WASTE COOKING OIL AND WASTE PLASTIC USED IN BITUMEN MODIFICATION

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Abstract

Now a day's population is augmenting at a frightening rate resulting in generation of substantial waste. This is because of the excessive use of the biodegradable and non- biodegradable products or materials such as plastic, rubber, cooking oil etc. The disposal of the generated waste requisite the junkyards for its disposal and may cause environmental pollution. Our main emphasis is on improving the properties of the bituminous mix used in flexible pavement by the addition of these waste additives or by the modification of bituminous mix we can intensify the various properties which helps in making the mix more durable, economical and also helps in reducing the environmental impact of these waste materials. Plastic is now available everywhere in our day today life. After using the products made from the plastic is termed as waste plastic and is thrown away. It is producing at an alarming rate in the developing countries like India. The disposal of the waste plastic is the key challenge for us. This is because of its non-biodegradable nature which leads to environmental pollution. If we use this plastic as a modifier in the bituminous mixes, we can intensify its properties

Keywords: biodegradable, non-biodegradable, Plastic, bituminous mix, disposal.

1.1 Introduction

GENERAL: The expansion in total population has prompted a critical increment in the interest of transportation. Since the thruway gives availability to almost wherever everywhere throughout the world. They are yet considered as the most ordinarily utilized transportation frameworks on the planet for both traveler and cargo transportation. Nonetheless, the expanding interest for transportation additionally prompts the exorbitant development of parkways, further builds the interest of crude materials utilized for the development of the pavements. There can be the deficiency of the crude materials utilized for these developments. There are two different types of pavements generally used in the construction of road while developing the transportation facility. These two types are explained below:

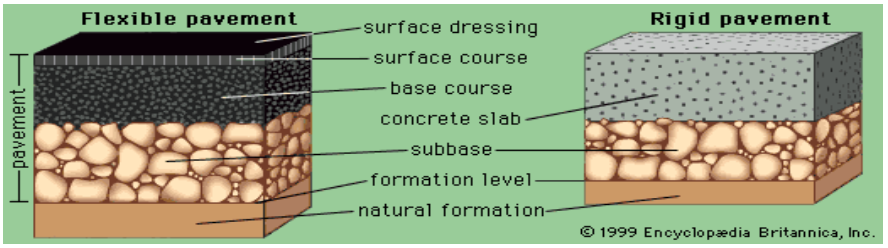
a) Flexible Pavements:

The top surface of these type of pavements are being constructed with a black sticky material termed as bitumen. As its name indicates that these pavements are flexible in nature means, the structure of these pavement layer can deflect due to the application of traffic loads. Hence, these pavements have low or negligible flexural strength.

b) Rigid Pavements:

If the pavement surface is being constructed with plain cement concrete, then this pavement is known as "rigid pavement". These pavements do not bend due to application of traffic loads and hence, are stiffer in comparison with the flexible pavements. This is due to high elastic modulus of PCC. Steel bars can be used as reinforcement.

Present study is only perturbed to the flexible pavement and therefore, different layers of flexible pavements are explained in the next sub-section of this chapter.



1.2 SCOPE OF THE STUDY

The pure bitumen can be replaced or eliminated by the waste plastic and waste food oil also known as waste cooking oil by comparing the various properties of modified bitumen with the pure bitumen. The scope of the study for future can be the modifying the binding possessions of bitumen. This study also helps in finding the alternative of waste plastics and cooking oil in the road construction of roads, which can reduce the environment pollution. This study also helps in finding the alternatives of bitumen because the petroleum products take too many years to getting replenished. This can enhance its various properties to match the demand of today's traffic as well as the increasing axle loads on the pavements. Moreover, these wastes generated are non-biodegradable in nature, and hence can be utilized in a better manner which may reduce these wastes on various dumping sites. Hence, makes this study economically as well as environmentally feasible. Therefore, in the above chapter we have studied about the impact due to development of the world in the field of transportation. This also covers various types of pavements, its layers and the various types of the bitumen mixes. Along with these we have studied about the modification of bituminous mixes with the help of used plastic and the used cooking oil and the need of modification of the bitumen mixes used for the construction of the flexible pavement.

