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"OPTIMUM UTILIZATION OF POLYETHYLENE TEREPHTHALATE (PET) RESIN IN FLEXIBLE PAVEMENT"

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Abstract - This study represent the optimum utilization of polyethylene terephthalate (PET) resin in flexible pavement and also the concept of eco-friendly road construction which comprises eco-design, eco-extraction, eco-manufacturing, eco-construction, eco-rehabilitation, eco-maintenance, eco-demolition, and socioeconomic empowerment. Good transportation is most important infrastructure for our nation development. Road is also the greatest mode of transportation in India. And it's essential to realize economy within the construction of roads. Alongside the economy, quality plays a crucial factor to be considered. On the opposite hand, the domestic wastage and industrial wastage disposal may be a big problem. Especially the plastic which creates many environmental problems can't be decomposable in nature. it's generally recycled and reused. This investigation is to utilize the plastic waste within the sort of reinforcement in construction so as to extend its performance. There are some ways to realize economy and quality in much. it's utilized in flexible pavement for stabilization, to scale back the thickness of pavement. It includes eco-friendly construction, waste management, development of innovative material for construction of flexible pavement.

***Key Words*: Polyethylene Terephthalate (PET), Flexible pavement, Modified bitumen, Polymer, Geo-synthetics, etc.**

1. INTRODUCTION

A road is neat, well-constructed and well maintained is important for agricultural, commercial, industrial and cultural progress i.e. for overall development of country. within the road foundation or pavement, various sorts of defects are occurs like instability, pot holes etc. thanks to improper proportion of materials, inadequate thickness of pavement & separation or settlement of any layer or any reason then this defects are often overcome by using various Geo-synthetic materials in road pavement to improves such defects this is often our actually study as mentioned above. Geo-synthetics are defined as the manmade or natural fiber, which is useful in construction. they're made from natural fibers or synthetic fibers, which are weaved or bonded with partial melting, needle punching or the addition of chemical agents Generally, the Geo-synthetics are made from Polymer based Polypropylene, PVC, Polyester, Polyethylene, Polyamide, PET High Strength Woven Polyester Geo-textiles. Many plastics common to lifestyle are found in geo-synthetics. The foremost common geo-synthetics are polyolefin and polyester, rubber, fiber, glass, and natural materials are used. The function of Geo-synthetics plays role as a separator, filter, drainage, and reinforcement, protection, as a liquid and gas barrier. It is often also utilized in construction of road, railway embankment, earthen dam etc. Polyethylene terephthalate is usually referred to as PET or beverages plastic bottle. The PET is common thermoplastic polymer resin of the polyester family is used in fibers for textile, containers, thermoforming for manufacturing, and together with optical fiber for engineering resins. the bulk of the world's PET production is for synthetic fibers in more than 60%, with bottle production accounting for about 30% of worldwide demand. within the context of textile applications, PET is mentioned by its common name, polyester, whereas the acronym PET is usually utilized in reference to packaging. Polyester makes up about 18% of world polymer production and is that the fourth most.

1.1 Objectives

- To study the factors affecting utilization of PET resin in road pavement.
- To analyze the mechanical property of PET resin in road.
- To conduct experimentation on optimum utilization of PET resin in flexible pavement

and analyze result on the basis of experimental work.

2. LITRATURE REVIEW

PET is considered as one of the most important engineering polymers in the past two decades due to rapid growth in its use. It is considered a best material for several applications and is widely used for creating liquid containers (bottles). It has excellent tensile and impact strength, chemical resistance, clarity, process ability, color ability and reasonable thermal stability.

1. **A.F. Ahmad, A. R. Razali, I. S. M. Razelan (2004)**

The quantity of plastics used throughout the world is increasing every year. Municipal solid wastes (MSW), manufacturing processes and repair industries produce tons of waste plastic materials. The increasing awareness among consumers about the environment has contributed to the concerns over disposal of generated wastes. The growing number of plastic materials per year and limited landfill conditions causes many alternatives exist for the disposal of plastic waste. This paper provides a summary of the study on the use of polyethylene terephthalate (PET) in construction. From research that PET can improve properties of modified asphalt mixture. Having considered the economic and environmental prudent angles, utilization of PET as an additive to asphalt mixture is suitable to be used for road pavement.

2. **SwaptikChowdhury, AasthaTashkantManiar, and Om.Suganya**

This paper presents the work on synthetic fiber Polyethylene terephthalate (PET) as alternative construction entity. As plastic is non-biodegradable, its disposal has been a problem. Recently, PET fibers were proposed to be used as either reinforcement in concretes or being casted as blocks. And it can be accepted that PET is a successful building materials. PET fibre reinforced concrete offer less compression strength and flexural rigidity than conventional concrete but it offers high ductility thereby increasing deforming capability of the concrete. Also, lightweight materials production because of it reduces the density of the reinforced concrete.

