

Experimental study of bitumen properties by using polythene waste

Swapnil Anant Sadi¹, Ajay Digamber Rathod², Suyash Rajendra Ture³, Rohit Sharad Thakare⁴,
Prof. S.S.Mane⁵, Dr.N.V. Khadake⁶

Student, of Civil Engineering, JSPM's Imperial College Of Engineering & Research Wagholi, Maharashtra, India

Assistant Professor, Dept. of Civil Engineering, JSPM's Imperial College Of Engineering & Research Wagholi, Maharashtra, India

Abstract: *The purpose of the experimental investigation is to look into how bitumen's properties are affected by the addition of polythene trash. Due to its inability to degrade naturally and its long-lasting negative effects on the environment, polythene trash is a significant environmental hazard. In order to dispose of polythene trash sustainably, the study suggests adding it to bitumen, which is frequently used in road building. In this study, different amounts of polythene trash were added to bitumen (2%, 4%, 6%, 8%, and 10% by weight of bitumen) and their properties were compared to those of pure bitumen. Standard tests, such as those for penetration, softening point, ductility, and viscosity, were used to assess the bitumen's qualities. The study's findings demonstrated that bitumen's characteristics were enhanced by the addition of polythene trash. As polythene concentration rose, the penetration value dropped, suggesting that bitumen stiffness had increased. The modified bitumen's softening point grew, showing that its high-temperature characteristics had improved. The modified bitumen's ductility also increased, indicating a rise in its capacity to deform without breaking. Finally, the modified bitumen's viscosity increased, showing that its workability had improved. Overall, the study finds that mixing polythene trash with bitumen is a viable way to improve bitumen's qualities while lowering polythene waste's environmental impact. Due to the low cost and easy availability of polythene trash.*

Keywords - *Experimental study, bitumen properties, polythene waste, sustainable solution, environmental impact, road construction, penetration, softening point, ductility, viscosity, high-temperature properties, workability, cost savings.*

I.I

INTRODUCTION

Bitumen: Based on the material provided, it appears that the writers are discussing bitumen's detrimental impacts on the environment and the economy as well as the quest for alternative, more environmentally friendly techniques for flexible pavements. The study's authors noted that a range of materials, including waste and bio-based materials, were used in its execution, including plastics, polymers, waste cooking oil, and waste oil. The use of plastic trash to create local materials and goods is also discussed in this study. The authors also mentioned that India now discards 5.6 million tonnes of plastic waste annually. The writers emphasise the harm that plastic trash does to both people and animals as well as the significance of disposing of plastic garbage properly in compliance with legal requirements. The usage of cement waste, according to the authors, can have considerable economic and environmental advantages. The authors also noted that polyethylene is the main material used to make plastic waste and that using waste in building will be a significant means of cutting waste.

Recycling has the advantage of being popular and lasting a long period, which makes it take a long time for waste to remove wastewater. The demand for products made of plastic is rising along with the number of automobiles in India over the past several years.

Given the higher cost of raw materials, usage limits, and environmental issues, such as the disposal of trash that is related to fire and health, prompt execution of waste disposal is crucial. In this world, there is only one thing. Each year, 1.5 billion waste plastics are created, of which 40% are produced in developing nations including China, India, South America, Southeast Asia, South Africa, and Europe. Plastic is currently abundant in this area because it is used in every new car in India. According to analysis, the nation generates 600,000 tonnes of plastic waste annually. The average person should discard one piece of plastic each year, according to the plastics industry.

The best estimate that can be made is based on plastic items, taking into account the nation's plastic stocks. Therefore, as India's population grows, so will the amount of plastic garbage in the years to come. Plastic trash disposal from supporting actors at locations may also be made mandatory in urban areas by 2010–11 and across all of India by 2012–13. The management of plastic garbage, one of the numerous distinct waste types that cities contend with, has been progressively more challenging in recent years. Since plastics have a propensity to float to the surface, they are all challenging to dispose of.

Storage immediately results in a loss of energy and resources, in addition to fire and health risks, and environmental issues. Common usage and fundamental characteristics of plastic. Additionally, the expansion of India is closely related to the demand for plastics. From 1960 to 2005, the average annual growth of polymers climbed from 7 million tonnes to 196 million tonnes, and it continued to rise to over 365 million tonnes in 2015, rising by 6.5% annually in 2020 utilising a variety of different methods.

growth factors. Plastic items are thrown away when used. They are not biodegradable, so they end up in landfills or are incinerated. They are not environmentally friendly processes as both pollute the soil and air.