2. LITERATURE REVIEW

2.1 F. Moreno et al. (2011): The utilization of piece elastic modifier (CRM) in bituminous blends made by the dry procedure isn't as broadly utilized as the wet procedure. In any case, this examination reports that the dry procedure has different focal points, for example, the possibility to devour bigger amounts of piece elastic, hence bringing about more noteworthy reserve funds in vitality and characteristic assets. This examination study adds to the further improvement and development of the dry procedure through the investigation of the impact of the absorption time (the contact time between the piece elastic and the bitumen) and the amount of morsel elastic on the blend plan properties. The after effects of the examination demonstrated that the processing time had no effect on the determination of the ideal fastener content or on the compaction of the blend. Conversely, the digestion time was found to affect the mechanical presentation of the blend. In this regard, an expansion in the amount of morsel elastic added to a relating increment in the measure of bitumen required, and furthermore made the blend become less conservative. This examination indicated that a scrap elastic level of under 1% of the combined weight of the blend and a processing time of 90 min delivered the best outcomes.

2.2 Amol S. Bale (2011): This research is done on the various sort of waste plastic and found that melting point is expanded by the expansion of plastic in bitumen. This study shielded us from the dangerous plastic waste. These plastic asphalts are blast for hot and sticky atmosphere as in India. In India temperature cross 50 degrees Celsius and in blustery seasons having overwhelming rainfalls which corrupts the asphalts. Thus, this examination demonstrates that the utilization of plastic waste is reasonable for asphalt development.

2.3 Köfteci et al. (2014): To reduce the effects of increasing traffic loads and adverse weather conditions, generally the bitumen is used in a modified form. These modifiers used to improve the properties of bitumen, which results in the use of these properties of the hot bituminous mix in the construction of flexible pavements. They evaluated the performance of the bitumen by using various plastic materials. Bitumen is modified with the use of waste plastics like ground PVC cable, PVC blind sand PVC window obtained in a powder form, from a recycling facility in Antalya. They compared the performance of the pure bitumen with the modified bitumen by adding these plastics in the percentages1%, 3% and 5%. The results had shown that at high temperature, the addition of PVC blinds and window wastes in the amount of 1–3% helps in enhancing the performance of modified bitumen. Whereas at low temperature, only about 5% of the cable wastes improved the performance of bitumen.

2.4 Amir Modarres, Hamidreza Hamedi (2014): The main goal of the study was to examine the effect of Polyethylene Terephthalate (PET) obtained from waste plastic bottles on the fatigue and stiffness of bitumen mixes at 5° C and 20°C. Similarly, the effect of PET was compared to Styrene Butadiene Styrene (SBS). In dry process, the PET in the percentage of 2– 10% by weight of bitumen was mixed directly to mixture. Then the tests for fatigue and resilient modulus were conducted on cylindrical samples. Increase in PET content reduces the stiffness of the bitumen. The PET mix was acceptable based on the results of fatigue and resilient modulus tests and concluded that it shows the improved behavior at both temperatures.

2.5 Wan Nur Aifa Wan Azahar et al. (2016): This study states that the cause of alteration value of waste vegetable oil like acid value and water content is due to hydrolysis, oxidation and polymerization process occurs during frying. This might affect the performance of the waste vegetable oil in the modification of binder. Hence, this research is related with the quality of this waste by determining the parameter of waste cooking oil and physical testing. The result of this study states that the high quality of waste vegetable oil affects the good performance of it. The higher value of rutting resistance as well as temperature failure at 64ºC is achieved by the bitumen binder modified by the waste cooking oil.

2.6 Z. Xie, J. Shen (2016): This investigation was done to decide whether the rubberized black-top blend executes just as polymer-adjusted black-top concrete, test areas of rubberized and control Polymer Modified Asphalt Concrete Permeable European blend (PEM) in Georgia were analyzed through a visual examination and research centre testing. The after effects of this investigation demonstrated that the exhibition of rubberized PEM asphalts from visual assessment was practically equivalent to that of (PMAC) PEM with no breaking or rutting. Following 5 years of administration in I-75 Perry, the rubberized PEM still played out a little improved rutting opposition, despite the fact that the rubberized segment witnessed about twice combined traffic.

