"Investigation of Various Bitumen Mixes using Plastic Waste"

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ABSTRACT

The rapid-fire rate of urbanization in India has led to adding plastic waste generation. This increase has redounded in a large quantum of plastic waste, particularly plastic bags and PET bottles, being littered on the geography of India. In this environment, exploration has been carried out to contribute to the development of effective policy approaches on plastic waste in India. Many programs have been executed by the government to address the acute problem of littering in the country. The strengths, weakness and missing links of the being programs were linked. The analysis has revealed that the being programs on plastic waste haven't been suitable to address the issue of littering, primarily because these haven't tried to give a long- term result to the problem. In the case of PET the lack of legislation to manage the rising consumption has been linked as the crucial problem. Grounded on the analysis a many policy recommendations have been made that could help decision makers in their sweats to develop a Comprehensive plan of action form plastic waste operation. The purpose of this design is to probe the possibility of using Polyethylene Terephthalate as polymer complements in Bituminous Mix. The characteristics of PET- modified bituminous blend is attained by fix mixing temperature, was delved. The binders were prepared by mixing the PET in 2, 4, 6, 8 and (by the weight of optimum bitumen) with80/100 penetration grade bitumen at temperature of 200-220ºC. It may be inferred that PET modified bituminous binders give better stability when compared to conventional binders. Using PET- modified bituminous blend also contribute to the recirculation of plastic waste, as well as to the protection of the terrain.

KEYWORDS: *Bitumen Mixes, Plastic Waste, Plastic roads, Plastic west, Bitumen plastic road.*

1. INTRODUCTION

Any nation's progress is directly dependent on structure. India is on the threshold of a major forward thrust in the field of transportation structure. Over the once two decades, business volumes have increased, demanding from pavement masterminds, stronger and long lasting pavements. New styles of pavement design are being developed to ameliorate the performance of roads. New accoutrements are being used to replace the old bones to

ameliorate the continuity, strength, aesthetics and frugality. One of the promising ways is to use plastics in bituminous road construction assiduity. Moment, the vacuity of the waste plastics is enormous, as the plastic accoutrements have come part and parcel of diurnal life. However, their present disposal is either by land stuffing or by incineration, If not reclaimed. Both these processes have certain impact on the terrain. Under this circumstance, an alternate use for the waste plastics is the need of the hour. In this study to the Marshall parcels of bituminous composites have been plant when plastic wastes are incorporated into them. Plastic in different forms is plant to be nearly 5 in external solid waste, which is poisonous in nature. It's a common sight in both civic and pastoral areas to find empty plastic bags and other type of plastic quilting material littering the roads as well as rainspouts. Due to its biodegradability it creates recession of water and associated hygiene problems. In order to overcome this problem exploration has been carried out whether this waste plastic can be reused productively. The trial at several institutes indicated that the waste plastic, when added to hot total will form a fine fleece of plastic over the total and similar total, when mixed with the binder is plant to give advanced strength, advanced resistance to water and better performance over a period of time. Use of advanced chance of plastic waste reduces the need of bitumen by 10. It also increases the strength and performance of the road. Plastic roads would be a boon for India's hot and extremely sticky climate, where temperatures constantly cross 50 °C and torrential rains produce annihilation, leaving utmost of the roads with big potholes.

This paper envisages the use of waste plastic in different proportion (6 to 14 by weight of bitumen) to prepare job blend formulae for S.D.B.C. The variation Marshall parcels of for the composites containing different quantum of plastic waste are studied.

2. LITERATURE REVIEW

The Use of plastic waste in flexible pavements would open up a solution for the disposal issues regarding plastic wastes. Many research works have been done in the area of use of plastic waste in bituminous road construction.

Dr. R. Vasudevan (2007) investigated that the coating of plastics reduces the porosity, absorption of moisture and improves soundness. The polymer coated aggregate bitumen mix forms better material for flexible pavement construction as the mix shows higher Marshall Stability value and suitable Marshall Coefficient. Hence the use of waste plastics for flexible pavement is one of the best methods for easy disposal of waste plastics. Use of plastic bags in road help in many ways like Easy disposal of waste, better road and prevention of pollution.

