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Plastic Waste Bituminous Road Using Polythene

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ABSTRACT*:* The waste plastic and its disposal is a major threat to the environment, which results in pollution and global warming. The idea of using waste plastics in road construction is relatively new. Laboratory tests have shown positive results when a small amount (5-10% by weight) of plastic is incorporated in bituminous mixes (asphalt), resulting in improved pavement stability, strength, and durability. However, international field experience using plastics in actual road construction is quite limited. Bituminous Concrete (BC) is a composite material mostly used in constructionprojects like road surfacing, airports, parking lots etc. It consists of asphalt or bitumen (used as a binder) and mineral aggregate which are mixed together & laid down in layers then compacted.

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 demanding situation to think of some alternatives for the improvisation of the pavement characteristics and quality by applying some necessary modifications which shall satisfy both the strength as well as economical aspects. Also considering the environmental approach, due to excessive use of plastic in day to day business, the pollution to the environment is enormous. Since the plastic are not biodegradable, the need of the current hour is to use the waste plastic in some beneficial purposes. This paper presents a research conducted to study the behavior of BC mix modified with waste plastic.Various percentages of plastic are used for preparation of mixes with a selected aggregate grading as given in the IRC Code.

KEYWORDS*:* Bituminous Concrete (BC), Plastic Waste, Bituminous Road, Biodegradable, Pavement, Aggregate, Construction, Strength, flexible pavement

I. INTRODUCTION

1.1 General Introduction:

Plastic is everywhere in today's lifestyle. It is used for packaging, protecting, serving, and even disposing of all kinds of consumer goods. With the industrial revolution, mass production of goods started and plastic seemed to be a cheaper and effective raw material. Today, every vital sector of the economy starting from agriculture to packaging, automobile, building construction, been virtually revolutionized by the applications of communication or InfoTech has plastics. Plastic in different form is found, which is toxic in nature. It is commonly collected both urban and rural areas. It creates stagnation of water and associated hygiene problems. Plastic waste hazard to the environment .Plastic waste can be reused productively in the construction of road.

1.1.1 Bituminous Concrete (BC):

Bituminous binders are widely used by paving industry. A pavement has different layers. The main constituents of bituminous concrete (BC) are aggregate and bitumen. Generally, all the hard surfaced pavement types are categorized into 2 groups, i.e. flexible and rigid.

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.

Rigid Pavement :

If the surface course of a pavement is PCC then it is called "rigid" since the total pavement structure can't bend or deflect due to traffic loads. Such pavements are much stiffer than the flexible pavements due to the high modulus of elasticity of the Plain Cement Concrete material. Importantly, we can use reinforcing steel in the rigid pavements, to decrease or eliminate the joints.

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1.2 International experience using waste plastics in road construction:

Using waste plastics in road construction is a relatively new idea and no roads have been constructed entirely from plastics. However, a review by Huang et al. (2007) suggested that recycled plastics can either replace aggregates or serve as a binder modifier. Waste plastic has potential for use in bituminous road construction as its addition in small doses (about 5-10% by weight of bitumen) helps in substantially improving the stability, strength, fatigue life and other desirable properties of bituminous mixes, leading to improved longevity and pavement performance (Kalantar et al., 2012; Vasudevan et al., 2012; Indian Road Congress, 2013). Laboratory and field performance studies report that using waste plastic in bituminous mixes increases durability and results in higher resistance to deformation and water induced damage, indirectly contributing to user satisfaction and accident reduction (Bale, 2011; Behl et al., 2012; Bhoot et al., 2012; Khursheed and Singh, 2017; Manju et al., 2017). The addition of waste plastic in the bituminous mix results in a reduction of bitumen consumption, thereby resulting in reduction of costs (Vasudevan and Rajasekaran, 2006; Rashid et al., 2009; Behl et al., 2012; Vasudevan et al., 2012). Using waste plastic for road construction also contributes to longer road service life (Sojobi et al., 2016).

