



UTILIZATION OF PLASTIC-COATED AGGREGATE IN BITUMEN CONSTRUCTION

Prof. Pratik H. Rathod¹, Nishikant yambadwar², Yogesh Jane², Prem Fulzele², Shweta Nehare²

Project Guide¹, Department of Civil Engineering, Jagadambha College of Engineering & Technology, Yavatmal-445001

Project Members², Department of Civil Engineering, Jagadambha College of Engineering & Technology, Yavatmal-445001

ABSTRSCT

Disposal of waste materials including waste plastic bags has become a serious problem and waste plastic are burnt for apparent disposal which cause environmental pollution. Utilization of plastic bags in bituminous mix 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 2-3mm sieve using shredding machine. Use of this waste mix for road construction helps to use plastics waste. Once the plastic waste is separated from municipal solid waste, the organic matter can be converted into manure and used. This paper deals with the investigations of the use of waste plastic for coating of aggregate in the bituminous road construction. Plastic-waste, consisting of carry bags, cups and other utilized plastic can be used as a coating over aggregate and this coated stone can be used for road construction.

The mix polymer coated aggregate, and tyre modified bitumen have shown +higher strength. Use of this mix for road construction helps to use plastic waste effectively. Now a day's waste plastic is used in bituminous road construction. This technology is not a new concept but rather not practiced widely. Bottle, containers and packing strips etc. is increasing day by day. As a result, amount of waste plastic also increases. This leads to various environmental problems. Therefore, it is necessary to utilize waste effectively with technical development in each field. Many by-products are being produced using the plastic waste.

Keywords: *Waste Plastic; Physical Properties; Aggregate; Bitumen.*

1. INTRODUCTION

In whole world, single India generates 1,88,000 tons of garbage. It is common sight in both rural and urban areas to find plastic bags, plastic cups, plastic caps, and other types of plastic waste blocking the roads as well as drains. Due to the problem of poor Biodegradability, it creates hygiene issues and blockage of water due to plastic in drains. Bitumen construction is major goal for the country to its development. For the construction of Roads, a large amount of money is spent. In road construction bitumen is act as a binder. Today every sector around the world from agriculture to electrical, packing, automobile, building construction, communication sector is widely using plastic. Generally plastic is a non-biodegradable and much research found that plastic takes several years to degradation. Concrete is a material which consist of mineral aggregate and Bitumen. Bitumen is used as binding material that envelope aggregate. Generally, speaking when looking at the amount of material to be used, road construction is an expensive one. Therefore, we strive to reduce our total cost of road construction using cheaper material such as industrial waste. Now-a-days disposal of different waste produced from different industries is a huge problem.

The main purpose of this study is productive and safe disposal of waste. The rate of production of waste has increased tremendously in almost all parts of the world in the past few decades. Plastic is everywhere in today's life. It is used for packaging, serving, protecting and even disposing of almost all kinds of consumer goods. It was good to know that life of plastic is more than any other packaging materials which is used by human beings, but it become a problem to the safety of environment. The use of plastic with bitumen in road construction gives flexible pavement not only increases its smoothness and life but also helps in eco-friendly environment. The plastic is user friendly but not eco-friendly as they are not bio-degradable, generally it is disposed by way of land filling. If we use plastic waste in road construction, it will be beneficial for the road safety as it does not give damps and in this way, plastic will be reuse. So, concept of plastic waste can be use in bitumen construction as plastic gives binding property to the bitumen, so we can productively reuse plastic waste in bitumen construction.

Plastic waste is a growing issue due to population growth, rapid urbanization, and industrial activities. Plastic waste is crucial to reduce the environmental harm caused by human activities, and one potential valorization route is using plastic waste as a material in pavements.

2. LITERATURE REVIEW

The director of the Central Road Research Institute (CRRRI) said that bitumen mixed with plastic or rubber improves the quality and life of roads. The deputy director of the CRRRI said that polymers mixed with bitumen increased the construction cost up to six percent but increased the longevity of roads manifold. The performance studies carried out on the roads constructed in Tamil Nadu indicated satisfactory performance with good skid resistance, good texture value, stronger and less amount of progressive unevenness over a period of time. The experimentation carried out by CRRRI also indicated better stability value, indicating higher strength, less flow and more air voids. Al-Hadidy A.I., Yi-qiu Tan (2009), "Effect of polyethylene on life of flexible pavements", Ms. Apurva Chavan (2013) says that using plastic waste in mix will help reduction in need of bitumen by around 10%, increase the strength and performance of road, avoid use of anti-stripping agent, avoid disposal of plastic waste by incineration and land filling and ultimately develop a technology, which is eco-friendly.