2.7 K.S. Dhivya et al. (2017): It was seen that the recycled glass powder can be used to improve the performance of the bitumen. It investigates the properties such as elongation, melting point and tenacity of the bitumen by the use of recycled glass powder crumb rubber in the flexible pavement. The properties of six different bituminous mixes were compared with conventional bituminous mixes. The various tests on bitumen were performed to check its properties. It also includes the tests like Marshall Stability and flow value. Better results are gotten for an ideal substitution of 6% of crumb rubber by all out weight and 6% of reused glass fibre by all out weight. The use of these materials has enhanced the various parameters responsible for the properties of bitumen. The results of those parameters were as under:

- The modified bituminous mix had same specific gravity as ordinary bituminous mix.
- There is a reduction in the penetration value of the bitumen, which means that it can take the high impact load. The softening point has been increased significantly and hence can be preferred where the temperature may rise above 45ºC.

Hence, this bituminous mix with enhanced properties can have application in the areas having hotter climate, thereby reduce the cost,protect the environment from these plastics

2.8 H.T. Tai Nguyen, T. Nhan Tran (2018): Many attempts have been made to reduce the negative impacts of solid waste including the reuse of recycled rubber powder from waste tires as an additive for improving the performance of asphalt mixtures. In this study, he aims on the effects of crumb rubber (CR) on the mechanical properties like rutting resistance, of CR modified asphalt concrete (AC) and stone mastic asphalt (SMA) by varying two factors-

- The content of additive.
- Curing time.

He used the crumb rubber in the asphalt concrete by dry process. It means the crumb rubber is added as percentage of fine aggregates in the mixture. The size of used CR ranges from 0-2.36 mm, which is not too coarse for enhancing the CR–bitumen interaction and not too fine to facilitate the production of CR. He gradually increased the content of CR from 0-3% to examine the effects of CR content on the engineering properties. He observed that the optimum content of crumb rubber to be used is 1.5-2%. But, the optimal curing time to enhance the mechanical properties of the mix is not determined. Better will be the performance of the mixtures, if longer the mixture is maintained at high temperature in the range 0-5 hours of curing time.

2.9 Al-Omari et al. (2018): The main intention of this assessment is to check the authenticity of the use of waste cooking oil as an additional substance for the improvement of versatile black-tops. This will be deliberated as a genuine and legitimate system for orchestrating this waste material. The use of 1%, 2%,4%, 6% and 8% of waste cooking oil by volume of the dark top bond were done in this investigation. It was found that picking the fitting proportion of waste.

2.10 Albayati et al. (2018): In the pavement industry, the use of low temperature asphalt mixes and recycled concrete aggregates have effective engineering solutions to address the challenges caused by climate change and sustainable development. This paper reports on initial work which attempts to address this shortcoming. He states that some special treatment method is used to improve the quality of recycled concrete coarse aggregates.

Thereafter, the treated recycled aggregates were used in warm mix asphalt at varied rates to replace untreated raw coarse aggregates. The test performed on asphalt concrete mixes produced were tested for modulus, tensile strength, permanent deformation, moisture susceptibility and fatigue life. The comparison of these properties was done with that of the mixes using the same rates of untreated coarse aggregates from the same source.

2.11 Rasman et al. (2018): The present significant expense of unrefined oils for bitumen generation has prompted different investigations on the most conservative path in supplanting or diminishing the measure of virgin bitumen as a cover in street asphalt while expanding their asphalt execution. The point of this investigation is to research the impact of utilizing bio-oil, especially squander cooking oil on the designing properties of bitumen. Both physical and rheological properties of the first bitumen and waste cooking oil changed bitumen were estimated utilizing infiltration, relaxing point, consistency, and Dynamic

Shear Rheometer (DSR) bitumen 80/100 penetration was changed with WCO at various rates for example 1%, 2% what's more, 3% by weight of bitumen. In view of the outcomes, it was discovered that expansion of waste cooking oil project work and falls under are of interest. These researches had shown the modification in the various properties of the bitumen as well as the bituminous mixes by using some waste materials like plastic, engine oil, cooking oil, crumb rubber etc. as additives in different percentages. It can be stated that these materials can be used as the full or partial replacements of the bitumen as well as the aggregates.