1.3 India:

India is the country where there appears to be the most experience with using waste plastics in road construction. India has promoted the use of waste plastic in bituminous mixes for the construction of its national highways and rural roads, and has approved it as a default mode of periodic renewal with hot mixes for roads within 50 km periphery of urban areas with more than 500,000 population (Government of India, 2015; National Rural Roads Development Agency, 2019). The Indian Road Congress (2013) has published guidelines for the use of waste plastic in hot bituminous mixes while the National Rural Roads Development Agency (2019) provides guidance on the use of waste plastic specific to rural roads construction.Since 2002, waste plastic has been used to construct more than 2500 km of roads which were reportedly functioning well without potholes, ravelling and rutting up to ten years later (Vasudevan et al., 2010; Indian Road Congress, 2013). Poor binding between the aggregates and bitumen is one of the reasons for such defects in standard road construction, but binding between plastic coated aggregate and bitumen is stronger in comparison to standard construction techniques (Vasudevan et al., 2012; Mishra and Gupta, 2018). According to Vasudevan et al. (2012) a tonne of waste plastic was used for every 1 km of road constructed, which reduced carbon dioxide emissions by 3 tonnes/km in comparison to standard construction techniques.

1.4 Plastic Waste:

Plastic waste, or plastic pollution, is 'the accumulation of plastic objects (e.g.: plastic bottles and much more) in the Earth's environment that adversely affects wildlife, wildlife habitat, and humans. 'The waste plastic used are poly-ethylene, polystyrene , polypropylene. The waste plastic is shredded & coated over aggregate & mixed with hot bitumen and resulted mix is used for pavement construction. This will not only strengthen the pavement and also increases its durability.

Advantages of Plastic waste in Pavement:

- Reduce the need of bitumen by around 10%.
- Develop a technology which is eco-friendly.
- Improvements in fatigue life of roads.
- Increase the strength and better performance of the road.
- Use higher percentage of plastic waste.
- The gases released during traffic conditions are absorbed by smoke absorbent.

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(Fig 1: Plastic waste for Road Construction)

1.4.1 Disadvantages of plastic:

1. Decomposition:

The main disadvantages of plastic bottles is the shear amount of time they take to decompose he averages plastic bottle takes 500 years plastics decomposition can be agented by various factors, such as the types of plastic, the climate and acids in the landfill; plastic still lasts a long time, filling landfills for an indefinite period.

2. Non-renewable:

Plastic is manufactured using oil by products and natural gas material that could be used in numerous other applications or conserved was plastic usage lower. Natural gas for example, can be used to heat houses and cook food. Using plastic in the volume we currently do reduces the availability of these resources, which are gone forever when used up.

3.Hard to use:

The standard disposable plastic bottle is meant for one use, not many. Recycled plastic bottles are not refilled in mass they glass beer bottles are, and flimsy plastic bottles do not lead themselves well to at home re-usage. Water bottles, for example, are often reused in the home but become less and less sturdy over time and are ultimately thrown away.

4. Difficult to recycle:

Glass bottles can be meted and easily reused as can tin cans. Recycling plastic is not so simple. Much of the plastic placed in recycling boxes is not recycled at all, as most plastic cannot be recycled those bottles that are recycled are not used to make new bottles. Instead recycled plastic bottles are used to make non-recyclable products, such as t-shirts, lactic lumber or parking lot bummers. This means more raw materials need to be used to create new plastic bottles than is the case with easily recycled material, such as glass or tin.

1.4.2 WHY USE OF PLASTIC:

Polymers have a number of vital properties, which exploited alone or together make a significant and expanding contribution to construction needs.

1. Durable & corrosion resistant.
2. Good insulation for cold, heat & sound saving energy and reducing noise pollution.
3. It is economical and has a longer life.
4. Maintenance free.
5. Hygienic & problems.
6. Ease of processing/ installation.
7. Light weight.

1.5 Role of plastic or polymer in pavement:

Modification of BC, with the synthetic polymer binder can be considered as a solution to overcome the problems, arising because of the rapid increase in wheel loads and change in climatic conditions. Polymer modification can be considered as one of the solution to improvise the fatigue life, reduce the rutting & thermal cracking in the pavement. Asphalt, when blended or mixed with the polymer, forms a multiphase system, containing abundant asphaltenes which are not absorbed by the polymer. This increases the viscosity of the mix by the formation of a more internal complex structure.

