



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 12, December 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)



# Use of Waste Plastic in Flexible Pavements of Cold Region Area's

Benit-Ul- Islam<sup>1</sup>, Shahid Basheer<sup>2</sup>

B.Tech Student, Department of Civil Engineering, Aryans Group of Colleges, Rajpura Punjab, India<sup>1</sup>

Assistant Professor, Department of Civil Engineering, Aryans Group of Colleges, Rajpura Punjab, India<sup>2</sup>

**ABSTRACT:** Transportation is an essential component for the infrastructure of all the countries. The economy & economic status of any country is determined by its network of roads, railways & airways. The road network of India is second biggest in the globe. In the northern parts of the country like Kashmir, himachal Pradesh & Utrakhnad, roads are the most important source of connectivity. Due to cold weather conditions which include factors like snow, rain & frost, roads of such areas suffer excessive damage & thus hamper the movement of people as well as goods across these parts of the country. To improve the condition of such roads every year huge amount of money is being invested. The maintenance cost of such roads is very high & almost after every 6 months roads of these area needs to be maintained. These roads are not able to withstand against various temperature variations and hence they start getting degraded at such faster rate. To prevent the damage of these roads by such factors like snow & rain, no particular innovation has been developed. Use of waste plastic in bituminous mixes can be of importance of curbing the excessive damage to roads in cold weather conditions. The addition of polymer to the bitumen can result in improvement of properties such as adhesion, cohesion etc. Also the temperature susceptibility & stiffness of mixes can get increased by addition of polymer like waste plastic. By using waste plastic in flexible pavements, roads of cold region areas can become durable against various temperature variations like snow, which in turn can reduce the maintenance cost of such roads. Using waste plastic in road construction can also prove as the safest disposal mechanism of waste plastic.

**KEYWORDS:** Bituminous mix, waste plastic, flexible pavements, Cold Region Area's, environmental pollution.

## I. INTRODUCTION

The plastic waste is available in today's world in huge abundance. There has been a constant increase in the utilization of plastic in the form of plastic cups, bottles etc. It has been observed that the majority of plastic (around 60%) is utilized in the process of packaging. This Plastic is the main source of waste since it has high durability and is not biodegradable. This plastic waste is not properly disposed and may result in health problems such as cancer, genital problems in both humans and animals. This plastic waste on coming in contact with water bodies breaks down. The aquatic animals mistake this for food resulting in deaths of a large number of fish and thus highly disturbing the aquatic life. Plastic waste in the form of municipal waste also contaminates the land and renders it useless for cultivation and other purposes. Many a times, this plastic waste is burned, which results in harmful toxics getting discharged into the atmosphere thus causing harm to the environment. Thus plastic is highly harmful to land, air as well as to the water bodies of earth. It is thus highly recommendable to find the alternatives of plastic and also a proper method for its disposal. One such method of disposal can be in the form of construction processes. For the last 20 years, trucks and other heavy vehicles have multiplied in percentage as well as volume. This has resulted in the increased demand for pavements with high service life and durability. In view of meeting this demand, investigations are being carried out with the help of new materials as additions to the already available construction processes. Also research works are being carried out to look for improvements in the properties of binder. The present study is based on a research for studying the "Effect of waste plastic on the deterioration of bituminous mixes in cold climates". The bitumen and plastic blend thus obtained will be used for construction of flexible pavements resulting in the improvement of their properties and also provide a safe means for disposal of highly harmful waste plastic. This use of Plastic for construction process is not new. Polyvinyl chloride and High density polyethylene pipes already employ this idea of addition of plastic in the construction processes. The plastic roads help in prevention of Rutting by easing the tyre pressures and also by distribution of activity loads throughout the surface. Scientists have been working towards the use of plastic waste And the recently concluded studies towards this work has provided huge scope for use of waste plastic in the construction of roads. Engineers from an engineering college and a firm from Bengaluru have been working for developing a method for induction of waste plastic as an ingredient in the road construction processes. The strength and durability tests were first carried out by this team in the year of 1997. Plastic cups, bottles and packaging carry bags



which are the main source of waste form an essential and major component of the material used for the process of road construction. This plastic waste melts down due to the heat from bitumen and forms a coating over aggregates and thus reduces the pores and makes it more resistant to water. The laying and compaction of plastic waste roads is done in the same manner as normal bituminous roads. In present time and conditions, Pavements are required to exhibit better performance even with a constant increment in the percentages of traffic volumes sand activity loads. This can be done by improving the properties of binders. The modification of binders is done by addition of polymers. Studies have shown that the use of plastic results in the reduction of rutting phenomenon and also prevents the formation of cracks which may arise due to low temperature. The field tests carried out on plastic further proved that the use of plastic as an additional ingredient would enhance the desirable properties of roads and also be beneficial in decreasing the hazardous effects of plastic waste by providing an efficient method for its disposal. Due to the presence of plastic in abundance, it may be considered as a cheap and a very effective material for utilization in mixes. Thus the utilization of waste plastic can be helpful in improving the qualities of the roads as well as reduce the cost of construction of roads. With the improvement in technology and further research in this field, Plastic roads may even be considered as the future of road construction.