II. Materials

Bitumen: Petroleum that is viscous, black, sticky, or semi-solid. It is a crucial component in roofing, waterproofing, and construction. It is an asphalt and mineral aggregate mixture that is used in building. Bitumen is a strong, weatherproof substance. When building walls, roofs, and other structures, bitumen-based waterproof membranes are utilised to keep out water. Surfaces are coated with bituminous coating, which is made by combining bitumen and solvents, to protect them from water and other environmental elements. Bitumen is used as a binder to create this particular form of concrete. Used for laying: parking lots, airport runways, and roads. These protective coatings are used to guard against corrosion and other harm to metal surfaces. To stop water intrusion, they are used to seal joints and fissures in concrete, asphalt, and other surfaces.

Thermoplastic waste: Thermoplastic is a form of plastic that can be repeatedly melted and replaced without causing the product to change chemically. However, the disposal of thermoplastic trash could raise environmental issues due to their non-biodegradable nature. One of the most popular thermoplastics, polyethylene (PE), is utilised in a variety of packaging materials, including plastic bags, bottles, and food containers. PE waste can be recycled into a variety of goods, including plastic bags, sheets, and films. Polypropylene (PP) is a tough and light material used in a wide range of goods, such as packaging, automobiles, and home goods. Waste polypropylene (PP) can be recycled into new materials, fibres, and other goods.

Polystyrene (PS) is a thermoplastic that is lightweight and strong and is used to make a number of items, including plates, glasses, and food containers. PS garbage can be repurposed into picture frames, insulation, and other goods. Polyvinyl Chloride (PVC): PVC is a robust, long-lasting thermoplastic that is utilised in a wide range of products, such as instruments, tubing, and medical equipment. Waste PVC can be utilised for roofing, flooring, and other construction materials.

Fiber Plastics:

Fiber reinforced plastics (FRP) are composites made from a polymer matrix, usually a thermoset resin or thermoplastic, to which fibers such as glass, carbon, or aramid are added.

Glass Fiber Reinforced Plastic (GRP): FRP is a composite material produced from glass fiber reinforced thermoset resin. It is generally used in building panels, roofs and pipes in the construction industry.

III. LITERATURE REVIEW

Thermoplastic: Thermoplastic polymers are materials used for the design and manufacture of various products in a variety of applications. G R E Mărieş (2018) Thermoplastic materials can be heated at a certain temperature and a certain pressure to form the desired shape, and this process can be repeated many times without changing the change in the first product sample. Ala R. Abbas et al. (2013) described the effect of using asphalt tiles on the physical and chemical properties of untreated asphalt binders. Untreated asphalt binder was mixed with RAS at different ratios (0%, 5%, 7% and 10%). However, PAV-aged connectors with a high percentage of RAS achieved a high level of aging; this indicates that the addition of RAS generally affects the durability of bituminous binders. The addition of RAS makes it more difficult to mix and hold the asphalt binder and improves the performance of the asphalt binder in rutted conditions. AMIT GAWAANDE (2012) The two main classes of plastics, thermoplastics and thermosets. It is also important to note that thermoplastics are the most widely used plastic products. You also said that the chart shows that the average amount of municipal waste in India is between 0.21 and 0.50 kg per capita per day. This means that India generates an average of 0.21 to 0.50 kg of waste per person per day, including plastics and other materials. This information can be useful to policy makers and individuals when developing waste management strategies and practices to reduce the environmental impact of plastics and other waste products. It highlights the need for sustainable solutions and increased awareness of responsible waste disposal practices to minimize negative impacts on the environment and public health. Rayees Ahmad Khan (2020) shows the rapid growth of the bottling industry, where sales have increased 500% over the last decade. Bottled water production requires a lot of plastic, and 1.5 million tons of plastic are used in bottled water each year. However, plastic bottle recycling has not kept up with the increase in sales of virgin polyethylene terephthalate (PET), so care must be taken to reduce, reuse and recycle plastic waste. Recycling of plastic bottles thrown from jugs is an important area. These bottles are usually made of high density polyethylene (HDPE) or low density polyethylene (LDPE). To avoid this, used plastic bottles can be cut and shredded, which is a necessary step in the recycling process. By recycling waste plastic bottles, we can reduce the amount of plastic waste that ends up in landfills and the oceans, and create new products from recycled materials. This promotes a sustainable approach to plastic waste management and helps protect the environment.

