

REVIEW PAPER ON PLASTIC ROAD

Er. Ravi Kamboj¹, Er. Ashok Anand², Er. Vipin Kumar³

¹ Asst. Prof Ravi Kamboj., Civil Department, Roorkee College of Engineering, Roorkee, Uttarakhand,

² Asst. Prof Ashok Anand., Civil Department, Roorkee College of Engineering, Uttarakhand, India

³ Lecturer Vipin Kumar., Civil Department, Roorkee College of Engineering, Uttarakhand, India

ABSTRACT

A Government order in November 2015 has made mandatory for all road developers in the country to use waste plastic, along with bituminous mixes, for road construction. This is to help overcome the growing problem of plastic waste disposal in India. Plastic roads are different from standard roads in the respect that standard roads are made from *asphalt concrete*, which consists of mineral aggregates and *asphalt*. The technology was developed by the 'Plastic Man' of India, Prof Rajagopalan Vasudevan, Professor at Thiagarajar College of Engineering, Madurai. Plastic has slowly become an integral part of all human requirements. **Plastic roads** are made entirely of *plastic* or of *composites* of plastic with other materials.

Keyword : Plastic Road, Asphalt Bitumen Stone Road

1. INTRODUCTION

Plastic carry bags, packaging material, bottles, cups, and various other items have slowly replaced everything made of other material due to the advantages of plastic. Plastic is durable, easy to produce, lightweight, unbreakable, odour less, and chemical resistant. Plastic garbage is commonly seen around the country and has started causing several problems. Plastic waste clogs drains, causing floods. It chokes animals who eat plastic bags, etc. Plastics found in fields blocks germination and prevent rainwater absorption. Plastic 'dissolved' in water bodies caused pollution. Plastic is used as binder. Plastic is non- biodegradable. Waste plastic is very useful. In general Bitumen Road failure can easily occur. We all know that plastic is a good binder. Steps for plastic collection are Segregate, clean, Shred & Collection. Plastic increases life of Road. It will remain safe upto 25 years. The plastic waste items that can be used for road construction are various items like plastic carry- bags, plastic cups, plastic packaging for potato chips, biscuits, chocolates, etc. Plastic roads developed by [Rajagopalan Vasudevan](#) consist of an asphalt mix with plastic waste incorporated into the asphalt mixture. The implementation of plastics in roads also opens a new option for recycling post consumer plastics. [Australia](#), [Indonesia](#), [India](#), the [United Kingdom](#), the [United States](#), and many other countries have used technology which can incorporate plastic waste into an asphalt mix.

There are two kinds of Plastic roads in the world:

- The "PlasticRoad": consist of modular, hollow and prefabricated road elements made from consumer waste plastics.
- Plastic Roads: consist of an asphalt mix with plastic waste incorporated into the asphalt mixture

SALIENT FEATURES – ROAD

- Strength increased by 100%
- No pot holes, rutting and raveling formed
- Withstand heavy load
- Decreased bitumen consumption
- Construction cost reduced
- Value addition to waste plastics
- Nil maintenance cost for more than 7 years
- No effect of radiation like uv
- Life of the road – doubled

Initial Development

The technology was initially developed and patented by [Dr. Rajagopalan Vasudevan](#) of the [Thiagarajar College of Engineering](#). He developed an innovative method to reuse plastic waste to construct better, more durable and very cost-effective roads. This method will help in making roads much faster and also will save the environment from dangerous plastic waste. The roads also show greater resistance to damages caused by heavy rains. In an interview with *The Better India Firm*, he explained, “The advantages of using waste plastics for road construction are many. The process is easy and does not need any new machinery. For every kilo of stone, 50 gms of bitumen are used and 1/10th of this is plastic waste; this reduces the amount of bitumen being used. Plastic increases the aggregate impact value and improves the quality of flexible pavements. Wear and tear of the roads has decreased to a large extent.”