## II. METHODOLOGY

So as to achieve the whole extent of study, Evaluation of mixes was made using Marshall Method of Design. For this purpose various materials viz aggregates, binder, PET water bottles are being used. Optimum binder content will be selected. Grading was done according to the specifications. The procedure involved in this study is as:

1. The material to be used were collected from the nearby area of Srinagar Kashmir.
2. The waste PET water bottles were collected in the shredded form of size 4mm.
3. Bitumen grade VG-10 was to be used
4. Properties of modified bitumen was compared with normal bitumen
5. Optimum binder content for normal mix in marshal test was determined by varying bitumen content from 5.5 to 6.5%
6. Optimum plastic waste was kept as 6-8% for modified bitumen mix
7. Control mix & modified bitumen mix were made as per job mix formula & both of them were examined by marshal stability test.
8. Samples of both control mix and modified bitumen mix were subjected to multiple freeze and thaw and then were tested.
9. Result obtained were compared to examine the effects of addition of waste plastic to the mix

## III. TEST RESULTS & ANALYSIS

For performing this study various materials were used. These were as:

- i. Plastic waste,
- ii. Aggregates
- iii. VG10 bitumen

Various tests conducted on these materials are as

*Table 1 physical properties of Aggregates*

Physical properties	Size = 13.2mm	Requirements as per MORTH
Specific gravity	2.7	2.6- 2.8
Impact value	19%	Max 24%
Crushing value	3%	Not mentioned
Loss angels value	26%	Max 30%
Water absorption	0.98	Max 2%



Table .2 physical properties of bitumen

Physical properties	Vg -10	Vg-10	Test method
	Determined	Required	
Penetration	91	80-100	IS-1203-1978
Specific gravity	1.32	0.99 MIN.	IS-1202-1978
Softening point	46	40 MIN.	Is-1205-1978

**IV. EXPERIMENTAL WORK**

Marshal stability test was conducted on the samples. Control mix samples each of of 1200 gram with 5.5% optimum bitumen content were made & were subjected to marshal stability test. Job mix formula found was 56:42:2 of 1200 gram. (Coarseaggregate: fine aggregate:filler)

In the similar way job mix formula for samples with waste plastic was found to be 50:42:3:6 of 1200 gram. (Coarseaggregate: fine aggregate:filler: waste plastic). Optimum waste plastic was used as 6% & optimum bitumen content was also 5.5%. Both the samples were subjected to marshal test and the results observed were as

Table 3 MarshalTest results

Marshal test	Control mix	Modified mix with plastic
Stability ( kg)	1900	2784
Flow value ( mm)	2.3	3.98

Both samples were also subjected to 8 freeze & thaw cycles , after 8 freeze & thaw cycles marshal test was conducted on the both & the results are as

Table 4 MarshalTest results after 8 freeze & thaw cycles

Marshal test	Control mix	Modified plastic mix
Stability ( kg)	1345	2100
Flow value	2.1	3.31



## V. CONCLUSION

1. Mixes having waste PET water bottles can be utilized in the construction of BC pavements. Mixes with 6% PET show good results and can hence replace aggregate in virgin mixes.
2. The optimum amount of PET for mix in BC was found to be 6% at a bitumen content of 5.5%.
3. The comparative study of the results obtained for mixes with modified mix and control mix after 8 repeated Freeze Thaw cycles also indicate much better Stability and Marshall flow values for modified plastic mix.
4. By exposing the mix to 8 repetitive Freeze Thaw cycles, majority of the Stability is lost by the both Control Mix and less stability is lost by modified mix.
5. The modified plastic mix even after 8 freeze & thaw cycles exhibit stability values similar to that of control mix under ideal conditions. Thus, it can be concluded that plastic should be added to the mix for use in places having low day and night temperatures.
6. By using waste plastic in pavements of cold region areas, the roads will definitely show resistance against temperature variations, which in turn will slow the rate of degradation of road in such Areas.
7. Roads made from waste plastic proves to be economical roads of cold region Area's.
8. Using waste plastic in pavements proves to be one of the safest disposal mechanism of waste plastic in nature.

## REFERENCES

1. Ahmadiania E., Zargar M., Karim M. R., Abdelaziz M., "Performance evaluation of utilization of waste Polyethylene Terephthalate (PET) in stone mastic asphalt," *Construction and Building Materials*, vol. 36, pp. 984–989, 2012.
2. ASTM D6927-15, "Standard Test Method for Marshall Stability and Flow of Asphalt Mixtures," ASTM International, Pennsylvania.
3. Awwad M.T. and Shbeeb L., "The use of polyethylene in hot asphalt mixtures," *American Journal of Applied Sciences*, volume 4, no. 6, pp. 390–396, 2007.
4. Bindu C.S and Beana K.S, "Influence of Additives on the Characteristics of Stone Matrix asphalt," *International Journal of Resereach for Engineering Technology.*, vol. 3, no. 7, pp. 83– 88, 2014.
5. Chavan M., "Use of Plastic Waste in Flexible Pavements," *International Journal of Application or Innovation in Engineering & Technology*, vol. 2, no. 4, pp. 540–552, 2013.
6. Gawande A., Zamare G., Renge V. C., Tayde S., and Bharsakale G., "An overview on waste plastic utilization in Asphaltting of roads," *Journal of Engineering Research and Studies*, vol. III, no. II, pp. 1–5, 2012.
7. Ghorpade M. R "A Study of Enhancement of Bituminous Mix by Use of Modifiers," *Imperial Journal of Interdisciplinary Research*, vol. 2018, no. 1, 2018.
8. Gundaliya P. J., "Utilization of Waste Polyethylene Materials in Bituminous Concrete Mix for Improved Performance of Flexible Pavements," *Indian Journal of Applied Research* Vol. 1 Issue 12. pp. 2–3, September, 2012.



Impact Factor:  
7.569



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details