International Journal of Engineering, Management, Humanities and Social Sciences Paradigms (IJEMHS)
Volume 30, Issue 02, Quarter 02 (April to June 2018)
An Indexed and Referred Journal with Impact Factor: 2.75
ISSN (online): 2347-601x
www.ijemhs.com

Utilization of LDPE and HDPE Polymer as a Binder and as Filler in Bituminous Mix

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Publishing Date: June 07, 2018

Abstract

The millennium objective for the development encourages countries to a sustainable management of their waste based on the preservation of their environment and natural resources. So, plastic waste management has become a major challenge considering their life span and their impact on environment. Disposal of waste materials like plastic bags has become a serious problem. Waste, mostly plastics are burnt for apparent disposal which cause severe environmental pollution. Utilization of waste plastic bags in bituminous mixes has proved that these enhance the properties of mix in addition to solving disposal problems. Plastic waste which is cleaned is cut into a size such that it passes through 2-3 mm sieve using shredding machine. The use of the innovative technology will not only strengthen the road construction but also increases the road life as well as will help to improve the environment. By this process a road of 1 km length and 3.375 m width of single lane can consumes 1000000 carry bags and the road strength is increased by up to 100 % and there is no pothole formation. The mix polymer bituminous concrete showed higher strength. Use of this mix for road construction helps to use plastic waste. Once the plastic waste is separated from municipal waste, the organic matter can be converted into manure and used. The main object of the project is to analyze & study how the waste plastic can be efficiently utilized in construction of flexible pavements as a binder material for replacing the content of bitumen and as a filler in aggregate in detail process & its successful application.

Keywords: *LDPE, HDPE, Bituminous Mix.*

Introduction

Present Scenario

Bituminous binders are widely used in road paving and their visco-elastic properties are dependent on their chemical composition. Now-a-days, the steady increment in high traffic intensity in terms of commercial vehicles, and the significant variation in daily and seasonal temperature put us in a situation to think about some alternative ways for the improvement of the pavement characteristics and quality by applying some necessary modifications which shall satisfy both the strength as well as economic aspects. Bitumen can also be modified by adding different types of additives to achieve the present requirement. One of these additives is the polymers.

Waste Plastic: The Problem

Today availability of plastic waste is enormous. The use of plastic materials such as carry bags, cups, etc. is constantly increasing. Nearly 50% of total plastic are consumed for packing [1]. Once used, plastic packing materials are thrown outside and they remain as waste. Plastic wastes are durable and non-biodegradable. The improper disposal of plastic may cause cancer, reproductive problems in humans and animals, genital abnormalities and much more. These plastic wastes get mixed with water, disintegrate, and take the forms of small pallets which cause the death of fishes and other aquatic life who mistake them as food material. Sometimes they are either land filled or incinerated. Plastic wastes get mixed with the municipal solid waste or thrown over a land area. All the above processes are not eco-friendly as they pollute the land, air and water. Under these circumstances, an alternative use of these plastic wastes is required. So any method that can use this plastic waste for purpose of construction is always welcomed.

Objective of the work

The main objective of this work is to evaluate the influence of the waste plastic on the mechanical properties of the bituminous concrete mixes with a view of finding an alternate disposal and usage of this waste plastic.

Results

Experimental Observations

Table 1: Marshall Properties of bitumen with variable composition of LDPE

Bitumen Content	LDPE Content	Flow Value	Stability	Water Absorption %	% Air Voids
5	3	5.7	2100	0.882	8.22
5.5	3	5.8	1785	0.67	7.64
5	5	5.79	1738	1.2	8.6
5.5	5	7.43	1828	0.7	8.11
5	8	6.53	2055	1.02	8.3
5.5	8	7.82	2025	0.82	9.08
5	0	6.71	1650	0.99	10.37
5.5	0	8.18	1522	0.88	9.91

Table 2: Marshall Properties of bitumen with Variable composition of HDPE

Bitumen %	HDPE Content %	Flow Value	Stability	Water Absorption	% Air Voids
5	5	8.226	3041	0.76	4.97
5.5	5	6.14	3205	0.72	5
5	8	7.89	3581	0.7	7.62
5.5	8	5.42	3241	0.68	6.1
5	12	9.26	3776	0.65	10.19
5.5	12	7.89	3479	0.63	11.49
5	0	6.71	1650	0.99	10.37
5.5	0	5.2	1522	0.88	9.91

Table 3: Test results of Ductility and Penetration tests with variable LDPE composition

Test	LDPE Content	Test Results	Standard Results
Ductility	0%	77.4	75
	3%	55.5	17
	5%	46.2	11
Penetration	0%	69.7	50-80
	3%	39	30-50
	5%	31.3	20-30

Table 4: Comparative Analysis Result for different properties of Marshall Mix

	Plastic	% Content	Bitumen	Stability	Flow Value	% Water Absorption	% Air Void
Plastic as a Binder	LDPE	3%	5.0%	2100	5.7	0.882	8.22
			5.5%	1785	5.8	0.67	7.64
		5%	5.0%	1738	5.79	1.2	8.6
			5.5%	1828	7.43	0.7	8.11
Plastic as A filler	LDPE	8%	5.0%	2055	6.53	1.02	8.3
			5.5%	2025	7.82	0.82	9.08
	HDPE	5%	5.0%	3041	8.226	0.76	4.97
			5.5%	3205	6.14	0.72	5
		8%	5.0%	3581	7.89	0.7	7.62
			5.5%	3241	5.42	0.68	6.1
		12%	5.0%	3776	9.26	0.65	10.19
			5.5%	3479	7.89	0.63	11.49
Normal Mix		0%	5.0%	1650	6.71	0.99	10.37
			5.5%	1522	8.18	0.88	9.91

Conclusion

In dry process plastic coating on aggregates is used for the better performance of roads. This helps to achieve a better binding of bitumen with plastic wasted coated aggregate due to increased bonding and increased area of contact between polymers and bitumen. The polymer coating also reduces the voids. This prevents the moisture absorption and oxidation of bitumen by entrapped air. This has resulted in reducing rutting, raveling and there is no pothole formation. The roads can withstand heavy traffic and show better durability. In wet process plastic mixing with bitumen is used for the better performance of roads. Polyethylene shows adhesion property in its molten state. Plastic will increase the melting point of the bitumen. The waste plastic bitumen mix forms better material for pavement construction as the mix shows higher Marshall Stability value. By this technique, which is in situ, waste polymer like carry bags, foam, laminated sheets, cups are all used for road laying. Moreover, the use of polymers helps to reduce equivalent quantity of bitumen, thus reducing the cost of the road laying.

References

[1] Central pollution control board (2008)
[2] IS 2386 ,1963
[3] ASTM D 1559
[4] IS 1203 ,IS 1205,IS 1208 (1978) and IS 15462,2004
[5] Eco- friendly binder inflexible pavement Mayura M. Yeole&Vishvas A. Jagpat (2014)
[6] Effect of plastic waste content on Physico-Mechanical properties of flexible Pavements (2011)Konin A,
[7] A technique to dispose waste plastics in an eco-friendly way – Application In construction of flexible pavements(2011)R. Vasudevan , A. Ramalinga Chandra Sekar , B. Sundarakannan, R.Velkennedy
[8] Effective Utilization of Waste Plastic In Construction Of Flexible Pavement For Improving Their Performance Mr. P. B. Rajmane, Prof. A.K. Gupta Prof. D. B. Desai.