Dr. R.Vasudevan and S. Rajasekaran, (2007) stated that the polymer bitumen blend is a better binder compared to plain bitumen.Blend has increased Softening point and decreased Penetration value with a suitable ductility.

Swami et al. (2012) investigated the Use of waste plastic in the construction of bituminous Road. They concluded that plastic waste consisting of carry bags, cups and other utilized plastic could be used as a coating over aggregates and this coated stone could be used for Road construction.

Sultana et al. (2012) investigated the utilization of waste plastic as a strength modifier in surface course of flexible and rigid pavements. They concluded that the potential use of waste plastic as a modifier for asphalt concrete and cement concrete pavement. Gawande et al. (2012) investigated the "An overview on waste plastic utilization in asphalting of roads". They reviewed techniques to use plastic waste for construction purpose of roads and flexible pavements.

Raji et al. (2007) investigated the "Utilization of marginal materials as an ingredient in bituminous mixes". They concluded that when plastic wastes can be used as additives on bituminous pavements. Hence in their study, the properties of bituminous mix when modified with shredded syringe plastic waste were investigated. The work was carried out by mixing shredded autoclaved plastic syringes with heated aggregates by dry process.

Bhageerathy et al. (2014) investigated the use of Biomedical Plastic Waste in Bituminous Road Construction. They concluded that the Marshall Stability value of plastic modified mix was found to be 51 percent more than that for the normal mix which indicates an increase in load carrying capacity

3. MATERIAL AND METHODOLOGY

In this study VG30 viscosity grade Bitumen is used. Coarse aggregates of 9.5mm and 6mm size, hard, angular, BT metal and fine aggregates (dust) is used in different proportion to satisfy MORTH specification as shown in table (1) .the apparent specific gravities are found as under .

To study the effect of mixing plastic waste in bituminous mixes. The following methodology was adopted

The plastic waste like carry bags, Polythenes etc. was collected and shredded to size passing through 2.36 mm sieve and Retained on 600 micron sieve. The shredded plastic waste was mixed in the hot aggregates. Normal mix specimens were prepared with bitumen contents of 7.5 percent, 10 percent, 12.5 percent and 10 percent. The Optimum Bitumen Content (OBC) was found out using Marshall Test. Plastic modified mix specimens with plastic contents of 4.5%, 4.75%, 5%, 5.25%, 5.5%, 5.75%,and 6% by weight of bitumen were prepared through dry process by adding plastic to heated aggregates. Marshall Test were conducted on plastic modified mix specimens to study different parameters.

4. RESULT AND DISCUSSION

The Marshall specimen were prepared without adding plastic waste and adding plastic waste 6%to 14% by weight of bitumen in the mix .The Marshall parameters obtained are summarized in table 2.the variation of stability ,flow value ,bulk density ,air voids and voids fill bitumen (VFB%) and optimum binder content is shown in fig 1 to 6

CONVENTIOANL MIX RESULTS							
Effective Asphalt Content	Pbe	4.5	4.750	5.00	5.25	5.50	5.75
Voids Filled with Mineral Aggregate	VMA	16.60	16.75	16.90	17.05	17.20	17.45
Air Voids	Vv	6.46	6.03	5.61	5.19	4.76	4.48
Voids Filled with Bitumen	VFB	61.11	63.98	66.80	69.58	72.32	74.31
Flow Value	mm	4.10	4.13	4.20	4.40	4.70	5.10
Marshall Stability Value	In kg	900.00	910.00	925.00	960.00	980.00	975.00
Theoretical Density Of Specimen	ϒt	2.30	2.30	2.30	2.30	2.31	2.30

Table-1: Test Result Evaluation for All Mixes

PLASTIC 7.5 % RESULTS							
Effective Asphalt Content	Pbe	4.5	4.75	5	5.25	5.5	5.75

