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USE OF LOW DENSITY POLYETHYLENE IN FLEXIBLE PAVEMENTS

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ABSTRACT

The utilization of plastic waste in flexible pavement construction has emerged as a sustainable solution to address environmental concerns and improve the performance of road infrastructure. In this work, the use of low density polyethylene (LDPE) carry bags manufactured from shredded waste plastic has been compared between wet and dry bituminous mixes for flexible pavements. The ductility test on bitumen is conducted to measure the elongation properties of a binder material in the mix for the blends. The data suggests that plastic-modified aggregates exhibit favorable properties, making them a promising avenue for sustainable road construction practices. Additionally, utilizing waste plastic in road construction contributes to sustainable waste management practices by diverting plastic waste from landfills and oceans. This thesis investigates the feasibility and benefits of integrating polyethylene, a versatile polymer, into flexible pavement systems. Through comprehensive laboratory testing and analysis, it examines the impact of polyethylene additives on pavement properties. Key parameters including mix design, polymer dosage, and manufacturing techniques are evaluated to optimize pavement performance. Additionally, environmental and economic implications are assessed to understand the feasibility aspect of employing polyethylene in flexible pavements.

Keywords: Flexible pavement, Polyethylene additives, Durability, LDPE, Marshall Stability, Waste Plastic.

INTRODUCTION:

The construction industry has been increasingly drawn towards sustainable practices, seeking innovative solutions to address environmental concerns while maintaining infrastructure integrity. Among these innovations, the integration of recycled materials into construction materials has emerged as a promising avenue for sustainable development. One such material of growing interest is Low Density Polyethylene (LDPE), a widely used plastic known for its versatility and durability.

The utilization of LDPE in flexible pavements, focusing on its effects on aggregate and bitumen properties, as well as its impact on Marshall values for plastic blends. Flexible pavements are characterized by their ability to distribute loads over a wider area. By exploring the incorporation of LDPE, we aim to assess its potential to enhance the performance and longevity of flexible pavements while concurrently addressing the issue of plastic waste. The integration of LDPE into flexible pavements is a multifaceted process that involves understanding its interaction with key components such as aggregates and bitumen. Aggregates serve as the foundation of pavement structure, providing stability and load-bearing capacity, while bitumen acts as the binder, holding the aggregates together. Therefore, any alterations to these components must be thoroughly evaluated to ensure optimal pavement performance.

Marshall method is widely adopted technique for evaluating the mechanical properties of asphalt mixtures, provides valuable insights into the behavior of LDPE-modified blends. By analyzing Marshall values such as stability, flow etc we can assess the overall performance of LDPE-modified mixtures and compare them with traditional asphalt mixes.

LITERATURE REVIEW

Wilson Uzochukwu Eze (2023) [1] Since what matters most after usage is what we do or do not do, plastics are not intrinsically harmful. When used properly, plastics are lightweight, smooth to the touch, visually appealing, practically cost-effective, and sustainable. The demand for, and use of, plastic products for a wide range of applications are steadily increasing due to these advantageous qualities.

Sahil Harshe (2022) [2] Pollution and global warming are the results of disposing of plastic waste, which is a serious environmental issue. Asphalt mixtures are strengthened and given additional properties by adding plastic waste. Along with fixing other pavement flaws including ruts, potholes, and corrugation, it will also provide a solution for the disposal of plastic.

Nitin Dutt Anupam (2022) [3] Waste made by plastic is a widespread issue these days. Waste plastic that, with the right processing, can be used again to build roads. Plastic is an everlasting and poisonous substance. Because waste plastics are not biodegradable and are very damaging tohuman health when disposed of improperly, they constitute a threat to global security and

pollution of the earth and water. Betel nut, chocolate, chip, hand bag, cold drink bottle, and all other plastic wrappers pose serious environmental and financial issues.

Prof. Y. S. Patil (2021) [4] All around the world, plastic is a global phenomena with lingering effects. Researchers have shown that plastic garbage is not biodegradable and can persist on Earth for up to 4500 years without experiencing any changes. Two categories of plastic trash exist: thermoses and thermoplastic. These polymers include polyethylene tetrathatate, polyimide, and polyoxemethylene. Making items out of thermoplastic is simple.