1.6 Plastic waste for Road Construction:

- The Central Roads and Research Institute had urged the PWD and NHAI to use plastic waste using hot mix process for bituminous roads.
- The central Pollution Control Board has cleared the use of plastic for road construction as it increased road life with better resistance to water. It increases the life of road by almost 2 years and also help in saving money by reducing bitumen by 10% and also reducing wear and tear of roads.
- Indian Road Congress in its report IRC:SP:98-2013 has said “Only plastic conforming to Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE), PET and Polyurethane shall only be used in pavement construction.”
- PVC shall not be used since they release lethal levels of dioxines
- Waste Plastic 6 to 8 % (Depending upon climate condition high % for high rainfall area) of the weight of the bitumen can be used for Open-Grade Premix Surfacing and Mix Seal surfacing mix. Quantity of bitumen can be reduced correspondingly.
- The choice of PET, LDPE, HDPE, PU and PP was made as it does not give any toxic gases at 180°c
- Recycling of PET/Polyester waste and used PET bottles is essential to maintain cleanliness of environment.

II. LITERATURE REVIEW

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1. Amit Gawande (2012) - The quantum of plastic waste in municipal solid waste (MSW) is increasing due to increase in population, urbanization, development activities and changes in life style which leading widespread littering on the landscape. Thus disposal of waste plastic is a menace and become a serious problem globally due to their non-biodegradability and un aesthetic view. Since these are not disposed scientifically & possibility to create ground and water pollution. This waste plastic partially replaced the conventional material to improve desired mechanical characteristics for particular road mix. In conventional road making process bitumen is used as binder. Such bitumen can be modified with waste plastic pieces and bitumen mix is made which can be used as a top layer coat of flexible pavement. This waste plastic modified bitumen mix show better binding property, stability, density and more resistant to water.

2. Sunil J. Kulkarni (2015) - Minimization of waste material is important aspect of the modern growth and development initiatives4 . Plastic is used in various domestic and industrial applications. Use of plastic bags and bottles is very common. The disposal of plastic waste is major problem due to non-biodegradable nature of plastic. The plastic can be used as feedstock for ethanol like products. It can be used for road construction and other construction related activities. The current review summarizes the research on use of waste plastic.

3. Rishi Singh Chhabra (2014) - In the highway infrastructure, a large number of originates materials and technologies have been invented to determine their suitability for the design, construction and maintenance of these pavements. Plastics and rubbers are one of them. Also considering the environmental approach, due to excessive use of polythene in day to day business, the pollution to the environment is enormous. The use of plastic materials such as carry bags, cups, etc. is constantly increasing day by day. Since the polythene are not biodegradable, the need of the current hour is to use the waste polythene in some beneficial purposes. The use of these materials as a road construction proves eco-friendly, economical and use of plastic gives strength in the sub-base course of the pavement.

4. J.Ragapriyan (2015) "Experimental Studies on Partial Replacement of Fine aggregate by using Marble Waste Powder in Concrete" In this experimental study, the effects of using waste marble powder (WMP) as a fine material on the mechanical properties of the concrete has been investigated. For this purpose four different series of concrete mixtures were prepared by replacing the fine sand (passing 4.75 mm sieve) with waste marble at proportions of 0%, 10%, 20%, 30%, 40%, and 50% by weight. In order to determine the effect of the WMP on the workability was found from slump test. Tests for compressive strength were carried out on specimens at the age of 1, 7, 14, 28, 56 and 90 days. The split tensile strength and bond strength tests were also carried out at the age of 28 days. The test results were compared with the results of specimen prepared after control mix. The result is that the mass which is 40% of total marble quarried has reached as high as millions of tons. From this study it was concluded that 50% replacement of cement by fly ash contribute reasonable strength along with 20% of silica fume.

