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Study of Construction of Road Pavement by Waste Material

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ABSTRACT: With the evolution of the road industry and growing traffic on roads, construction materials have also been evolved and more unconventional ingredients have been incorporated. The rationale was the scarcity of conventional natural materials and the jeopardized environment which have underpinned the tendency towards evaluation other materials resources to be incorporated in the road industry. The inclusion of such materials entails several secondary and tertiary materials. Several waste by-products and materials have been investigated, assessed, evaluated for utilizations and practiced in the field. Depending on the attributes of the characteristics of the recycled material, the inclusion varies. Some recycled material have been proven to possess preferable properties over the other and have performed satisfactorily in the field.

KEYWORDS: Replacement, Analysis, E- waste, Plastic waste, Flexible Pavement, Construction Material, Light Weight Aggregate

I. INTRODUCTION

The major threat to the environment is the disposal of waste plastic. In a highway, the potholes and corrugation is the major problem. Plastic pavement will be a better solution to the above stated problems. A material that contains one or more organic polymer of large molecular weight, solid in its finished state, can be shaped by its flow is called as "plastic". The durability of plastic is high and it degrades very slowly. Also plastic has high resistance to degradation. Plastic can be divided into two major categories- thermosets & thermoplastics. Thermosets have high durability and strength because they solidify irreversibly when heated, henceforth can be used primarily in construction application. Plastic is a non-degradable waste, causes greenhouse effect and global warming. The various experiments have been carried out whether the waste plastic can be reused productively. The various literature indicated that the waste plastic when added to hot aggregates will form a fine coat of plastic over the aggregate and such aggregates when mixed with binder is found to have higher strength, higher resistance and better performance over a period of time. Along with bitumen, use waste plastic increases its life and smoothness. It is economical and ecofriendly.

II. SCOPE & PROMOTIONAL EFFORTS BY THE GOVERNMENT

One lakh km of road built using plastic waste, government aims to double it, and Plastic has been used in the 270-kilometre-long Jammu Kashmir National highway. About 1.6 tons of plastic waste was used in the two kilometre-long stretch of Delhi-Meerut highway near UP Gate, according to Hindustan. The central government has been

using plastic waste in road construction to properly utilize the material which otherwise is not recycled. So far, one lakh kilometer of road has been constructed using plastic waste, Hindustan Times' sister publication Hindustan reported. The construction of every kilometer of road required nine tones of bitumen and one tons of plastic waste. This means for every kilometer of road, one tons bitumen is saved, which costs about Rs 30,000. Plastic roads consist of 6-8 per cent plastic, while 92-94 per cent is bitumen.

III. OBJECTIVE OF PROJECT

The objective of this thesis was to survey the literature for innovative usages of waste and 12 recycling materials in the construction industry. To accomplish this objective, better documentation for different green building benefits addressing economic and environmental concerns. This thesis provides a survey of selected waste and recycled material currently being used in civil engineering applications by contractors, manufacturers, and construction companies.

- The main object of this project is to detail study about the wastes that can be used as a road construction and pavement construction material.
- The suitability of these waste materials is checked and can be helpful as a replacement of fine aggregate in base and bituminous layers of road pavement.
- The properties of different waste material can be studied and their suitability in embankment, sub grade, sub base, base and bituminous layer of road
- Understanding benefits and drawbacks of utilizing some of these materials in comparison to the other.
- Identify some knowledge gaps related to any of the explored materials

IV. RESULT AND DISCUSSION

Testing program:

To achieve the objectives of this study; one type of bitumen grade (40-50) was blended with aggregate, filler, and plastic waste. The effects of the following parameters of plastic waste have been considered in this study:-

- Size: by adding (10% by weight of total aggregate) with a specific size of plastic waste in the mixture, where six different sizes of particles (passing sieve 3/4", 1/2", 3/8", No.4, No.8, and No.16) were used.
- Thickness: by adding (10% by weight of total aggregate) with a specific thickness of plastic waste in the mixture, where four different thicknesses of plastic waste (0.2, 0.5, 0.8, 1.0) mm were used.
- Percent of content: adding five different percentages (5, 10, 15, 20, 25) percentage of a certain size of plastic waste by weight of total aggregate.