This paper also presents the study on some other innovative ideas like PET panels and mattress or direct use of PET bottles for construction of non-load bearing walls with suitable fillers. The solution offered in the paper is one of the answers to long standing menace of waste disposal.

3. METHODOLOGY

3.1 Material Used:

1. Bitumen
2. Polyethylene terephthalate (PET) resin.

3.1.1 Bitumen

Fig 1- bitumen

Bituminous materials or asphalts are extensively used for roadway construction, primarily due to their excellent binding characteristics and water proofing properties and comparatively low cost. Bituminous materials consists of bitumen which may be a black or dark coloured solid or viscous cementitious substances consists chiefly high molecular weight hydrocarbons derived from distillation of petroleum or natural asphalt, has adhesive properties, and is soluble in carbon disulphide. Tars are residues from the destructive distillation of organic substances like coal, wood, or petroleum and are temperature sensitive than bitumen. Bitumen gets dissolved in petroleum oils where unlike tar. The desirable properties of bitumen depend on the combination type and construction.

3.1.2. Polyethylene terephthalate (PET) RESIN:

Fig 2 - Polyethylene terephthalate

PET is the most used thermoplastic polyester. PET is an acronym for polyethylene terephthalate, which may be long-chain polymer belonging to the generic group of polyesters. Polyethylene terephthalate (PET) is a semi-crystalline, thermoplastic polyester. PET is the polyesters which formed by a polymerization reaction between an acid and alcohol. PET may be polymer which easy to handle and also durable and strong, has low gas permeability, thermally stable and chemically. PET was used widely in the form of the automobile part, lighting product, food packaging, electronics, sports tools, x-ray sheets, house ware, textile, power tools and photographic applications. There are 60% of PET productions in term of bottles synthetic fibers.

3.2 Sources of PET Wastes:

Waste PET source can be subdivided into three which are foils, bottle, and cord from tires. Foils have two small problems with material recycling which is related to utilization of additive in production and molecular mass of PET. The bottle also has the same problem with foils, and it also has another one problem which is impurities problem. The cord from tires has big material recycling problem which is pollution of ground tire rubber and metals. Most of this waste is used as alternative fuel.

SN	Properties	Bitumen	PET resin
1.	Density	1.01 to 1.06	1.38
2.	Young's modulus	2000 Mpa	2800 Mpa
3.	Specific gravity	0.97 to 1.02	More than 1.1
4.	Melting point	120*C	More than 250*C
5.	Boiling point	More than 538*C	More than 350*C
6.	Solubility	None in water	None in water

3.3 Experimental performance of modified bitumen

3.3.1 Modified Bitumen

Certain additives or blend of additives called as bitumen modifiers can improve properties of Bitumen and bituminous mixes. Bitumen treated with these modifiers is called as modified bitumen. Polymer modified bitumen (PMB)/ crumb rubber modified bitumen (CRMB) should be used only in wearing course depending upon the wants of utmost climatic variations. The detailed specifications for modified bitumen are issued by IRC: SP: 53-1999. It must be noted that the performance of PMB and CRMB is depends on strict control on temperature during construction.

The advantages of modified bitumen are:

- Lower susceptibility to daily and seasonal temperature variations
- More resistance to deformation at high temperature
- Better age resistance properties
- Higher fatigue life for mixes
- Better adhesion between aggregates and binder
- Prevention of cracking and reflective cracking

3.4. EXPERIMENTAL TESTS ON MODIFIED BITUMEN

1. Penetration test
2. Ductility test
3. Flash and Fire point test
4. Softening point test
5. Specific gravity test
6. Viscosity test

4. RESULT

SN.	TEST ON MODIFIED BITUMEN	EXPERIMENTAL RESULT
1	PENETRATION TEST	32 mm
2	DUCTILITY TEST	45.5 cm
3	VISCOCITY TEST	52 sec.
4	FLASH POINT TEST FIRE POINT TEST	180*C 205*C
5	SOFTNEING POINT TEST	76*C
6	SPECIFIC GRAVITY TEST	1.2

Table 1- Result analysis

5. CONCLUSIONS

This research showcased the importance of eco-friendly road construction in our quest toward achieving sustainable development in the twenty-first century. It sheds light on the concept of eco-friendly road construction and likewise revealed the factors responsible for its emergence, the obstacles being faced in its adoption by stakeholders, and the benefits derivable from embracing eco-friendly road construction.

- Utilizing of pet improve properties of flexible pavement such as increase stability, stiffness and viscosity.
- Discarded plastic material can be used effectively in the modification of bitumen for construction of flexible pavement.

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