5. Prof.Dhiraj Agrawal (2014) This paper said that, 2014, "Utilization of industrial waste in construction material" The various methodologies for the use of industrial waste products by partial replacements of cement and fine aggregates in concrete and mortar have been reviewed. Various physico-mechanical and chemical properties of the concrete and mortar incorporating different waste materials are studied in accordance with the reviewed literature and the standards. It is seen that waste materials like fly ash, rice husk ash, Paper pulp, GGBF, marble waste were used extensively and sufficient research have been done on them. The study in turn is useful for various resource persons involved in using industrial or agricultural waste material to develop sustainable construction material.

6. Alok D. Sakalkale (2014) October 2014 "Experimental Study on Use of Waste Marble Waste in Concrete". This paper concludes that, Concrete is the most important component used in the construction industry throughout the world, where the fine aggregate is generally natural sand. The use of sand in construction activities results in the excessive mining. Due to unnecessary mining, natural resources are getting exhausted; results in increase in scour depth and sometimes flood possibility. Thus, it is becoming inevitable to use alternative material in concrete. Marble is one of the important materials used in the construction industry. Marble powder is produced from processing plants during the sawing and polishing of marble blocks and about 20 - 25% of the processed marble is turn into powder form. Disposal of the marble powder material from the marble industry is one of the environmental problems worldwide today. The present study is aimed at utilizing Waste marble powder construction industry itself as fine aggregate in concrete, replacing natural sand. The replacement is done partially and fully in the proportion 0%, 25%, 50% and 100% and its effect on properties of concrete were investigated.

7. Dr.Vanita Aggarwal (2014) (IOSR-JMCE), "Effect on Partial Replacement of Fine Aggregate and Cement by Waste Marble Powder/ Granules on Flexural and Split Tensile Strength" This paper said that, Marble as a building material especially in palaces and monuments has been in use for ages many studies have been reported in literature on the performance of the concrete containing waste marble dust or waste marble aggregate. It can be seen that

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combination of marble dust and other ingredients has modulus or compressive strength higher than alone for 7 days and 28 days respectively. The use of high proportion of marble dust increases the strength of cement paste..This study shows the experimental investigations on the replacement of cement and sand both partially & combined with the waste marble powder/waste marble granules in which, by the partial replacement of cement and sand, the compressive, flexure and split-tensile strength get increased up to a certain percentage but get decreased with the combined replacement of combination of cement & sand.

8. Chirag Garg &Aakash Jain (2014)"Green Concrete: Efficient & Eco-Friendly Construction Materials" IJRET, This paper said that, The concrete is made with concrete wastes which are eco-friendly so called as Green concrete. Green concrete is a revolutionary topic in the history of concrete industry. Concrete is an environmental friendly material and the overall impact on the environment per ton of concrete is limited. The paper covers the aspect on how to choose a material for green concrete. It presents the feasibility of the usage of by product materials like fly ash, query dust, marble powder/ granules, plastic waste and recycled concrete and masonry as aggregates in concrete. The use of fly ash in concrete contributes the reduction of greenhouse emissions with negative impacts on the economy.

III. RECENT APPLICATIONS

1. A 25 km plastic modified bituminous concrete road was laid in Bangalore. This plastic road showed superior smoothness, uniform behaviour 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).

2. 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.

3. 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.

4. 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%).

IV. MATERIALS USED

The materials used are as follows.
i. Aggregates
ii. Bituminous Binder
iii. Mineral Filler
iv. Polythene

4.1 Aggregate:

Aggregate constitutes the granular part in bituminous concrete mixtures which contributes up to 90-95 % of the mixture weight and contributes to most of the load bearing & strength characteristics of the mixture. Hence, the quality and physical properties of the aggregates should be controlled to ensure a good pavement.

1) Aggregates should have minimal plasticity. The presence of clay fines in bituminous mix can result in problems like swelling and adhesion of bitumen to the rock which may cause stripping problems. Clay lumps and friable particles should be limited to utmost 1%.
2) Durability or resistance to weathering should be measured by sulphate soundness testing.
3) The ratio of dust to asphalt cement, by mass should be a maximum of 1.2 & a minimum of 0.6.