Voids Filled with Mineral Aggregate	VMA	16.19	16.30	16.42	16.54	16.66	16.82
Air Voids	Vv	6.82	6.41	6.00	5.59	5.17	4.83
Voids Filled with Bitumen	VFB	137.33	154.38	173.80	196.11	222.01	248.31
Flow Value	mm	4	4.1	4.2	4.3	4.6	5
Marshall Stability Value	In kg	920	931	955	972	989	973
Theoretical Density Of Specimen	Ɣt	2.29515	2.29709	2.29903	2.30097	2.30291	2.29903

Table-2: Test Result Evaluation for All Mixes with Plastic 7.5%

PLASTIC 10 % RESULTS							
Effective Asphalt Content	Pbe	4.500	4.750	5.000	5.250	5.500	5.750
Voids Filled with Mineral Aggregate	VMA	16.073	16.180	16.217	16.255	16.364	16.580
Air Voids	Vv	6.968	6.561	6.075	5.587	5.178	4.916
Voids Filled with Bitumen	VFB	56.650	59.451	62.543	65.629	68.355	70.351
Flow Value	mm	4.000	4.100	4.200	4.300	4.600	5.000
Marshall Stability Value	In kg	931.000	939.000	958.000	975.000	996.000	977.000

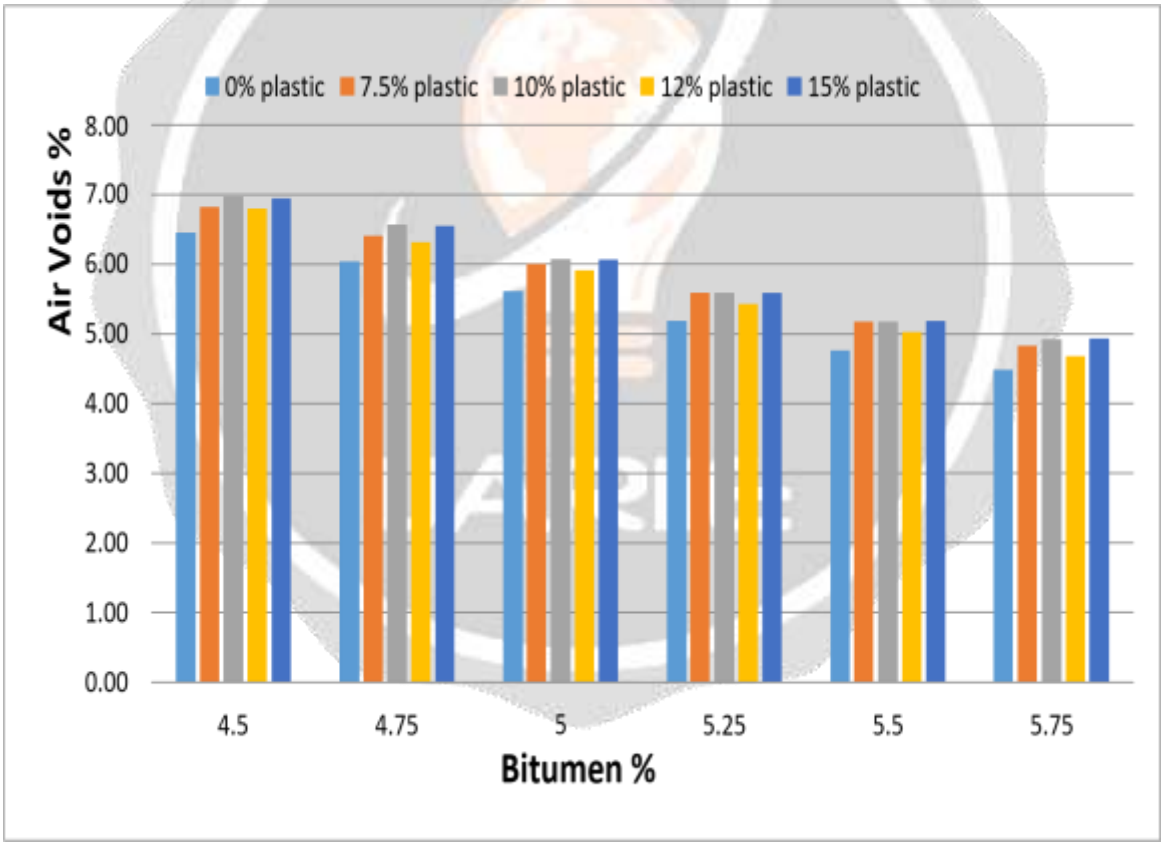
Table-3: Test Result Evaluation for All Mixes with Plastic 10%