The plastic-bitumen road-laying technique covered under a patent held by the [Thiagarajar College of Engineering](#) in 2006.^[7] Dr Vasudevan has since made it free to use for the greater good. The technology is simple and is described in a dedicated TCE website.

It involves

- a) collecting waste plastics, including plastic carry bags, cups, soft and hard foams, and laminated plastics;
- b) cleaning it by washing;
- c) shredding it to a uniform size;
- d) melting the waste plastics at 165 °C, and blending it with hot aggregates and bitumen and using this mixture to lay the road., where a village converted 430 kg of plastic waste into a kilometer long road in 2018.

Concept of Plastic Road:

Vasudev Ji has constructed 1 km long plastic road in 2002. Even now no crack is their in that road. Vasudev ji has also invented Interlocking stone plastic blocks using 60% plastic & 40% Stone Blocks. These blocks are stronger than Concrete interlocking blocks. Laboratory results of mixing waste plastic with heated bitumen and coating the mixture over stone proved positive. He implemented the use of plastic waste on a road constructed inside the premises of his college in 2002. The entire process is very simple. The plastic waste material is first shredded to a particular size using a shredding machine. The aggregate mix is heated at 165°C and transferred to the mixing chamber, and the bitumen is heated to 160°C to result in good binding. It is important to monitor the temperature during heating. The shredded plastic waste is then added to the aggregate. It gets coated uniformly over the aggregate within 30 to 60 seconds, giving an oily look. The plastic waste coated aggregate is mixed with hot

bitumen and the resulting mix is used for road construction. The road laying temperature is between 110°C to 120°C. The roller used has a capacity of 8 tons.

Advantage:

Benefits of Plastic road are Waste material diminishes, Simple, efficient, Low Cost & easier to construct. It is a new revolution that how we build roads. Reduce Reuse & Recycle are most important for environment conservation.

- Plastic-bitumen composite roads need not be especially discriminating with the plastics used, thus increasing the reuse of plastic. Most plastic waste is not recycled because it is usually mixed with different [types of plastic](#) and non-plastic (e.g. paper labels) and, so far, the segregation process is labor-intensive with no easy solution.
- Using less asphalt saves on cost and resources. Asphalt concrete requires petroleum which is becoming more scarce.
- Plastic-bitumen composite roads have better wear resistance than standard asphalt concrete roads. They do not absorb water, have better flexibility which results in less rutting and less need for repair. Road surfaces remain smooth, are lower maintenance, and absorb sound better.
- Plastic roads can have hollow space built in to allow ease of wiring, connecting pipes, etc.
- Since plastics come with various chemical and physical properties, roads can be engineered to meet specific requirements (e.g. weather and wear resistance)
- Plastic roads can be built from waste plastic --- the majority of which is usually put into landfill, incinerated, or polluted into the environment. Land-filling and incinerating plastic are both problematic methods of managing plastic waste. Plastics in landfills can leak pollutants into the surrounding soil; incinerating creates gaseous pollutants, such as carbon dioxide.

Disadvantages:

Plastic Pollution, According to this technology plastic available in India is Insufficient. Plastic cut into small peaces. We give temperature up to 170 Degree centigrade. Stone 160 C. Then We mix heated plastic & stone. If we will not use it then it will harm our soil fertility.

- Pure plastic roads require use of compatible plastics because, when melted, plastics of different types may phase-separate and cause structural weaknesses, which can lead to premature failure.
- Plastics in the road can break down into [microplastics](#) and can find their way into the soil and bodies of water. These microplastics can also absorb other pollutants.
- Every time maintenance is performed on these modular roads the flow of power, water, and internet that has been installed within will be interrupted.

