polythene foods in a certain range of bitumen (80/100).

E. Sindhu J. Nair et.al. (2023), The most common sources of waste products are from the growth of various industries and increase in population. The type of waste which is most hazardous to the nature is the Plastic Waste. The main concern about the plastic waste is its non-biodegradability. According to recent researches plastic waste when mixed with bitumen gives it desired mechanical properties. Bitumen is primarily used in the construction of flexible pavements and when it is mixed with plastic waste it improves the water resistivity, capacity and stability of the mix. Laboratory test have proved that it can be used as a binder material in the bitumen mix for construction of flexible pavements. Plastic waste percentage in bitumen has to be checked. Marshal stability test is the most commonly used method to relate with field conditions. The samples used are made up with bitumen concrete commonly called Asphalt in which plastic content and bitumen are kept at various percentages in each of the sample. The tests have shown positive results and gives a scope of further practical implementations. The basic objective of the test is to find out the optimum percentage of plastic waste which can overrule the bitumen content in the mix for the design of flexible pavements. The basic intention behind this study is to replace bitumen by a conventional and non-biodegradable material which is the plastic waste.

F. P Ramshankar et.al. (2023), To develop an optimum bituminous mix by studying the properties of construction demolition waste aggregate (CDWA) and plastic waste as a par-tial replacement of natural coarse aggregate and bitumen. The performance and strength of the conventional bituminous mix and modified bituminous mix were studied using marshall stability test. Methods: Construction demolition waste aggregate (CDWA) is produced by crushing and screening old concrete from construction demolition waste, which is then used as a replacement for natural aggregates in pavement construction. This method helps reduce the need for new aggregate materials and conserves natural resources. The plas-tic waste is melted and blended with asphalt to create a more durable and weather-resistant material. This method reduces the amount of plastic waste in landfills and provides a 20 sustainable solution for pavement construction. Find- ings: Based on the research, the optimum mix proportion of bituminous mixis found as 10% plastic waste blended with 15% construction demolition waste aggregate. The results of marshall stability test have shown significant increase in strength of pavement mixes by adding construction demolition waste and plastic

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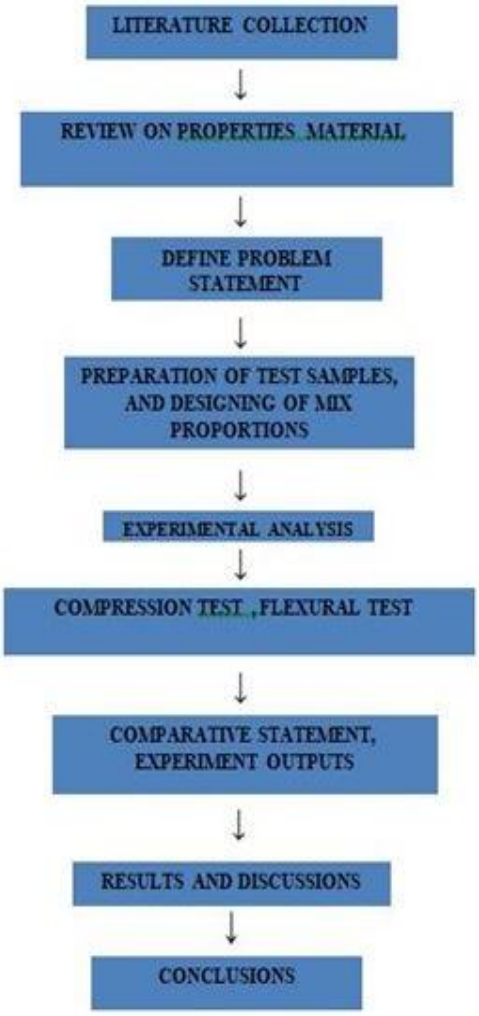
waste. Novelty: The novelty of this study lies in its approach to address-ing two major environmental issues simultaneously: waste management and sustainable construction practices. The study proposes a solution to reduce the amount of natural resources such as natural coarse aggregate and bitumen by blending alternate recyclable waste materials such as construction demolition waste aggregate and plastic waste shredded from waste bottles.

G. Tejashri Gulve et.al. (2023), India generates 1,88,000 tons of garbage every day. Plasti 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. Roads using plastic waste have been constructed through simple process innovation in various states like Tamil Nadu, Karnataka, Himachal Pradesh and to a lesser degree in Goa, Maharashtra and Andhra Pradesh. The concept of "Use of Plastic Waste in Road Construction" was implemented in 2001 as a solution to the serious problem of disposal of Plastic Waste in India. The utilization of plastic waste in bituminous mixes.

III. RESEARCH METHODOLOGY



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