

A Review Literature On The Use Of Waste Plastics And Waste Rubber Tyres In Pavement

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Abstract-Worldwide, sustainability is the pressing need of the hour in the construction industry and towards this end use of waste material in road construction is being increasingly encouraged so as to reduce environmental impact. In the highway infrastructure, a large number of originate materials and technologies have been invented to determine their suitability for the design, construction and maintenance of these pavements. Plastics and rubbers are one of them. Also considering the environmental approach, due to excessive use of polythenes in day to day business, the pollution to the environment is enormous. The use of plastic materials such as carry bags, cups, etc. is constantly increasing day by day. Since the polythenes are not biodegradable, the need of the current hour is to use the waste polythene in some beneficial purposes. The main aim of this study is to focus on using the available waste/recycled plastic materials and waste rubber tyres present in abundant which can be used economically and conveniently. The use of these materials as a road construction proves eco-friendly, economical and use of plastic will also give strength in the sub-base course of the pavement.

Keywords-abundant, recycled, biodegradable, economical.

INTRODUCTION

Plastic materials have become the corner stone of our lives, so it leads to generation of huge quantity of plastic waste. There is an immediate need to improve the properties of pavement in the present scenario since a steady increase is observed in areas like wheel

loads, tyre pressure, change in climatic conditions and daily wear and tear which affect the performance of bituminous mix pavement in a huge amount [Ref. 6]. The amount of plastic waste materials are wither mixed with Municipal solid waste or dumped in an open area leading to increase in the area covered under waste land [Ref. 1]. Plastic waste, if not recycled is either land filled or incinerated, where both of them prove to be a disaster to environment. Incineration leads to air pollution whereas dumping the waste in open areas causes contamination of water bodies and soil. Thus, an alternative for treatment of plastic waste and waste rubber tyres are required as early as possible. The use of bitumen as a binder material for stone and sand in construction of road is given by John Macadam. It has become the need of the hour to think of some new option to alter and develop pavement characteristics both in terms of quantity and quality since there has been a sudden increase in the number of commercial vehicles and considerable difference in daily and seasonal temperature. Today's economy is based on ancient system of stewardship where resources are limited and we need to satisfy all aspects of durability and economy. Thus a judicious and appropriate use of resources is required.

LITERATURE REVIEW

Waste Scenerio-

Various activities like packing consume almost 50-60% of the total plastics manufactured. Plastics materials lack the quality of bio-decomposition thus leaving them to no option against being land filled or combusted as it is. Both of these processes are unhealthy to environment, hence leading to contamination of air and land [Ref. 4]. There has been tremendous increase in the consumption of plastic raising from 4000 tons/annum (1990) to 4 million tons annum (2009) and it is still expected to rise upto significant level of 12 million tons/annum by 2016. Chennai Corporation commissioner Rajesh Lakhoni says, "Of the 3,400 tons of plastic generated in the city every day, 35 to 40 tons is plastic waste and most of that is plastic bags." [7]. A plastic is a type of synthetic or man-made polymer; similar in many ways to natural resins found in trees and other plants. [3]. The annual available capacity for procured tyres retreading is 4.8 million for bus and truck tries and 4.5 million for car and jeep tyres. Bureau of Indian Standard has prepared standards for retreaded tyres. It becomes hard to recover useful substances from plastic waste since rubber compound in tyre because compounds like black carbon, zinc oxide, process oil, and sulphur are present in vulcanized stage. The process of retarding produces tyre crumb as it's by-product [Ref. 10]. Hence, before applying new rubber the old tread of tyre is buffed to produced crumb. On the basis of study conducted on behavior of cryogenic ground tyre crumb at Rubber Technology, the tyre crumb has a large number of uses like rubber extender, asphalt modifier for road surfacing, modifier implastics, making sports surfaces, safety surfaces, soil treatment etc. IIT-Kharagpur revealed that properties of vulcanizates containing crumb rubber depend on size, loading,

hardness, cross links and nature of polymer matrix of the crumb. The reclaim process is not environmentally friendly unless expensive scrubbers and effluent treatment plants are installed. [10]