Fibrous Plastics: A composite material consisting of two or more different physical components, the combination of which forms a polymeric material different from the component parts. K. P. Ashik (2015) Natural fibers dominate the automotive, construction and sports industries with their superior mechanical properties today. These natural fibers include flax, hemp, jute, sisal, kenaf, coconut, and others [2]. J. Nacer Akkouri (2020) The plastics industry is most important in Morocco, where three thermoplastics - polypropylene, low polyethylene and polystyrene - are widely used. But these materials create a lot of plastic waste, and most of it is not even reused. Recycling and reuse of plastic waste in Morocco is important in terms of reducing the negative impact on the environment, such as reducing the amount of plastic waste in nature, as well as improving the country's economy. It should be noted that Morocco's plastics industry relies on raw materials that can be expensive and affect the country's economy. Therefore, promoting the recycling of waste materials can create opportunities for the development of local recycling industries, thereby helping to reduce the country's dependence on raw materials and create new jobs. Also, knowing the public's knowledge of responsible waste disposal can encourage

people to reduce plastic waste and create a cleaner environment. Sahil Harshe (2022) shows that the use of plastic in road construction is not a new idea, PVC or HDPE pipe is already used as a mesh junction. These joints are made by connecting PVC or HDPE pipes to the plastic mattresses on the road so that the wet load does not leave ruts. Additionally, recent research has shown some promise in the use of plastic waste in road construction. Bangalore based company and team working in R. V. Bangalore. Engineering faculty discovered a way to use plastic waste in construction. The team conducted the first study to measure strength and endurance in 1997. Plastic cloth bags, disposable cups and PET bottles collected from landfills are often used as the main components of the product. When the plastic is mixed with hot asphalt, it melts to form an oil film on the aggregate and is then placed on the road like asphalt. The use of plastic waste in road construction will be a promising solution to the problem of plastic waste management while providing safe and sustainable roads. A new way to help reduce plastic pollution and improve road quality.

Table – I Percentage of modifiers by different authors

Author	Percentage of Modifiers	Type of Modifier
S. S. Kerkar	8-10	Polyvinyl chloride(PVC)
M. Mahalakshmi	5-9	HDPE and LDPE
T.Sarada	6-8	Polyethelene
R.Manju	10	PVC or HDPE
Satyam Pathak	5	LDPE
Neeraj kumar	8-10	PS, PP and PE

List of symbols and Abbreviations :

LDPE – Low Density Poly Ethylene LDPE

HDPE – High Density Poly Ethylene

PVC – Polyvinyl Chloride

PE– Polyethylene

PS– Polystyrene

PP– Polypropylene

PET– Polyethylene terephthalate

IV. CONCLUSION

Conclusion: By utilising different resources, such as thermoplastic and fibre waste, conventional asphalt's drawbacks and negative effects on the environment can be successfully avoided. It has been demonstrated that using polyethylene trash can strengthen and increase the workability of asphalt mixes while also offering a non-biodegradable waste management option. Utilising plastic trash in asphalt mixtures is a straightforward operation that may be carried out without the use of technology. It's crucial to research and adopt sustainable construction methods since plastic waste pollution is caused by the growing use of plastic products.

V. REFERENCE

- 1) G R E Mărieş “Thermoplastic polymers in product design,” IOP Conf. Series: Materials Science and Engineering 393 (2018) 012118 doi:10.1088/1757-899X/393/1/012118
- 2) K. P. Ashik “A Review on Mechanical Properties of Natural Fiber Reinforced Hybrid Polymer Composites,” Journal of Minerals and Materials Characterization and Engineering, 2015, 3, page no-320-326
- 3) T.Sarada*, G.Sreeja “An Experimental Study on Plastic Blended Bituminous Concrete Mix Roads”, International Journal of Engineering & Technology 7, page no :37-42.
- 4) R.Manju “Use of Plastic Waste in Bituminous Pavement” International Journal of Chem Tech Research, 2017, 10(8), page no : 804-811.
- 5) Ms. S. S. Kerkar “A Review on use of Plastic in Bituminous Roads” International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, 05, May-2021, page no:972-974.
- 6) Mrs. M. Mahalakshmi “Utilization of Waste Plastic in Bitumen” International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, 2, February – 2014, page no: 2720-2727.
- 7) Namarata Sanjay Desai “Effect of Hydrogenated Vegetable Oil and Grease On Stability of Bitumen Mix”, International Research Journal of Engineering and Technology (IRJET), page no: 2395-0056.
- 8) S. Shankar and C.S.R.K. Prasad, “Evaluation of Rutting Potential for Crumb Rubber Modified Bitumen in Asphaltic Mixes,” Emirates Journal for Engineering Research, pp.91-95, 14(2), 2009
- 9) Apurva J C,(2013), “Use of Plastic Waste in Flexible Pavements”, International Journal Of Application or Innovation In Engineering, Vol 2, Issue 4, PP.540-552.
- 10) Rokade S. “Use of Waste Plastic and Waste Rubber Plastics in Flexible Highway Pavements,” 2012 International Conference on Future Environment and Energy (IPCBE), vol.28(2012), IACSIT press, Singapore.
- 11) Nacer Akkouri “Recycled thermoplastics modified bitumen improved with thermoplastic elastomer,” E3S Web of Conferences 150, 0 (2020).