PLASTIC 12.5 % RESULTS							
Effective Asphalt Content	Pbe	4.5	4.75	5	5.25	5.5	5.75
Voids Filled with Mineral Aggregate	VMA	15.675	15.701	15.799	15.827	15.925	16.061
Air Voids	Vv	6.800	6.318	5.913	5.429	5.023	4.683
Voids Filled with Bitumen	VFB	56.618	59.764	62.573	65.698	68.458	70.844
Flow Value	mm	3.820	3.900	4.100	4.250	4.330	4.560
Marshall Stability Value	In kg	1104.000	1134.000	1145.000	1157.000	1135.000	1129.000
Theoretical Density Of Specimen	Ɣt	2.299	2.303	2.305	2.309	2.316	2.307

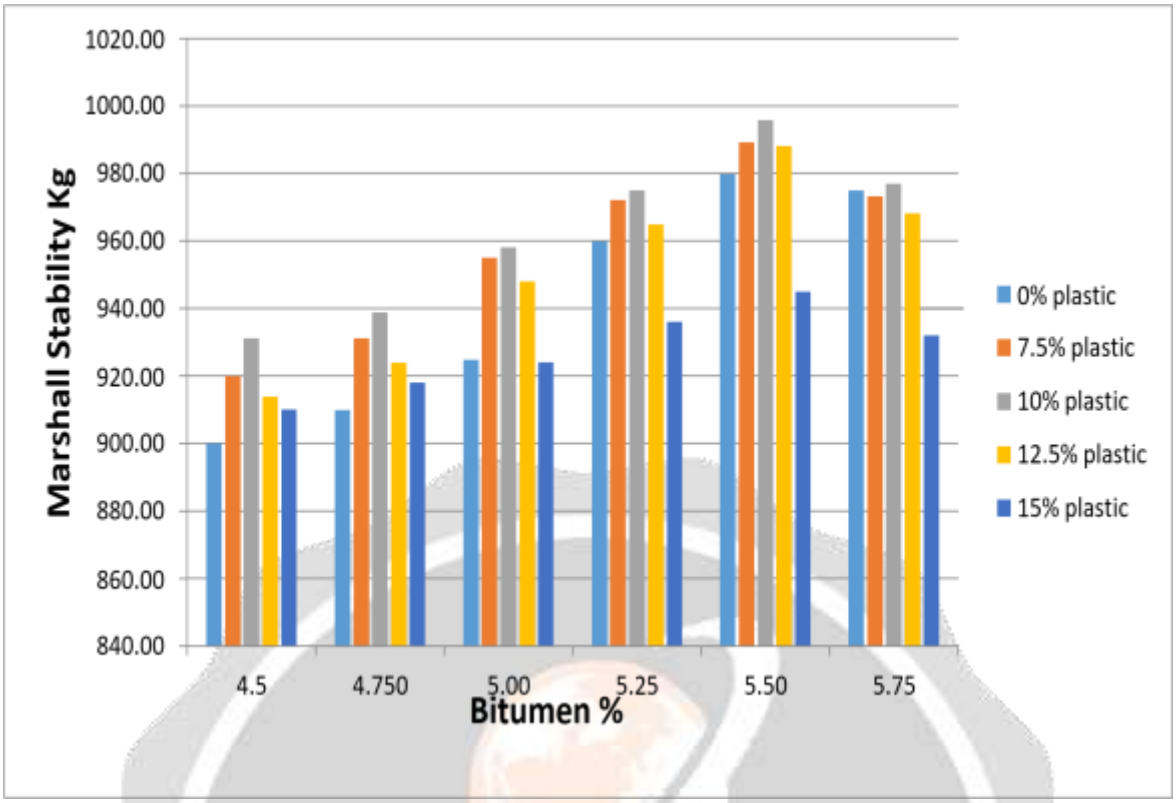
Table-4: Test Result Evaluation for All Mixes with Plastic 12.5%

