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"UTILIZATION OF WASTE POLYETHYLENE IN BITUMINOUS CONCRETE MIXES"

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Abstract The quantum of plastic waste in is growing because of growth in population, urbanization, Improvement sports and modifications in existence fashion which main full-size littering at the landscape. Thus disposal of waste plastic is a threat and turn out to be a extreme hassle globally because of their non biodegradability and unaesthetic view. Since those are now no longer disposed scientifically & opportunity to create ground & water pollution. This waste plastic partially changed the traditional cloth to enhance desired mechanical traits for specific street blend. In the prevailing paper advanced strategies to apply plastic waste for creation reason of roads and flexible pavements has reviewed. In traditional street making technique bitumen is used as binder. Such bitumen may be changed with waste plastic portions and bitumen blend is made which may be used as a pinnacle layer coat of flexible pavement. This waste plastic changed bitumen blend display higher binding property, stability, density and greater proof against water.

Key words*:* Bituminous Concrete (BC), Marshall Stability, Flow value, Optimum Polythene Plastic Aggregate, Polyethylene,

INTRODUCTION

General

Bitumen is a darkish brown to black viscous liquid or strong, consisting basically of hydrocarbons and their derivatives. It is soluble in trichloroethylene, is significantly non-volatile, and softens steadily whilst heated. Although strong or semi-strong at regular temperatures, bitumen can be with no trouble liquefied via way of means of making use of heat, via way of means of dissolving it in petroleum solvents, or via way of means of emulsifying it in water. Bitumen is received via way of means of refining petroleum crude oil, even though it's also located as a obviously going on deposit. As a binder, bitumen is in particular treasured to the engineer due to the fact it's far a strong, with no trouble adhesive, exceptionally water resistant and sturdy material. It additionally affords a few flexibility to combos of mineral aggregates with which additionally it is combined. It is exceptionally proof against the motion of maximum acids, alkalis and salts. Bitumen is likewise used in lots of packages now no longer associated to standard production and shipping industries. However, about 90% of the bitumen

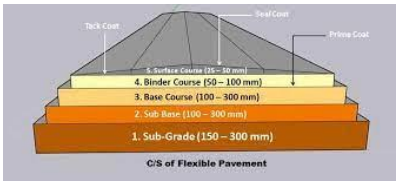
The composition of bitumen:-

Bitumen is a complicated aggregate of hydrocarbons with small portions of sulphur, oxygen, nitrogen and hint portions of metals consisting of vanadium, nickel, iron, magnesium and calcium. Crude oils usually include small portions of polycyclic fragrant hydrocarbons (PAHs), a part of which become in bitumen.

Although a number of those PAHs are suspected of inflicting most cancers in human beings, the concentrations are extraordinarily low and no causal hyperlink to most cancers in human beings has been established. Most bitumen`s fabricated from a variety of crude oils include:
Carbon 82 - 88%, Hydrogen 8 - 11% , Sulphur 0 - 6%, Oxygen 0 - 1.5% , Nitrogen 0 - 1%
Bituminous binders are broadly utilized by paving industry. A pavement has specific layers. The principal elements of bituminous concrete (BC) are mixture and bitumen. Generally, the entire tough surfaced pavement

(a)Flexible Pavement :

Flexible pavement can be defined as the one consisting of a mixture of asphaltic or bituminous material and aggregates placed on a bed of compacted granular material of appropriate quality in layers over the sub grade. Water bound macadam roads and stabilized soil roads with or without asphaltic toppings are examples of flexible pavements. Fig.-1



The design of flexible pavement is based on the principle that for a load of any magnitude, the intensity of a load diminishes as the load is transmitted downwards from the surface by virtue of spreading over an increasingly larger area, by carrying it deep enough into the ground through successive layers of granular material. Thus for flexible pavement, there can be grading in the quality of materials used, the materials with high degree of strength is used at or near the surface. Thus the strength of sub grade primarily influences the thickness of the 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.