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4) It is recommended AASHTO T-209 to be used for determining the maximum specific gravity of bituminous concrete mixes.

4.2 Bitumen: Asphalt binder 60/70 and 80/100 are used in this research. The bitumen used should have the following properties.

1) Grade of bitumen used in the pavements should be selected on the basis of climatic conditions and their performance in past.
2) 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.
3) 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
   (g) Residue Ductility
   (h) Residue Viscosity

4.3 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.

4.4 Polythene:
The polythene used in OMFED 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

V. PROPOSED METHODOLOGY

5.1 General:
It involves mainly 2 processes. i.e.
a) Preparation of samples
b) Void analysis
c) Testing
Prior to these experiments, the specific gravity of polythene used was calculated as per the guidelines provided in ASTM D792-08.

5.2 Determination of specific gravity of polythene:
The procedure adopted is given below
1) The weight of the polythene in air was measured by a balance. Let it be denoted by “a”.
2) An immersion vessel full of water was kept below the balance.
3) A piece of iron wire was attached to the balance such that it is suspended about 25 mm above the vessel support.
4) The polythene was then tied with a sink by the iron wire and allowed to submerge in the vessel and the weight was measured. Let it be denoted as “b”.
5) Then polythene was removed and the weight of the wire and the sink was measured by submerging them inside water. Let it be denoted as “w”. The specific gravity is given by
$s = a / (a + w - b)$
where:
a = apparent mass of specimen, without wire or sinker, in air
b = apparent mass of specimen and of sinker completely immersed and of the wire partially immersed in liquid
w = apparent mass of totally immersed sinker and of partially immersed wire. From the experiment, it was found that
a = 19 gm

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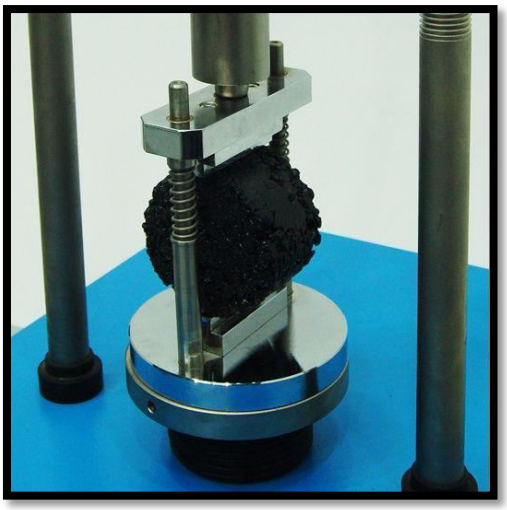
b = 24 gm
w = 26 gm
=> s = 19 / (19+26-24) = 19/21 =0.90476 Take s = 0.905.

5.3 Sample Preparation:
5.3.1 Marshall Sampling Mould:



(Fig 2: MARSHALL SAMPLING MOULD)

TABLE –1 Dimensions of Marshall Sampling mould & hammer:

APPARATUS	VALUE	WORKING TOLERANCE
MOULD		
Average internal diameter, mm	101.2	± 0.5
HAMMER		
Mass, kg	4.535	± 0.02
Drop Height, mm	457	± 1.0
Foot diameter, mm	98.5	± 0.5

5.3.2 Mixing Procedure:
The mixing of ingredients was done as per the following procedure (STP 204-8).
1) Required quantities of coarse aggregate, fine aggregate & mineral fillers were taken in an iron pan.
2) This was kept in an oven at temperature 1600C for 2 hours. This is because the aggregate and bitumen are to be mixed in heated state so preheating is required.
3) The bitumen was also heated up to its melting point prior to the mixing.
4) The required amount of shredded polythene was weighed and kept in a separate container.
5) The aggregates in the pan were heated on a controlled gas stove for a few minutes maintaining the above temperature.
6) The polythene was added to the aggregate and was mixed for 2 minutes.
7) Now bitumen (60 gm), i.e. 5% was added to this mix and the whole mix was stirred uniformly and homogenously. This was continued for 15-20 minutes till they were properly mixed which was evident from the uniform colour throughout the mix.
8) Then the mix was transferred to a casting mould.
9) This mix was then compacted by the Marshall Hammer. The specification of this hammer, the height of release etc. are given in Table – 1.
10) 75 no. Of blows were given per each side of the sample so subtotal of 150 no. of blows was given per sample.
11) Then these samples with moulds were kept separately and marked