PLASTIC 15 % RESULTS							
Effective Asphalt Content	Pbe	4.500	4.750	5.000	5.250	5.500	5.750
Voids Filled with Mineral Aggregate	VMA	15.562	15.649	15.665	15.681	15.769	15.966
Air Voids	Vv	6.948	6.548	6.069	5.589	5.187	4.931
Voids Filled with Bitumen	VFB	55.355	58.155	61.256	64.359	67.104	69.113
Flow Value	mm	4.000	4.100	4.200	4.300	4.600	5.000
Marshall Stability Value	In kg	1104.000	1134.000	1145.000	1157.000	1135.000	1129.000
Theoretical Density Of Specimen	Ɣt	2.347	2.372	2.409	2.204	2.199	2.247

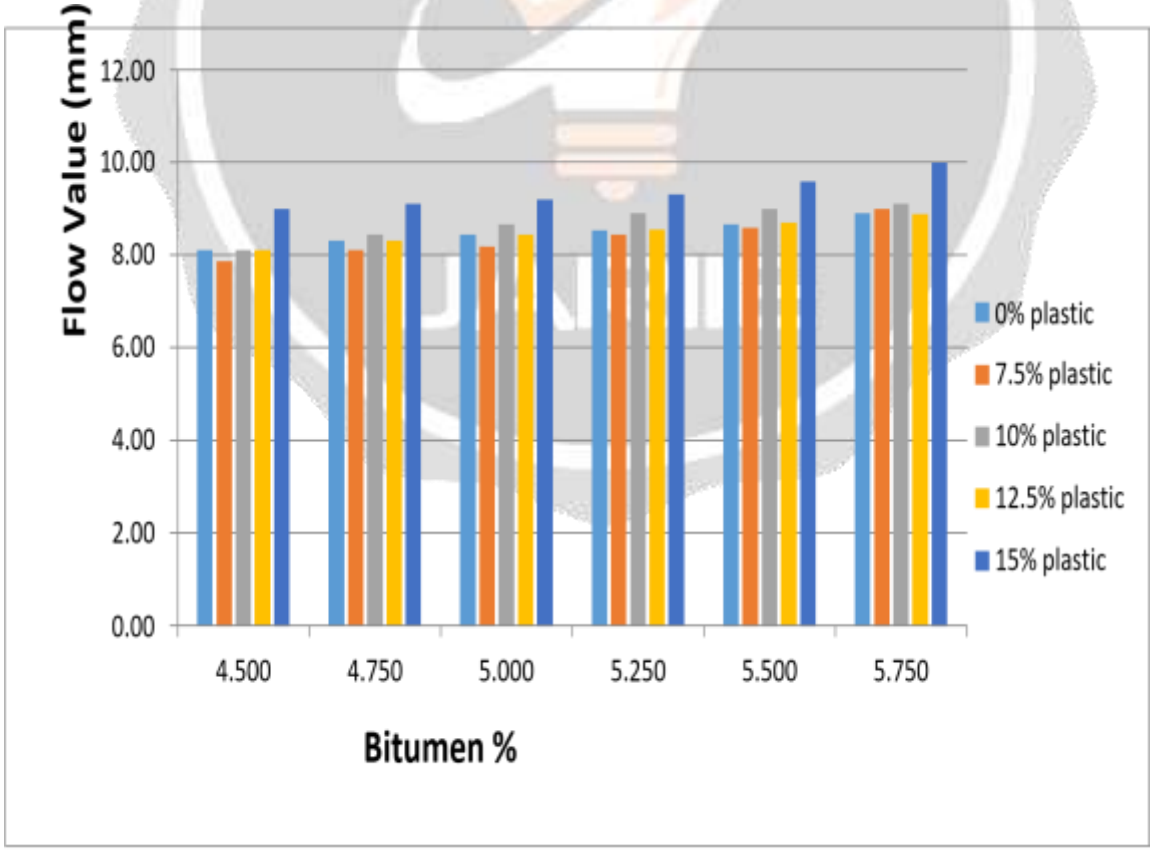
Table-5: Test Result Evaluation for All Mixes with Plastic 15%



