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## **Review Paper on Use of Waste Polythene in Bituminous Concrete Mixes for Flexible Pavement**

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**Abstract:** *This research documents an extensive study on the design and characterization of asphalt mixtures for use as road pavement material. Several aspects of asphalt mixtures were addressed using the state of the art laboratory test equipment and technical literature from different information sources. A systematic, simplified design approach was recommended in which asphalt mixtures are designed based on the locking point concept, analytical aggregate gradation method and fundamental mechanistic properties that describe the behavior of asphalt mixtures based on sound engineering principles. In this thesis be use the Marshall method for determining the actual percentage of the waste polythene. Waste plastic is accumulation all over the world causing serious environmental problems. This paper aims to study the Plastic Waste Mixed Bituminous Concrete Using Dry Process for Road Construction. The study evaluates the addition of shredded waste plastic in the bituminous concrete which results in significant increase in the stability value and Marshall Properties of mix. The study reveals that the use of waste plastic in bituminous concrete is safe and sustainable for road construction.*

**Keywords:** Bituminous Concrete, Waste Polythene, Road construction.

### **Introduction**

Road transport in Indian has been developing at a very fast rate in view of various advantages it enjoys. Motor

vehicle population is currently witnessing a so appalling that serious economic losses like fuel wastages, delays, congestion, accidents and pollution hazards are posing daunting challenges. Therefore with the increased traffic planners got realize that there is a need to upgrade India's road system. The new road should be capable of handling the increase in the number of motor vehicles with comfort, speed, and safety. For this massive investments are required to achieve. Road network of any country is backbone of its economy. Construction of road involve huge amount of money. One can achieve the desired durability and Considerable saving may be done during the construction of roads if proper engineering design is done. The desired properties to be considered during design of bituminous mix are sufficient stability, durability, Flexibility, Skid resistance, Workability, Air voids and Economy. Increase in population, rapid urbanization, development activities and change in life style has resulted in increase of quantum of plastic waste in India. This huge amount of generated plastic had become a serious problem for our environment. The disposal of plastic wastes is a great problem. These are non-biodegradable product due to which these materials pose environmental pollution and problems like breast cancer, reproductive problems in humans and animals, genital abnormalities and even in human sperm count and quality [1]. One of the solutions to this problem is to convert the waste plastic into some useful product. Indian government has already taken an initiative to implement 4R



policy i.e. reuse, reduce, recycle and recover in the form of “Swatch Bharat Abhiyan”.

The generation of waste plastic has caused many effects on the environment, resulting in huge landfill mountainous structure which is harmful to the human health as well as to all living organisms. Therefore, the recycling and reusing of plastic wastes is found to be more advantageous. The natural bitumen extraction has resulted in more usage of non-renewable sources which are not sustainable in environment. The plastic usage in roads can replace some percentage of natural bitumen that is extracted or distilled from petroleum sources. The rutting, cracking, formation of potholes and disintegration of surface layers of flexible pavements roads due to temperature and seasonal variations, stresses due to heavy traffic loads usually occurs. Hence the utilization of waste plastic in the roads can minimize the above effects and therefore it is more important to make the roads more durable and stronger. The present study investigates the use of plastic waste using dry process in bituminous concrete for road construction.

## **II. Related Work**

Amol S. Bhale (2011) stated that in recent years, applications of plastic wastes have been considered in road construction with great interest in many developing countries. It was concluded that on heating at 100-160°C, plastics such as polyethylene, polypropylene and polystyrene, soften and exhibit good binding properties. Blending of the softened plastic with bitumen results in a mixed that is amenable for road laying. In future this will also result in having strong, durable and eco-friendly roads which will relieve the earth from all type of plastic-waste.

R. Sathish kumar et.al, (2013) investigated and revealed that properties of bitumen can be improved with the incorporation of modifiers. The bitumen treated with these modifiers is known as Modified Bitumen. In this study, bitumen of grade VG 30 is selected and improved its properties by the addition

of modifiers such as Low Density Poly Ethylene (LDPE) waste and Pulverized Tyre Waste (PTW). Results showed that Penetration value of modified bitumen decreases by 6.8% for PTW and 13.6% for LDPE waste. Softening point value increases by 8.16% for PTW and 14.28% for LDPE waste. Ductility value has decreased by 39.6% for PTW and increased by 18.86% for LDPE waste. In Marshall test, the stability value has increased by 30% for PTW and 28.46% for LDPE waste. Addition of the modifier reduced the flow value by 34.69% for PTW and 39.59% for LDPE waste, which shows that the flow property has increased. Thus results of this study concluded that addition of PTW and LDPE waste has improved the properties of penetration, ductility and softening temperature of the modified bitumen. As the stiffness of the material is improved, it is capable of taking high load and increase the resistance and durability of the pavements.

Afroz Sultana.SK et.al, (2012) studied Utilization of Waste Plastic as a Strength Modifier in Surface Course of Flexible and Rigid Pavements. The study investigates the potential use of waste plastic as a modifier for asphalt concrete and cement concrete pavement. Plastic waste, consisting of carry bags, cups etc can be used as a coating over aggregate and this coated stone can be used for road construction. Different ratios of plastic such as Polypropylene (PP), Low Density Polyethylene (LDPE), and High Density Polyethylene (HDPE) by weight of asphalt were blended with 80/100 paving grade asphalt. By using plastic as a coating over aggregates, the properties of aggregates are improved. Based on the stability values, the optimum percentage of plastic is 8%, 6% for plastic coated aggregate samples and polymer modified bitumen samples respectively for PP type of plastic, and 8% is optimum for LDPE type of plastic for both plastic coated aggregate and polymer modified samples. This shows that weak aggregates can be used in construction by using plastic as a binder material. By adding plastic to the unmodified bitumen, the rheological properties have been improved. There is an increase in the softening



point and decrease in penetration and ductility values.