Since many years the utilization of plastic in flexible pavements has been done to increase the stability, durability of roads and reduce the cost of construction of roads by replacing some percentage of bitumen with that of the waste plastic. The LDPE can only be used in this technique as it gets softened at the desired temperature i.e., 160°C and coated over the aggregates. There is no modification in the plant is required because plastic is mixed at the same time when aggregates are poured into Hot Mix Plant for 30 - 50 secs, hence no fuel consumption takes place. There is consistent research still going on to attain the optimality and many have stated to use the plastic in road construction.

3. 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

- Durable & corrosion resistant.
- Good insulation for cold, heat & sound saving energy and reducing noise pollution.

It is economical and has a longer life.

- Maintenance free.
- Ease of processing/ installation.

4. SCOPE OF WORK

The scope of work included:

- Assessment of plastics such as polyethylene, polypropylene, polystyrene among others mentioned in the IRC standard SP-98, would include but not be limited to them.
- Report would include assessment of durability of plastic as compared to other materials comparing the use and on a limited scale the performance.
- Evaluation aspects would include – Technical, Financial, Administrative and Organizational efficiency aspects of operational and implementation of plastic roads.
- Financial models and implementation monitoring was included in the project.
- Qualitative assessment through interviews and field visit would be limited to 3 specific locations within India.

Population Growth and Impact on Overall Waste Generation and Future Predictions until 2041:

Year	Population(Millions)	Per Capita	Total Wastegeneration Thousand Tons/year
2001	197.3	0.439	31.63
2011	260.1	0.498	47.3
2021	342.8	0.569	71.15
2031	451.8	0.649	107.01
2041	518.4	0.693	131.24

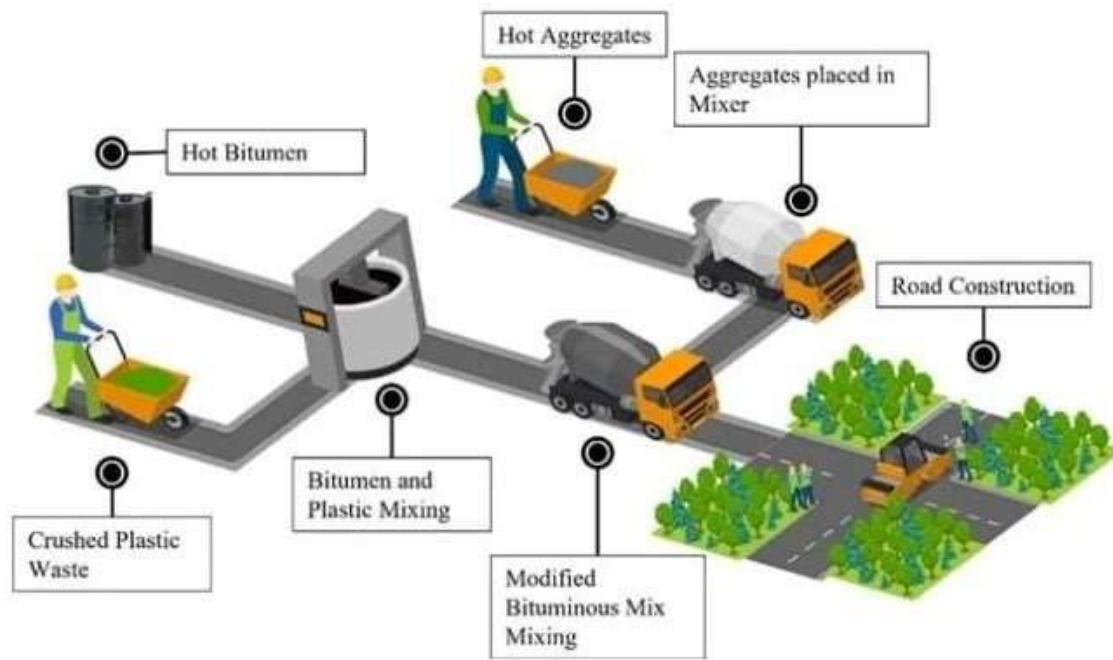
2051	598.4	0.741	160.96
------	-------	-------	--------