5.3.3 Calculations involved:
Total weight of sample = 1200 gm
Optimum Bitumen Content = 5 %
So weight of bitumen = 60 gm
Weight of aggregate + polythene = 1200-60 =1140 gm

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The polythene content was varied from 1 to 5 % and for each polythene content, 3 samples were prepared.
The samples were named, the weight of polythene & aggregate for each sample were calculated and shown in Table .2 below.

Table – 2: Amounts of raw materials

Polythene %	Wt. of polythene gm	Wt. of aggregate gm
0	0	1140
0	0	1140
0	0	1140
1	11.4	1128.6
1	11.4	1128.6
1	11.4	1128.6
2	22.8	1117.2
2	22.8	1117.2
2	22.8	1117.2
3	34.2	1105.8
3	34.2	1105.8
3	34.2	1105.8
4	45.6	1094.4
4	45.6	1094.4
4	45.6	1094.4
5	57	1083
5	57	1083
5	57	1083

5.3.4 Marshall testing:
The Marshall test was done as procedure outlined in ASTM D6927 – 06.

Table – 3: MARSHALL STABILITY VALUE (S):

Sample no.	polythene %	No. of divisions (N)	Marshall Stability Value (S) (KN)
1’	0	460	13.66
2’	0	500	14.85

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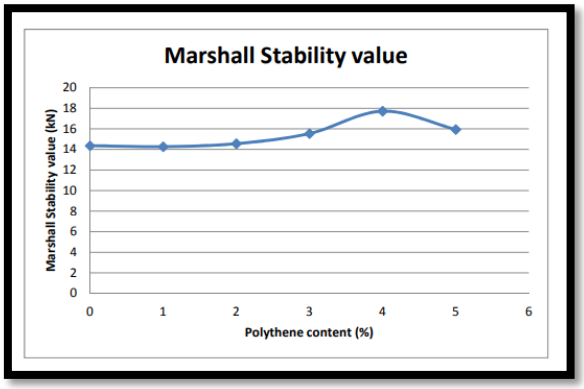
3’	0	490	14.56
1	1	490	14.56
2	1	470	13.96
3	1	480	14.26
4	2	490	14.56
5	2	480	14.26
6	2	500	14.85
7	3	520	15.44
8	3	570	15.74
9	3	600	15.44
10	4	620	16.93
11	4	540	17.82
12	4	520	18.41
13	5	490	16.04
14	5	580	15.44
15	5	520	16.34

VI. ANALYSIS OF RESULTS

6.1 Plotting Curves:



(Figure – 3: Marshall Stability Value vs. Polythene Content)

VII.CONCLUSION

The plastic mixed with bitumen and aggregates is used for the better performance of the roads. The polymer coated on aggregates reduces the voids and moisture absorption. This results in the reduction of ruts and there is no pothole formation. The plastic pavement can withstand heavy traffic and are durable than flexible pavement. The use of plastic mix will reduce the bitumen content by 10% and increases the strength and performance of the road. This new technology is eco-friendly. The use of smoke absorbent material (titanium di-oxide) by 10% of polymer content can reduce the vehicular pollution.

1. Plastic will increase the melting point of the bitumen.
2. This innovative technology not only strengthened the road construction but also increased the road life.