(b)Rigid Pavement:

An inflexible pavement is created from cement concrete or strengthened concrete slabs. Grouted concrete roads are within side the class of semi-inflexible pavements. The layout of inflexible pavement is primarily based totally on imparting structural cement concrete slab of enough electricity to resists the hundreds from site visitors. The inflexible pavement has pressure and excessive modulus of elasticity to distribute the burden over a particularly huge place of soil.

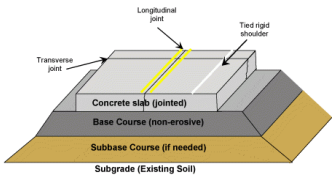


Fig 2: Rigid Pavement Cross-Section

Minor versions in sub grade electricity have little impact at the structural potential of a inflexible pavement. In the layout of a inflexible pavement, the flexural electricity of concrete is the important

element and now no longer the electricity of sub grade. Due to these assets of pavement, whilst the sub grade deflects below the inflexible pavement, the concrete slab is capable of bridge over the localized screw ups and regions of insufficient aid from sub grade due to slab action.

If the floor direction of a pavement is PCC then it's miles called "inflexible" considering the fact that the entire pavement shape can`t bend or deflect because of site visitors loads. Such pavements are tons stiffer than the bendy pavements because of the excessive modulus of elasticity of the Plain Cement Concrete material. Importantly, we will use reinforcing metal within side the inflexible pavements, to lower or do away with the joints.

LITERATURE REVIEW

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

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

(iii)Mohammad T. Awwad et al (2007), polyethylene as one sort of polymers is used to investigate the potential prospects to enhance asphalt mixture properties. The objectives also include determining the best type of polyethylene to be used and its proportion. Two types of polyethylene were added to coat the aggregate High Density Polyethylene (HDPE) and Low Density Polyethylene (LDPE). The results indicated that grinded HDPE polyethylene modifier provides better engineering properties. The recommended proportion of the modifier is 12% by the weight of bitumen content. It is found to increase the stability, reduce the density and slightly increase the air voids and the voids of mineral aggregate.

(iv)Dr. R. Vasudevan (2007) **i**nvestigated that the coating of plastics reduces the porosity, absorption of moisture and improves soundness. The polymer coated aggregate bitumen mix forms better material for flexible pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for flexible pavement is one of the best methods for easy disposal of waste plastics. Use of plastic bags in road help in many ways like Easy disposal of waste, better road and prevention of pollution.

(v)Raji et al.(2007) investigated the “Utilization of marginal materials as an ingredient in bituminous mixes”. They concluded that when plastic wastes can be used as additives on bituminous pavements. Hence in their study, the properties of bituminous mix when modified with shredded syringe plastic waste were investigated. The work was carried out by mixing shredded autoclaved plastic syringes with heated aggregates by dry process.

(vi)Shankar et al **(2009),** crumb rubber modified bitumen (CRMB 55) was blended at specified temperatures. Marshall's mix design was carried out by changing the modified bitumen content at constant optimum rubber content and subsequent tests have been performed to determine the different mix design characteristics and for conventional bitumen (60/70) also. This has resulted in much improved characteristics when compared with straight run bitumen and that too at reduced optimum modified binder content (5.67%).

(vii)Swami et al. (2012**)** investigated the Use of waste plastic in the construction of bituminous Road. They concluded that plastic waste consisting of carry bags, cups and other utilized plastic could be used as a coating over aggregates and this coated stone could be used for Road construction. Sultana et al. (2012) investigated the utilization of waste plastic as a strength modifier in surface course of flexible and rigid pavements. They concluded that the potential use of waste plastic as a modifier for asphalt concrete and cement concrete pavement.

(viii)Gawande et al. (2012) investigated the "An overview on waste plastic utilization in asphalting of roads". They reviewed techniques to use plastic waste for construction purpose of roads and flexible pavements.