Akanksha Yadav (2016), has stated that the use of polymer coated aggregate is better than the use of polymer modified bitumen in many aspects. The aggregate is heated about temperature 160°C. After the heating of aggregate, the hot aggregate is transfer into the mixing chamber. At the mixing chamber, the shredded plastics waste is to be added. It gets coated uniformly over the aggregate within 30 to 60 seconds, giving an oily look. The bitumen is added in hot plastic coated aggregate at 160°C. It is observed that Marshall Stability value increases with polyethylene content up to 6% and thereafter decreases and also the Marshall Flow value decreases upon addition of polythene i.e the resistance to deformations under heavy wheel loads increases.

Vatsal Patel et.al, (2014) highlighted the urgent need for re-examining and formulating new guidelines and specifications with regard to the design and construction of roads in India using plastic wastes. The cost of road construction is also decreased and the maintenance cost is almost nil. The roads are found to be stronger with increased Marshall Stability value, better resistance towards rain water and water stagnation so no stripping and no potholes, increase binding and better bonding of the mix thus reduction in pores in aggregate and hence less rutting raveling.

Arjita Biswas, Amit Goel, Sandeep Potnis (2019) With the Indian Road Congress bringing out a code of specs on plastic roads (IRC SP: ninety eight - 2013), many companies are coming ahead to enforce plastic roads in India as it is a sustainable approach and additionally want of the hour. However, for a massive scale implementation, the overall performance and durability of these roads want to be evaluated comprehensively. This paper offers the a number residences of bituminous mix with 8% waste plastic when in contrast with everyday bituminous combine with the assist of a comparative case study. In Pune, Maharashtra, India ten town roads which

had been overlaid with regular bituminous combine and ten roads which have been overlaid by means of bitumen blended with shredded waste plastic have been studied for their overall performance over period of two years from the time of laying of the overlays. Laboratory experiments and on- area exams have been carried out to consider their useful and overall performance traits after they had been opened to traffic. The effects document an increased overall performance of plastic roads over the traditional ones.

Rahman MT, Mohajerani A, Filippo Giustozzi (2020) Waste administration has grown to be an difficulty of growing challenge worldwide. These merchandise are filling landfills and lowering the quantity of livable space. Leachate produced from landfills contaminates the surrounding environment. The traditional incineration system releases poisonous airborne fumes into the atmosphere. Researchers are working continually to discover sustainable approaches to manipulate and recycle waste materials. Recycling and reuse are the most environment friendly techniques in waste management. The pavement enterprise is one promising sector, as one of a kind varieties of waste are being recycled into asphalt concrete and bitumen. This paper presents an overview of some promising waste merchandise like high-density polyethylene, marble quarry waste, constructing demolition waste, floor tire rubber, cooking oil, palm oil gas ash, coconut, sisal, cellulose and polyester fiber, starch, plastic bottles, waste glass, waste brick, waste ceramic, waste fly ash, and cigarette butts, and their use in asphalt concrete and bitumen. Many specialists have investigated these waste substances and tried to discover methods to use this waste for asphalt concrete and bitumen. In this paper, the effects from some considerable lookup have been analyzed, and the scope for in addition investigation is discussed.

Sandip Karmakar, Tapas Kumar Roy (2021) The charge of uncooked polymers used for making most of the waste plastics has limited the implementation of polymer modified bitumen (PMB) solely to the



primary avenue projects. In view of the same, a try to make a PMB via such wastes used to be viewed as a “state-of-art” in this investigation. Therefore, the distinct proportions of waste plastic fractions have been blended with the pristine bitumen and the ensuing mixture characterized by means of thermal kinetics analysis, microstructural analysis, and Marshall Mix design, respectively. The main findings have envisioned the very best thermal steadiness of the combination used to be done via mixing plastic bags, plastic milk pouches, and plastic cups collectively in share of 2:0.25:1 to virgin bitumen with no thermal decomposition. Further, uniform dispersion of “bee-like structure” in that mixture has mirrored its homogeneity. Besides, such modified bitumen has improved the Marshall quotient of the bituminous combine by using 16%, which can preferentially be used in the rural roads safely, verified via Marshall Mix design.

### III. Some Applications

In Bangalore a 25 km plastic modified bituminous concrete road was laid. This plastic road showed superior smoothness, uniform behaviour and less rutting as compared to a plastics-free road which was laid at same time, which began developing crocodile cracks very soon after. In 2003 The process has also been approved, by the CRRI (Central Road Research Institute Delhi).

Justo et al.2002 used processed plastic bags as an additive in asphalt concrete mixes at the Centre for Transportation Engineering of Bangalore University The properties of the ordinary bitumen were compared to that of modified bitumen. It was pointed that ductility values and penetration values of modified bitumen was decreasing with the increase in proportion of the plastic additive, up to 12 % by weight.

Mohammad T. Awwad et al. 2007 in order to investigate the potential prospects to enhance asphalt mixture properties polyethylene as one sort of

polymers is used. The objectives also include finding the best quality of polyethylene to be used and its proportion. Two types of polyethylene High Density Polyethylene (HDPE) and Low Density Polyethylene (LDPE) were used to coat the aggregate. The results indicated that in order to attain better engineering property grinded HDPE polyethylene modifier provides should be used. The recommended amount of the modifier is 12% by the weight of bitumen content.

### IV. Conclusion

After going through number of researches I conclude that waste polythene can be used for a beneficial purpose since waste polythene is a concern if not used in a proper way therefore it is necessary that different types of waste plastics should be collected and used in bituminous mix.

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