Plastic Waste Particles Size	Marshall Test Results					
Passing Sieve	(mm)	Stability (KN)	Flow	Flow (mm)	Bulk Density (gm/cm ³)	Air Void (%)
3/4"	19.0	7.15		4.35	2.057	6.25
1/2"	12.	7.92		4.50	2.168	6.10

	5				
3/8"	9.5	8.37	4.22	2.164	5.54
No.4	4.7	8.83	3.81	2.21	4.52
	5				
No.8	2.3	9.65	3.52	2.212	4.30
	6				
No.16	1.1	9.72	3.45	2.285	3.92
	8				

Stability & Flow of Sample with Plastic:

There were 18 sample molds, which were tested for stability and flow. Three molds for each binder type contained 2% of plastic with 98% of bitumen, 4% of plastic with 96% of bitumen, 6% of plastic with 94 % of bitumen, 8% plastic with 92% of bitumen, 10% of plastic with 90% of bitumen and 12% of plastic with 88% respectively. The stability and flow data of each of the six binders are shown in table 8 and optimum bitumen value as per stability and flow values are shown in table.

Test results of samples with plastic:

Ba tch	Plastic percentage	Stability (KN)	Flow (MM)	Marshal quotient
A	2	17.66	3.256	5.426
B	4	18.649	3.081	6.052
C	6	20.414	2.980	6.832
D	8	21.686	2.839	7.604
E	10	22.813	2.673	8.538
F	12	19.35	3.11	6.227

From the stability data of all the six binders, we noted that the binders D and E had a better stability as compared to other, E was noted to be the best from the Marshall Stability and flow data. Further studies on void analysis or volumetric analysis are to be carried out in future to confirm the optimum plastic percentage.

V. TURNING PLASTIC WASTE INTO ECO-FRIENDLY BUILDING MATERIALS & PRODUCTS

Since the past 65 years, about 8.3 billion tons of plastics have been produced worldwide, which is equivalent to 10,000 Eiffel Towers or 35,000 Empire State Buildings. But only 9 percent of all plastics gets recycled, while the rest ends up as trash. About 8 million tons goes into the ocean every year and the figure could rise to 500 million tons by 2022. Plastic has an adverse effect on human health, marine life, and the environment, as it pollutes our soil and water. Flagging their concern at the recent International Plastic Bag Free Day, people resolved to eliminate plastic in their daily life. They asserted that the inventors of plastic should now devise ways to get rid of it. Enough is enough, said the environmentalists, with their message: Reduce, Recycle & Reuse.

- Utilisation of plastic waste in road construction
- Converting plastic waste into tiles
- Making paper from plastic waste
- Turning plastic waste into building materials
- Converting plastic waste in light weight aggregate
- Making Bricks, Blocks, etc.



VI. FUTURE SCOPE

Clearly, plastic waste can prove to be a sustainable additive and partial replacement of conventional construction materials thereby addressing the dual issue of management of plastic waste and helping in the reduction of footprints caused by construction industry on the environment. However, a long road is ahead before the commercial implementation of the idea can be realized. More research is required to fully understand the advantages and limitations of plastic waste based construction material qualitatively and quantitatively. Several issues to be addressed for commercialization and for future research are:

- Optimum proportions of plastic waste as a constituent of construction materials are required.
- Safe methods of sanitization of plastic waste in order to eliminate the potential contaminants.
- Analysis of carbon life cycle to reinforce the claim for sustainability.
- Cost–benefit analysis for the commercial production of such construction material

VII. CONCLUSION

An evaluation based on technical, environmental, and economic factors indicated that reclaimed paving materials, coal fly ash, blast furnace slag, bottom ash, boiler slag, steel slag, and rubber tires have significant potential to replace conventional materials for various applications in highway construction and should be projected for future construction. Technical economic, and environmental problem associated with various applications of waste materials, identified under each waste material and briefly discussed must be addressed before extensive use of these waste products in highway construction.

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