3. Different layers of Flexible Pavements:

- The bottom most of this flexible pavement is known as "Subgrade". This layer act as a supporting layer to the upper layers of the pavement. For that reason, it should have sufficient thickness and strength to hold up the load coming from the above layers. It also helps in drain off the rain water which is being infiltrated from the above layers of the pavement. There should be aminimum thickness of 500 mm to be laid out for this subgrade layer.

- The next layer above the subgrade layer is known as "Sub base course". The materials used for the construction this layer are gravel, sand and stone. The main role of this layer is similar to that of the subgrade but also helps in distribution of the traffic load to the larger area to the subgrade. This layer may be excluded while constructing the footpaths.

- The third layer above the sub base course layer is known as "Base course". The function of this layer is almost same as that of sub base course but only difference is in the size of the aggregates used for its construction.

- The mixture of bitumen and aggregates can be used as an intermediate layer between the base course and surface course.

- The topmost layer of this flexible pavement and is termed as "Wearing course or Surface course". This lay out the smooth riding surface for the flow of traffic on the road. The maximum size of aggregates to be use for its construction should not exceed 25 mm and size of fine filler not more than

0.075 mm. The compacted bituminous mix should possess elastic properties and be productively impervious in nature

3.1 Different Types of Bituminous Mix

Following are the various types of bituminous mixes used for the construction of flexible pavements:

a) **Gap Graded Mix:** It is indicated from its name that some sizes of coarse aggregates are missing from the bituminous mix. These mixes have high resistance and strength

b) **Open Graded Mix:** In this type of bituminous mix fine aggregates and fillers are missing. As a result of which, it has good friction but have low strength for the movementof high- speed vehicles.

c) **Dense Graded Mix:** This type of bituminous mix comprises of all size of the aggregates in a well - defined proportion. This results in minimum void ratio and has high-density. Hence, it possesses adequate tensile strength as well as compressive strength

Plastic is most frequently used as an alternative for the modification of the bituminous mixes. It is broadly classified into two categories:

- Thermosetting: These types of the polymers are once heated and they get melted. They get hardened on cooling get hardened. These plastics have more strength as compared to thermoplastic polymers. There will be no consequence of heat once they get hardened. Handles of the pressure cooker, frying pan etc. are some of the examples of these types if plastics.

- Thermoplastic: The types of the polymers which get soften again on heating and can be remolded are known as thermoplastic polymers. It has low strength as compared to thermosetting polymer. Milk packets, carry bags, biscuit packets etc. are some examples of this type of plastic.

3.2 EFFECT OF PLASTIC ON THE ECOSYSTEM

Plastic disintegrates in water and forms small pallets which create ill effects on the life of fishes even death of fishes may occur. Sometimes disposed in landfills, get mixed with municipal solid waste. These processes are not eco-friendly they create pollution for land, air and water. In any method that can be use this waste in the construction purpose is always welcomed. The principle aims of fusing the modifiers like polymer in bitumen is to broaden the scope of amenity temperature or decrease the effect of temperature. Because of the significant expenses and reason for contamination of the polymer- based added substances the utilization of thermoplastic wastes being deliberated for modifying the bitumen. We can reduce the use of bitumen by replacing it with these polymer additives.

In pavement construction some of the aggregates are water loving in nature which makes bad effect over the whole pavement. Bitumen and polyethylene are the water hating materials and thus the addition of the plastic which is hydrophobic can produce a good quality material which is durable for the pavement work. Plastic is added in hot mixture and thus the mixture produced is laid over the road surface. These plastic pavements are generally use polyethylene carry bags, packets, bottles etc. which are collected from the garbage. For preventing the cracking and improving fatigue life, polymers are added in it. Thus, the properties of the mixtures get increased. It can't only produce durable surface for the pavements, but also provide a way to dispose of the plastic waste in an economic way. Waste Cooking Oil gathered from various long stretches of WCO assortment speak to the diverse continuous length times WCO was utilized, which influenced the corrosive worth outcome. The more drawn out the time WCO was utilized, the higher the subsequent corrosive worth the alteration should likewise be possible by utilizing waste cooking oil (WCO), has as of late increased broad significance in light of its agreeable execution as a waste material to supplant the constrained wellspring of the cover. A plenitude of WCO is a natural risk; along these lines, reusing or reusing WCO in black-top cover material is considered as the best possible usage and the executives of this waste. This methodology can likewise guarantee monetary and ecological advantages.

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