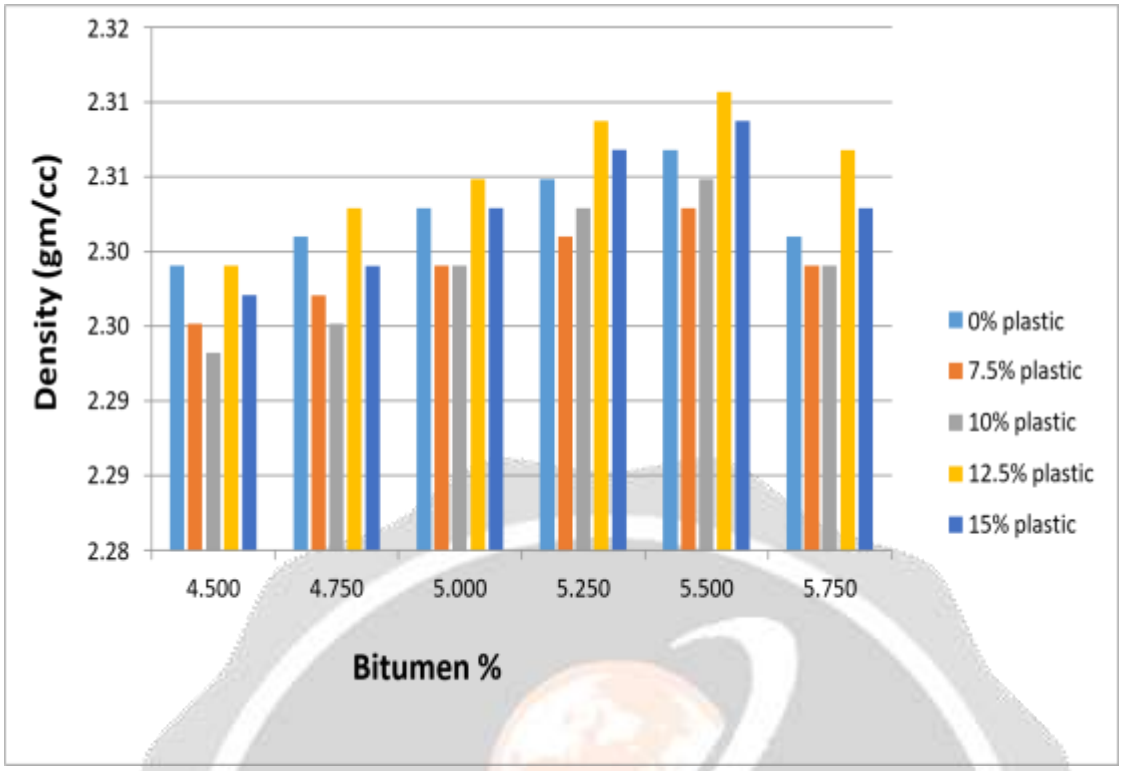
Graph-1: Bitumen Percentage v/s Air Voids