5. METHODOLOGY

1. Dry process
2. Wet process

Dry process: First of all, plastic waste is collected, separated, segregated, clean and then stored. Segregation process involves certain kind of plastic such as PVC cannot be used due to safety concerns. The next step is the cleaning of plastic waste. This is the most important step because most of the plastic has been used for packaging. After cleaning plastic waste should be dried. After that plastic waste goes through the process of shredding which involves cutting of plastic waste into 2mm to 4 mm size. After that aggregate heated to around 1600C to 1700C. And then in mixing chamber the cut plastic is added to hot aggregate to apply coating uniformly over aggregate for 30-45 seconds. Plastic coated aggregate is added to bitumen at a temperature between 1500C-1650C. This temperature is carefully regulated to make sure that the binding is strong.

Wet process: In this process, plastic waste is directly mixed with the hot bitumen at 1600C, and this mixture is mixed using a mechanical stirrer. This mixture also contains additional stabilizers and requires proper cooling. This method is not mostly popular because it requires huge amount of investments that is cost, larger plants and many more equipment in the comparison of dry process. So, dry process is economical and best to use in the least cost and least amount of equipment.



6. WET PROCESS

Advantages:

A well-constructed plastic road will result in following advantages:

- Strength and performance of the road increases.
- Reduces the bitumen requirement by around 10% resulting in reduction of overall cost.
- No stripping and no potholes.
- The maintenance except holes reduces to almost nil. Generates employment for rag pickers.
- The road life sustainably increases.
- Helps in disposal of plastic waste. Hence minimizing the pollution.

Disadvantages:

- The heated treatment of plastic may lead to release of harmful gases to atmosphere.
- Roads made of pure plastic leads to decrease in strength with small variation in temperature.
- The plastic may break into micro plastic particles due to atmospheric oxidation.

7. RESULT AND DISCUSSION

- The crushing value reduces from 23.32 to 14.22 for normal and plastic coated aggregate. The value was reduced by 40%. Lower the aggregate crushing value higher is the strength.
- The aggregate impact value of plastic coated aggregate was reduced by 9% then the normal aggregate. Its the higher toughness of plastic coated aggregates.
- Loss angeles abrasion value indicates the hardness of the aggregate. The abrasion value plastic coated aggregates were 21% less than the normal aggregates.
- The penetration value of bitumen is higher than the bitumen mixed with the plastic.
- The bitumen softness 100 C less than the bitumen replaced with plastic.
- The stability of modified bitumen (10% bitumen replaced by plastic) is higher than the normal bitumen.

8. CONCLUSION

By using plastic-waste coated aggregate in road construction, helps to

- Use higher percentage of plastic waste
- Reduce the need of bitumen
- Increase the strength and performance of the road
- Avoid disposal of plastic waste by incineration and land feeling
- Add value of plastic waste
- Generate jobs for rag pickers
- Develop a technology which is eco-friendly
- Plastic road would be a boon for India's hot and extremely humid climate where durable and eco-friendly roads which will relive the earth from all type of plastic waste.

REFERENCES

- [1] S.S Verma, "Roads from Plastic-Waste", The Indian Concrete Journal, pp.43-44, 2008.
- [2] Indian Roads Congress IRC: 37 -2012 – Guidelines for the design of flexible pavement-August 2012.
- [3] Miss Apurva J Chavan – Use of plastic waste in flexible pavements – ISSN23194847, Volume 2, Issue 4, April 2013
- [4] Dhodapkar A N. (Dec. 2008), Use of waste plastic in road construction Indian Highways, Technical paper, journal, P No. 31 -32.
- [5] ISI, "Indian Standards Specifications for Roads Tar", IS: 215,
- [6] Vasudevan. R, utilization of waste plastics for flexible pavement, Indian Highways (Indian Road Congress), Vol.34, No.7. (July 2006).