MATERIAL AND METHODOLOGY

1. Bitumen
2. Aggregate
3. Low Density Polyethylene

Table 1: Indian Bitumen Specifications of Viscosity Grade Bitumen

Properties Tested	IS Codes	Values for VG-30 Bitumen
Penetration	IS 1203	50-70
Softening Point	IS 1205	47
Ductility	IS 1208	40
Specific Gravity	IS 1202	1.02
Flash Point	IS 1209	220
Fire Point	IS 1209	230

The aggregates comprises of required grading having sizes of 20 mm and 10mm.

Table 2: Physical Properties of Aggregates

Descrition of Test	Specifications IRC 111-2009
Aggregate Crushing Value	Max. 30%
Impact Value	Max. 24%
Specific Gravity	2.5-3.0
Water Absorption Value	Max. 2%
Los Angeles Abrasion Value	Max. 30%

The plastic waste LDPE in shredded from the refuse of local area was used as an additive. It was cut into pieces of even size between 2.36 mm - 600 micron with the help of shredder.

Table 3: Properties of Plastic Waste

Property	Values
Size	2.36 mm-600 micron
Thickness	20-30 micron
Melting temperature	130-160

RESULT AND DISCUSSION

Following is the variation of aggregate properties with different percentage of plastic content

Table 4: Result of tests on aggregate

ggregates	astic content %	ggregate Impact alue %	os Angeles brasion value	ater absorption
ithout plastic		.04	2.76	
ith plastic		.57	.35	7
ith plastic	)	32	88	1

Following is the variation of bitumen properties with different percentage of plastic content

Table 5: Results of tests on bitumen

itumen	astic content %	enetration value	oftening point	Ductility
00		)	3	83
5		5	2	64
)	)	3	l	55