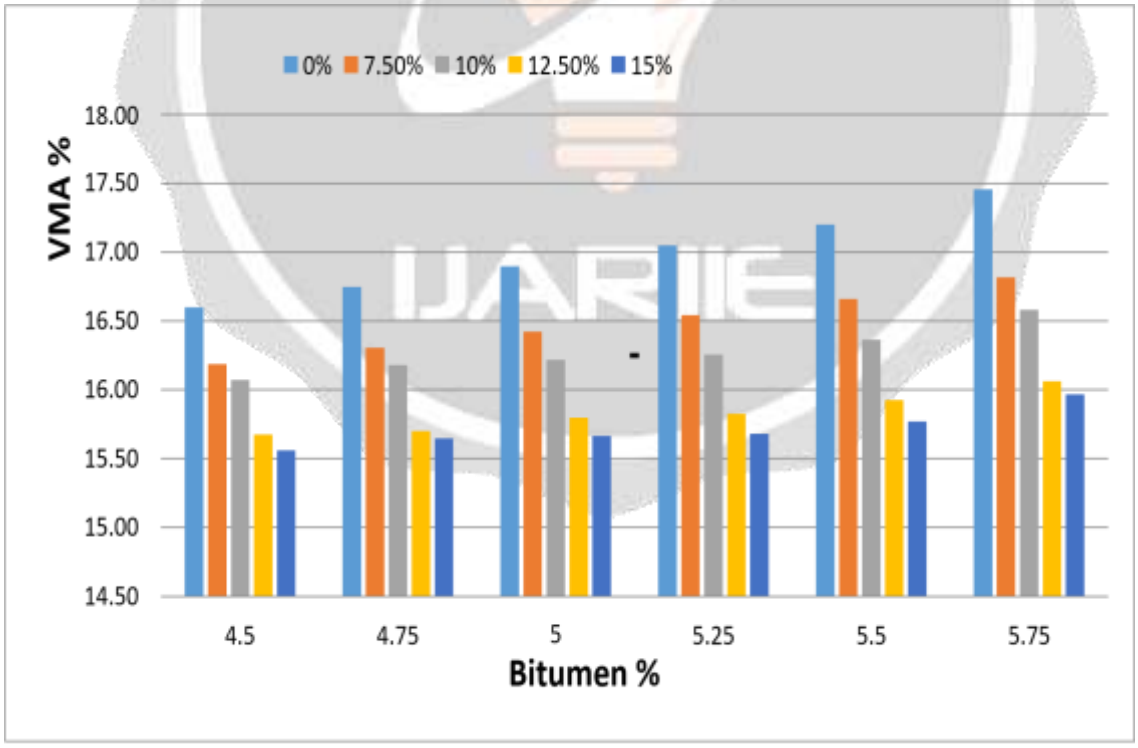
Graph-2: Bitumen Percentage v/s Marshall Stability



Graph-3: Bitumen Percentage V/S Flow Value



Graph-4: Bitumen Percentage v/s Density



Graph-5: Bitumen Percentage v/s Voids in Mineral Aggregate

5. CONCLUSIONS

Plastic coating on aggregate is used for better performance of roads. This helps in to have a better binding of bitumen with plastic wasted coated aggregate due to increase bonding and increase area of contact between polymers and bitumen. The polymer coating also reduces the voids. This prevents the moisture absorption and oxidation of bitumen. This prevents rutting, ravelling and there is no pothole formation. The roads can withstand heavy traffic and show durability.

1. Aggregate impact value of control specimen was 5.43%.it reduced to 4.91% for PP8 and 4.26% for PP10. Reduction in value was 10% for PP8 and 22% for PP10 .This shows that the toughness of the aggregate was increased to face the impact.
2. Crushing value was reduced from 19.2% to 13.33% and 9.82% for PP8 and PP10 respectively. Value reduced by 30%for PP8 and 48% for PP10. Low aggregate crushing value indicates strong aggregates, as the crushed fraction is low.
3. Water absorption is also reduced to nill for PP8 and PP10 from 1.7% for control specimen.
4. The use of plastic mix will reduce the bitumen contentment by 15% and increase the strength and performance of the road. This new technology is eco-friendly.
5. Stripping value was reduced from 8% for control specimen to nill for PP8 and PP10. This shows that coated aggregate is more suitable for bituminous construction than plain aggregate.

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