VIII.ACKNOWLEDGEMENT

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REFERENCES

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1. Abdullah, M.E., S.A. Abd Kader, R. Putra Jaya, H. Yaacob, N. Abdul Hassan and C.N. Che Wan (2017). Effect of Waste Plastic as Bitumen Modified in Asphalt Mixture. ISCEE 2016 : 2016 International Symposium on Civil and Environmental Engineering. Wuhan, China, MATEC Web of Conferences. 103.
2. Bale, A.S. (2011). "Potential reuse of plastic waste in road construction: a review." International Journal of Advances in Engineering & Technology (IJAET) 2: 233-236.
3. Behl, A., P. Jain and G. Sharma (2012). Study on waste polyvinyl chloride modified bitumen for paving applications. ARRB Conference, 25th, 2012, Perth, Western Australia, Australia.
4. Bhoot, K., K. Malviya and T.K. Prajapat (2012). "Potential reuse of plastic waste in road construction: A review." International Journal of Scientific Research in Engineering 1(9): 1-5.
5. Brasileiro, L., F. Moreno-Navarro, R. Tauste-Martínez, J. Matos and M.d.C. Rubio-Gámez (2019). "Reclaimed Polymers as Asphalt Binder Modifiers for More Sustainable Roads: A Review." Sustainability 11(3): 646.
6. Chakraborty, A. and S. Mehta (2017). "Utilization & Minimization of Waste Plastic in Construction of Pavement: A Review." International Journal of Engineering Technology Science and Research 4(8): 2394-3386.
7. Chavan, M.A.J. (2013). "Use of plastic waste in flexible pavements." International Journal of Application or Innovation in Engineering and Management 2(4): 540-552.
8. Department for Transport. (2019). "Technological trials to help future proof roads." Retrieved 24/04/2019, from https://www.gov.uk/government/news/technological-trials-to-helpfuture-proof-roads.
9. Government of India (2015). Use of plastic waste in bituminous mixes in construction of National Highways. M.o.R.T. Highway, Ministry of Road Transport & Highway.
10. Manju, R., S. Sathya and K. Sheema (2017). "Use of plastic waste in bituminous pavement." Int J ChemTech Res 10(08): 804-811.
11. Mishra, B. and M.K. Gupta (2018). "Use of plastic waste in bituminous mixes by wet and dry methods." Proceedings of the Institution of Civil Engineers - Municipal Engineer: 1- 11.
12. Vasudevan .R, utilization of waste plastics for flexible pavement, Indian High Ways (Indian Road Congress), Vol.34, No.7. (July 2006).
13. S.S.Verma,(2008),Roads from plastic waste, The Indian Concrete Journal ,pp.43-47
14. Kajal , N K S Pundhir , Sangita and A Chandra(2007), Use of waste plastics and copper slag for low cost bituminous roads, Journal Of Scientific and Industrial Research,Vol.66.pp.938-994
15. ISI, “Indian Standards Specifications for Roads Tar”, IS: 215, Indian standard Institution.
16. Ministry of Road Transport and High Ways, Manual for construction and supervision of Bituminous works, New Delhi, November 2001.
17. Dhiraj Agrawal, Pawan Hinge, U. P. Waghe,S.P. Raut, “Utilization of industrial waste in construction material – A review, International Journal of Innovative Research in Science, Engineering and Technology(An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 1, January 2014 Copyright to IJIRSET www.ijirset.com 8390
18. J.Ragapriyan , Dr. K. Sivalingam, T.Ramasamy, “Experimental Studies on Partial Replacement of Fine aggregate by using Marble Waste Powder in Concrete” ,International Journal on Applications in Civil and Enviornmental Engineering Volume 1: Issue 2: February 2015,
19. Aalok D. Sakalkale, G. D. Dhawale, R. S. Kedar, “Experimental Study on Use of Waste Marble Waste in Concrete”.Mr. Aalok D. Sakalkale Int. Journal of Engineering Research and Applications ISSN: 2248-9622, Vol. 4, Issue 10(Part- 6), October 2014,
20. Prof.Veena G. Pathan, Prof. Md. GulfamPathan, “Feasibility and Need of use of Waste Marble Powder in Concrete Production” IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 23-26. (ICAET-2014)
21. Prof.Jayeshkumar Pitroda1, Dr.L.B.Zala2, Dr. F .S .umrigar “innovative use of paper industry waste (hypo sludge) in design mix concrete ” Pitroda et al., International Journal of Advanced Engineering Technology E-ISSN 0976-3945. March., 2013.