METHODOLOGY-

Types of Plastics-

- PET, polyethylene terephthalate
- HDPE, high-density polyethylene
- PVC, polyvinyl chloride
- LDPE, low-density polyethylene
- PP, polypropylene
- PS, polystyrene

RUBBER TYRES-

There are a large number of ways to manage the waste rubber tyres. It can be in the form of whole tyre or slit tyre, chopped tyre, ground rubber or as a crumb rubber product. The rubber tyre employed in bituminous mix in the form of rubber particles, when subjected to a dual cycle of magnetic separation are then screened and recovered in various sizes, thus giving rise to the product called "Rubber Aggregate" [Ref. 5]. Various processes like de-dusting and washing are used to clean the waste rubber-tyre. All the rubber pieces are sieved through 22.4 mm sieve and retained through 5.6 mm sieve as per the specifications of mix design. These clear pieces are added in bituminous mix, 10-20% by weight of stone aggregate. Then, these well – sieved and cleaned rubber aggregate is mixed well with stone aggregate and bitumen at temperature of about 160°C-170°C for the proper mixing of bituminous mix. The waste rubber tyres are thermodynamically set, thus they are not melted in bitumen at the time of mixing altogether in a mix plant. Large quantities of waste rubber tyres are collected from road sides, dumpsites and waste – buyers. The collected waste tyres are sorted as per the required sizes for the mixing purposes. The waste tyres are cut in the form of aggregate size usually ranging from 22.4mm to

6.00mm (as per IRC:SP20) in the tyre cutting machine shown in the figure below-



Picture 1

Table5. Selection Criteria For PMB And CRMB Based On Atmospheric Temperature [Ref. 3]

| Maximum Atmospheric Temperature, °C | | | |
|-------------------------------------|-----------|----------|----------|
| | <30 | 30 to 40 | >40 |
| >-15 | PMB - 120 | PMB - 70 | PMB - 70 |
| 15 to -15 | CRMB-50 | CRMB-55 | CRMB- 60 |
| | PMB - 120 | PMB - 70 | PMB - 40 |
| >15 | CRMB-55 | CRMB-55 | CRMB- 60 |
| | | PMB - 40 | PMB - 40 |
| | | CRMB- 60 | CRMB- 60 |

| | | | |
|--|----------|--|--|
| | PMB - 70 | | |
| | CRMB-55 | | |

PMB - Polymer Modified Bitumen
CRMB - Crum Rubber Modified Bitumen

CONCLUSION:

The use of waste plastic and waste rubber tyre in construction of roads brings out a better performance. Since there is better binding of bitumen with plastic and tyre. The frequency of voids is also reduced due to increased bonding and area of contact between polymers and bitumen. This ultimately helps in decreasing the moisture absorption and oxidation of bitumen by entrapped air. Hence, the roads can withstand heavy traffic, thereby making them more durable. Whereas the mixing of rubber aggregate on the other hand while mixing in the bituminous mix decreases the quantity of stone aggregate by volume, makes it more flexible and also increases the flexural strength in the uppermost layer of the highways. The waste tyres can be used as well sized aggregate in the various bituminous mixes if it is cut in the form of aggregate and can be called as rubber aggregate. This not only minimizes the pollution occurred due to waste tyres but also minimizes the use of conventional aggregate which is available in exhaustible quantity.

- Disposal of waste plastic and rubber tyre will no longer be a problem.
- With the use of rubber aggregate, the problem of thermal cracking and permanent deformation will be solved.
- Conventional stone aggregate can be saved to a certain quantity.
- Problems like thermal cracking and permanent deformation are reduced in hot temperature region.
- As we already know the fact very well that rubber has property of absorbing sound, which also help in reducing the sound pollution of heavy traffic roads.
- Waste rubber tyres thus can be put to use and it ultimately improves the quality and performance of road.
- Optimum content of waste rubber tyres to be used is in between the range of 5% to 20%.
- Addition of waste tyres as rubber aggregate modifies the flexibility of surface layer.

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