(ix)Davide Lo Presti, "Recycled Tyre Rubber Modified Bitumens for Road asphalt mixtures: a literature review**",** Construction and Building Materials 49 (2013) PP 863– 881:Nowadays, only a small percentage of waste tyres are being land-filled. The Recycled Tyre Rubber is being used in new tyres, in tyre-derived fuel, in civil engineering applications and products, in moulded rubber products, in agricultural uses, recreational and sports applications and in rubber modified asphalt applications. The benefits of using rubber modified asphalts are being more widely experienced and recognized, and the incorporation of tyres into asphalt is likely to increase. The technology with much different evidence of success demonstrated by roads built in the last 40 years is the rubberized asphalt mixture obtained through the so-called ''wet process'' which involves the utilization of the Recycled Tyre Rubber Modified Bitumen's (RTR-MBs). Since 1960s, asphalt mixtures produced with RTRMBs have been used in different parts of the world as solutions for different quality problems and, despite some downsides; in the majority of the cases they have demonstrated to enhance performance of road's pavement.

(x)Bhageerathy et al.(2014) investigated the use of Biomedical Plastic Waste in Bituminous Road Construction. They concluded that the Marshall Stability value of plastic modified mix was found to be 51 percent more than that for the normal mix which indicates an increase in load carrying capacity.

(xi)Imran M. Khan, Shahid Kabir, Majed A. Alhussain, Feras F. Almansoor "ASPHALT DESIGN USING RECYCLED PLASTIC AND CRUMBRUBBER WASTE FOR SUSTAINABLE PAVEMENT CONSTRUCTION", Procedia Engineering 145(2016) :The seasonal change in temperature and loading nature has a significant effect on asphalt behavior because of its viscoelastic nature. Several types of flexible pavement failure/distress occur due to this behavior of asphalt binder, among which rutting and fatigue cracks are very common. In this study, Low Density and High Density Polyethylene and Crumb rubber were used as additions to base bitumen. Complex modulus (G*) and phase angle (δ) obtained from Dynamic Shear Rheometer (DSR) are the basic perimeters used to evaluate the behavior of the binder in

respect to rutting and fatigue cracking. It was concluded that Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE), and Crumb Rubber (CR) modified binder showed significant improvement in rheological properties of the binder. Furthermore, recycling these municipal wastes will contribute to solving environmental problems in the Kingdom of Saudi Arabia caused by the piling up of these wastes in dumpsites.

(xii) Utibe J. Nkanga, Johnson A. Joseph,Feyisayo V. Adams, Obioma U. Uche "CHARACTERIZATION OF BITUMEN/PLASTIC BLENDS FOR FLEXIBLE PAVEMENT APPLICATION",Procedia Manufacturing 7(2017) **:**Waste plastic materials including low density polyethylene (LDPE) grocery bags etc. are disposed through landfills: this poses an environmental pollution due to difficult in degradation of polymeric materials by environmental factors. Waste plastic materials can improve desired properties of bituminous mix for repair and construction of flexible pavements. In this project, various proportions of polymeric materials blended with bituminous mix were characterized. Strength and performance of bitumen/plastic blends were tested through marshall stability test, extraction test, sieve analysis, water absorption tests and bulk density.

(xiii)R.B.Ahmed, A.Rahman, K.Islam, J. Amin **,** S. K. Palit, "RECYCLING OF RECLAIMED BITUMINOUS PAVEMENT MATERIALS",(ICRICE 2018):Most of the highways and roads of Bangladesh are generally constructed as flexible pavement and are generally designed with fresh aggregates and neat bitumen. During road reconstruction and rehabilitation, proper handling of demolished pavement becomes a great problem. When this demolished pavement is not properly handled, it causes environmental hazards and creates disposal problems. Reusing of demolished pavement materials may become a possible alternative for pavement construction. Environmental, economic, and social benefits are the encouraging factors for pavement recycling. The global objective of sustainable development can be achieved by making use of Reclaimed Asphalt Pavement (RAP) in roadway paving new projects.