Table 6: Properties of Bitumen Plastic Blend

lastic Content %	Stabilty (kg)	Flow (mm)
0	970	3.5
5	1490	3.9
10	1700	4.6

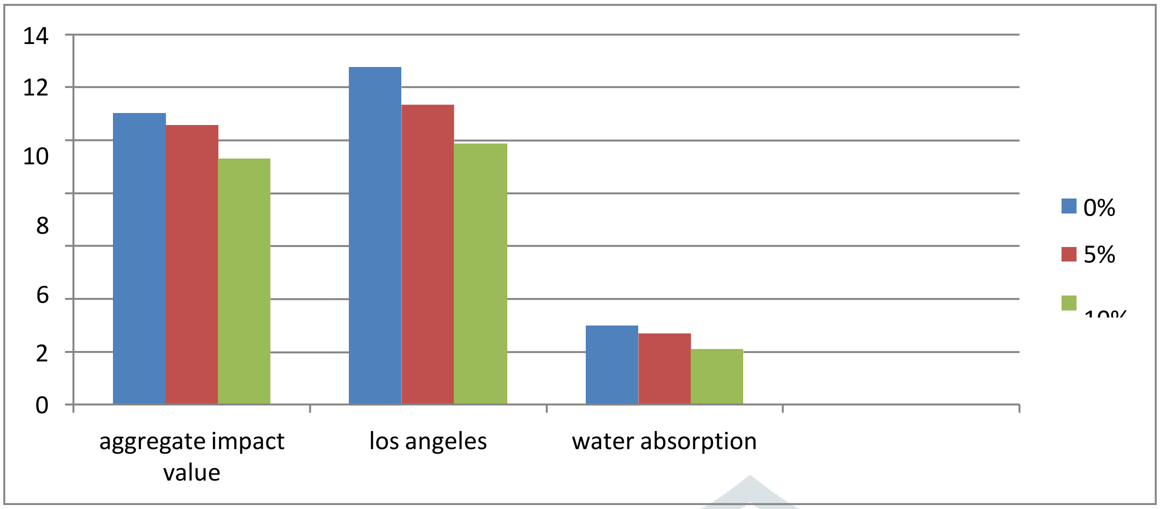

Figure 1: Graph represent results of various test on aggregate

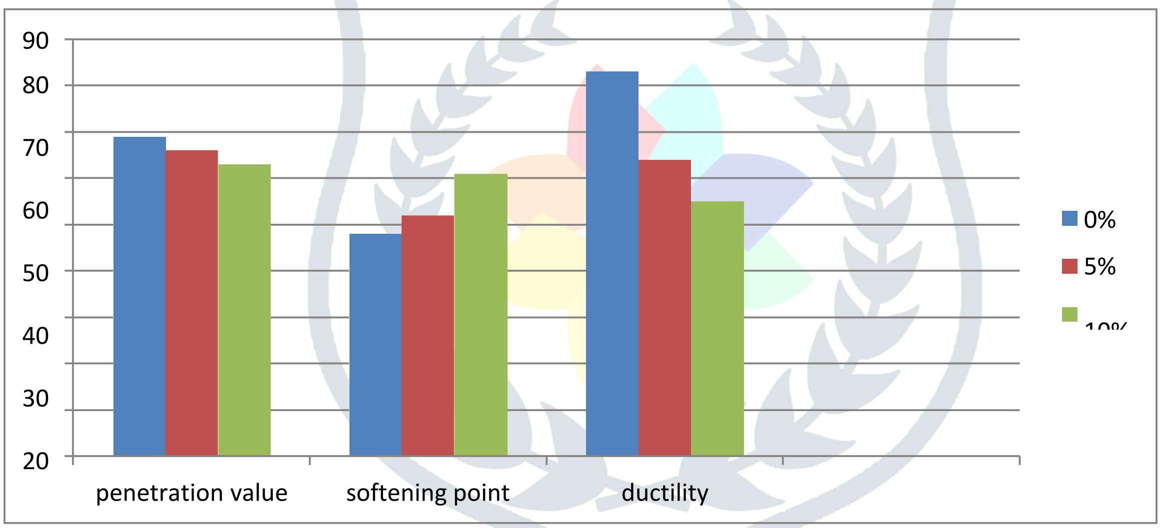

Figure 2: Graph represent results of various test on bitumen

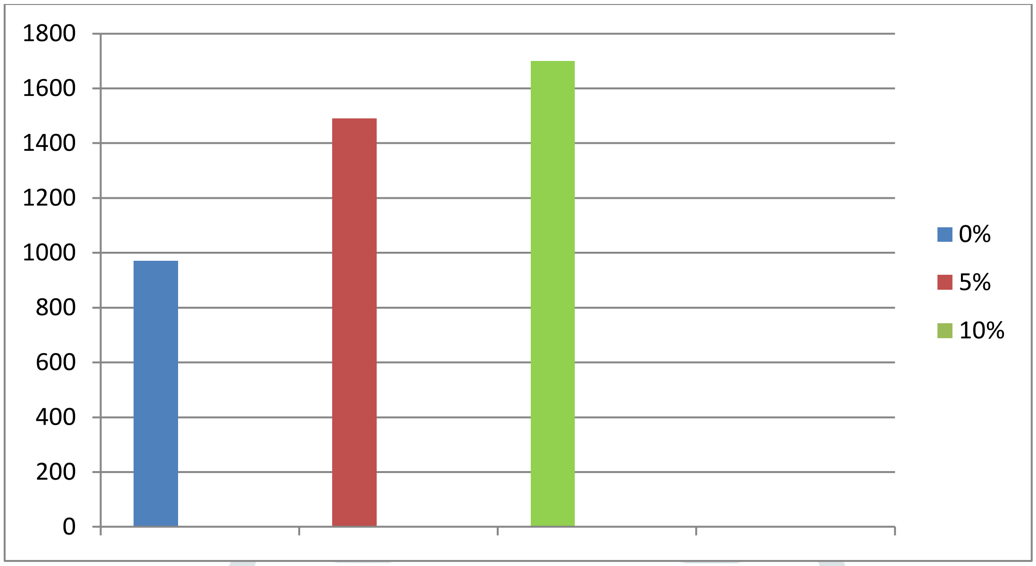

Figure 3: Marshall Stability chart with different proportions of plastic content

CONCLUSION

1 The utilization of LDPE in combination with aggregate and bitumen in flexible road construction presents a promising solution to address both environmental concerns and infrastructure needs.

2 It shows that the increase of waste plastic in bitumen increases the properties of aggregate and bitumen.

3 Use of waste plastic in flexible pavement shows good result when compared with conventional flexible pavements.

4 Stability and flow value in Marshall Stability test also increase with increase in plastic content.

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