CONSTRUCTION

Since plastic roads are a relatively new idea, construction processes vary. In [Jamshedpur, India](#), roads are created from a mix of plastic and [bitumen](#). In [Indonesia](#) roads are also being built using a plastic-asphalt mix in many areas including [Bali](#), [Surabaya](#), [Bekasi](#), [Makassar](#), [Solo](#), and [Tangerang](#). These roads are made from recycled plastics, and the first step in constructing them is to collect and manage the plastic material. The plastics involved in building these roads consists mainly of common post-consumer products such as product packaging. Some of the most common plastics used in packaging are [polyethylene terephthalate](#) (PET or PETE), [polypropylene](#) (PP), and high- and low-density polyethylene ([HDPE](#) and [LDPE](#)). These materials are first sorted from plastic waste. After sorting, the material is cleaned, dried, and shredded. The shredded plastic is mixed and melted at around 170 °C. Hot bitumen is then added and mixed with the melted plastic. After mixing the mixture is laid as one would with regular asphalt concrete.

So far, no large-scale, systematic approach has been employed to build roads entirely of plastics in Netherlands. On September 13, 2018, the Dutch company Volkerwessels built a bicycle path made of recycled plastic in [Zwolle](#), in the northeast part of the Netherlands. According to the Guardian, "A second path is to be installed in [Giethoorn](#) in Overijssel, and Rotterdam is the city most likely to take up the technology."



India

Chennai was among the first cities globally to adapt the technology in a big way when the municipality commissioned 1000 km of plastic roads in 2004. Since then all major municipalities in India have experimented with the technology including [Delhi](#), [Lucknow](#), [Pune](#), [Mumbai](#), [Surat](#), Indore etc.

Chennai: While the plastic roads may be a new concept in many parts of India, Chennai has been experimenting with it since 2011. Chennai has used nearly 1,600 tonnes of plastic waste to construct 1,035.23 kilometres length of roads in recent years, which include N.S.C Bose road, Halls road, Ethiraj Silai Street and Sardar Patel Street.

Pune: Using bitumen technology on waste plastic, the Pune Municipal Corporation constructed a 150-metre stretch of Bhagwat lane at Navi Peth near Vaikunth Crematorium in 2016. The other trial patches in Pune include Dattawadi Kaka Halwai Lane, Katraj Dairy, Magarpatta City HCMTR Road, Kavde Mala Road, Koregaon Park Lane No 3 and Yeravada Sadal Baba Darga Road from Chandrama Chowk.

[Jamshedpur](#): Jamshedpur Utility and Services Company (JUSCO), which is a subsidiary company of Tata Steel, constructed a 12-15 km road in the steel city as well as Tata Steel Works using plastic road, including a nearly 1 km stretch in Ranchi, 500m stretch each in Dhurwa and Morabadi, 3 km of roads in Chas and Jamtara each and 500m stretch in Giridih.

Indore: Dating 2014, the Madhya Pradesh Rural Road Development Authority (MPRRDA) has constructed around 35 km of roads in 17 districts with plastic waste.

Surat: The idea of using plastic-bitumen mix was executed in January 2017. The problem of potholes significantly reduced as no cracks developed in areas where roads were layered with waste plastic.

Test	Bitumen Road	Plastic tar Road	Reasoning – plastic tar road
Skid Resistance <65	More than the expected value 76	Within the limit 45	Not very smooth – supported by texture value
Sand Texture .6-.8	More depth 0.83	Less depth >0.6	Due to bonding- in permissible limit
Roughness 4000	More bumps 5200	Less Bump >4000	Better binding- less rutting and ravelling
Benkelman beam 0.5-1	Rebound slightly High 1.55	Rebound Less 0.5-1	Supported by bonding- base surface defect is taken care of by the plastic tar road
Density 2.86	Moderate 2.88	Moderate Value 2.55	Better binding

Table showing different characteristics of Road

Conclusion:

“The process is easy and does not need any new machinery. For every kilo of stone, 50 gms of bitumen is used and 1/10th of this is plastic waste; this reduces the amount of bitumen being used. Plastic increases the aggregate impact value and improves the quality of flexible pavements. Wear and tear of the roads has decreased to a large extent,” explains the proud Plastic Man of India The advantages of using waste plastics for road construction are many.

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