(xiv)Aditya Surkar , (june2021**)** investigated, - Most of the developing nations lack a proper solid waste management system owing to the difficulties faced during the sample collection and treatment phases. Low-density polyethylene (LDPE) contributes as a major source of such pollution due to the widespread use of its products which include water sachets, thin bags, wrapping paper etc. Improper disposal of this waste in the form of land filling can not only cause environmental impact but also negatively harm the surrounding soil and water bodies**.**

RAW MATERIALS-:

The Materials used are as follows:-

i. Aggregates
ii. Bituminous Binder
iii. Mineral Filler
iv. Polythene

Aggregates:- Aggregates (or mineral aggregates) are hard, inert materials such as sand, gravel, crushed stone, slag, or rock dust. Properly selected and graded aggregates are mixed with the cementing medium asphalt to form pavements. Aggregates are the principal load-supporting components of an Asphalt Concrete pavement. They total 90 to 95 percent of the mixture by weight and 75 to 85 percent by volume.

Hence, the quality and physical properties of the aggregates should be controlled to ensure a good pavement.

Bituminous Binder: Asphalt binder 60/70 and 80/100 are used in this research. The bitumen used should have the following properties. Fig. 3

(i)Grade of bitumen used in the pavements should be selected on the basis of climatic conditions and their performance in past.

(ii)It is recommended that the bitumen should be accepted on certification by the supplier (along with the testing results) and the State project, verification samples. The procedures for acceptance should provide information, on the physical properties of the bitumen in timely manner.

(iii) The physical properties of bitumen used which are very important for pavements are shown below. Each State should obtain this information (by central laboratory or supplier tests) and should have specification requirements for each property except specific gravity.

(a) Penetration at 77° F, (b) Viscosity at 140° F (c) Viscosity at 275° F (d) Ductility/Temperature

(e)Specific Gravity (f) Solubility (g) Thin Film Oven (TFO)/Rolling TFO; Loss on Heating (h) Residue Ductility (i) Residue Viscosity.

Mineral Filler:- Mineral filler consists of, very fine, inert mineral matter that is added to the hot mix asphalt, to increase the density and enhance strength of the mixture. These fillers should pass through 75µm IS Sieve. The fillers may be cement or fly ash.

Figure:-4 Mineral Filler

Polythene:- The polythene used in Amul Milk packets was used as raw material for preparation of the samples. These polythene packets were collected; they were washed and cleaned by putting them in hot water for 3-4 hours. They were then dried.
Specific Gravity of polythene = 0.905

Figure – 5 Amul Milk Polythene use

METHODOLOGY: - AtRs8-9 per kg, plastic wastes are taken from highways, scrap, jilting- spots, & compost installations, as well as rag- selectors and waste- buyers. Household plastic, similar as empty milk bags and waste-
plastic bag, was also collected forthe design's work.Thecollected plastic waste was separated according to consistence conditions. For the coming step, polyethylene with a micron size of 60 microns or lower is generally employed. At advanced temperatures (150 ° c- 180 °c), small sized plastic is fluently mixed in the binder.

The plastic fractions were settled via 4.75 mm sieve before being collected in 2.36 mm sieve. To begin, Bitumen was melted at a temperature of about 150°c- 180 °c. Pieces were gently put into the heated bitumen, which was around 150-180°C. For around 20-30 twinkles, the admixture was manually mixed. During that time, the temperature was maintained at around 160-170°C.Penetration, rigidity, flashpoint, and fire point tests, as well as stripping, ring and ball tests, &MarshallStability value tests,were carried out using polymerbitumen composites of colorful compositions.

CONCLUSION: Polymer changed pavements might be a boon for India's warm and extraordinarily humid climate, wherein temperatures often rises beyond 50°C and torrential rains create havoc, leaving maximum of the roads with heavy distresses. This adversely impacts the lifestyles of the pavements. The polymer changed bitumen display progressed residences for pavement constructions. This can also lessen the quantity of plastics waste which in any other case are taken into consideration to be a danger to the hygiene of the environment.

(i) The characteristics of bitumen are changed when waste plastic is added.
(ii) On comparison with standard results, the plastic mixed bitumen performs well.
(iii) The ideal percentage of waste plastic to be utilized is between 5% and 10%.
(iv) In warmer weather, problems such as bleeding are less likely.
(v) Plastic can absorb sound, which aids in the reduction of noise pollution caused by excessive traffic.
(vi) As a result, waste plastics can be put to good use, enhancing the standard and performance of theroads.

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