

A review on plastic roads: A Recent advancement in Waste Management

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Abstract: Plastic roads are roads made either entirely of plastic or of composites of plastic with other materials. The implementation of plastics in roads also opens a new option for recycling post-consumer plastics. Since plastic roads are a relatively new idea, construction processes may vary. Some of the most common plastics used in packaging are polyethylene terephthalate, polyvinyl chloride (PVC), polypropylene (PP), and high and low density polyethylene (HDPE and LDPE). In this present study, an attempt is made to study the construction process of plastic roads. It is concluded that use of these plastics in road construction is an innovative technology which not only strengthens the road but also increases the road life.

Keywords: Plastic roads, recycling, Plastic waste, mix of plastic and bitumen.

I INTRODUCTION

Plastic roads are roads made either entirely of plastic or of composites of plastic with other materials. 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. Currently, there are no records of regular roads made purely of plastic. Plastic composite roads, however, have existed and demonstrate characteristics superior to regular asphalt concrete roads; specifically, they show better wear resistance. The implementation of plastics in roads also opens a new option for recycling post-consumer plastics. This technology is getting replicated very fast in Jharkhand, after the plastic road laid at Jamshedpur city on 30 November 2011.

Construction

Since plastic roads are a relatively new idea, construction processes may vary. In Jamshedpur, India, roads are created from a mix of plastic and

bitumen. 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 consist mainly of common post-consumer products such as product packaging. Some of the most common plastics used in packaging are polyethylene terephthalate, polyvinyl chloride (PVC), 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.

Properties

Below are some of the pros and cons of plastic roads.

Pros

Heating and power generation can be incorporated into plastic roads. Heating can prevent roads from freezing; it can also help evaporate water from the surface.

Since plastics come with various chemical and physical properties, roads can be engineered to meet specific requirements (e.g. weather and wear resistance)

Plastic waste mixed in at 8% ratio to asphalt worldwide may solve the issue of plastics in landfills and oceans world-wide, soon becoming more valuable as a commodity in disadvantaged countries.

Plastic roads can be made into interlocking pieces that can be quickly assembled or disassembled. This makes on-site construction much faster and convenient. Simplicity and speed of road work also correlates to lower cost.

Plastic roads can be built from waste plastic --- the majority of which is usually put into landfill,

incinerated, or polluted into the environment. Landfilling 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.

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 and, so far, the segregation process is labor-intensive with no easy solution.

Using less asphalt saves on resources. Asphalt concrete requires petroleum which is becoming scarcer.

The use of plastic in road construction reduces the amount of asphalt used. This is beneficial to the environment since asphalt is responsible for 2% of global carbon emissions.

Modular plastic pieces are much easier to work with than asphalt.

The addition of plastic in asphalt can reduce the viscosity of the mix. This allows a lower working temperature, which lowers VOC and CO emissions.

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.

Cost effective: using recycled, post-consumer plastics is cheaper than using asphalt.

Cons

Pure plastic road requires using compatible plastics because, when melted, plastics of different types may phase-separate and cause structural weaknesses, which can lead to premature failure.

Wear on the surface of 100% plastic roads creates harmful plastic particulates which can worsen current microplastic pollution problem.

II LITERATURE REVIEW

The plastic wastes have been utilized in the construction of pavements in India since a decade now. It is seen that the use of plastics enhances the rheological properties of bitumen and hence that of the pavement. Considerable research has been carried out to determine the suitability of plastic wastes in the construction of bituminous pavements.

Dr. R. Vasudevan has stated in his works that the use of plastic in bitumen improves the binding properties of bitumen. [1] Prof. C.E.G Justo states that addition of 8% percent by weight of processed plastic is

desirable in saving 0.4% bitumen by weight of mix as it improves the stability, strength, life and other desirable properties of bitumen. [2] Dense bituminous macadam with recycled plastics, mainly low density polyethylene (LDPE) replacing 30% of 2.36 – 5 mm aggregates, reduced the mix density by 16% and showed 250% increase in Marshall Stability. Zoorab and Suparna stated that the use of recycled plastics in plain bituminous concrete mixes increases its durability and fatigue life. [6] D. N Little further worked on the effect of plastics on bitumen and found the resistance to deformation of asphaltic concrete modified with low density polyethylene (LDPE) was reasonably improved. [8] Studies have showed that the use of recycled polyethylene in bituminous pavement mixes reduces the permanent deformation in the form of rutting and the low temperature cracking of pavement surfacing. [9] Bindu et al. studied the effects of shredded plastic in stabilizing the stone mastic asphalt (SMA) mixture in flexible pavements. [3]

Advantages of plastic road

A lightweight prefabricated construction Faster construction and less maintenance time Higher quality and a longer lifespan Little to no maintenance required. The material is virtually impervious to conditions such as the weather and weeds.

The innovation is considerably more sustainable. The goal is to make the Plastic Road out of 100% recycled plastic and to make it fully reusable. It is perfectly in line with the Cradle to Cradle philosophy and the principles of the circular economy.

Double use of space. The hollow space in the design can be used to store water or as space for cables and pipes.

The possibility of constant safety and water drainage Everything on and around the road can be prefabricated .

The concept offers opportunities for further innovation. Examples include solar heated roads, light poles and traffic loop sensors.

Contribution to the social problem of plastic waste.

Disadvantages of Plastic Road

Toxic present in the co-mingled plastic wastes would start leaching.

But the presence of chlorine will definitely release HCL gas

III CONCLUSION

Plastics increase the melting point of the bitumen. The use of this plastics in road construction is an innovative technology which not only strengthens the road but also increases the road life. The analysis in this paper reveals that Durability, strength and cost. It is hoped that in near future we will have strong, durable and eco friendly roads which will relieve the earth from all type of plastic waste.

IV FUTURE SCOPE

As the population increases, the solid waste also increases proportionally. The best alternative is the usage of waste as construction material assuring a good disposal. As this method is economic the practice would be on satisfactory extent aiding the future generations for a good solid waste management.

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