

# Possibility of Re-use of Waste Plastic in Roads: A Review

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### ABSTRACT

Transportation is vital for the economic development of any region since every commodity produced whether it is food, clothing, industrial products or medicine needs transport at all stages from production to distribution. Safe and fast transport is of utmost importance of perishable use. The growth in various types of industries together with population growth has resulted in enormous increase in production of various types of waste materials, world over. There are many waste materials like plastic, which can be reused in the road construction. Plastics offer the unique advantage that one can recover the fuel value contained in the hydrocarbon polymer after its use. Plastics can also be made environmentally degradable, especially for packaging applications. Plastic can be reused as a construction material in roads, with further study and tests on it.

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Key Words: Plastic, Roads, re-use, Waste

## 1. INTRODUCTION

Transportation contributes to the economic, social and cultural development of any country. Transportation is vital for the economic development of any region since every commodity produced whether it is food, clothing, industrial products or medicine needs transport at all stages from production to distribution. Safe and fast transport is of utmost importance of perishable use.

Infrastructure has been the key element in fuelling the industrial growth of any country. Roads are the most important element of any infrastructure in fact they are the arteries of industrial activity.

#### 2. IMPORTANCE OF THE ROADS

The importance of adequate road infrastructure for a developing country cannot be over-looked. In 1951, railway transportation accounted for more than 75 % of the passenger and freight traffic. Today however, the road transportation accounts for more than 85 % of the passenger traffic and 65 % of the goods traffic.

Inefficient transportation means a loss of internal competitiveness. While commercial vehicles in the country run, on an average 250-30 kms per day, their counterparts in the developed countries are able to comer more than double the distance. The economic losses to the national exchequer due to sub-standard and inadequate roads are estimated to be more than Rs. 20,000 crores per annum.

#### **3. POSSIBLE WASTE MATERIALS USED IN CONSTRUCTION OF ROADS**

The growth in various types of industries together with population growth has resulted in enormous increase in production of various types of waste materials, world over. The creation and disposal of non-decaying waste materials such as Blast Furnace Slag, Fly-ash, Steel Slag, Scrap Tyres, Plastics, etc. have been posing difficult problems in developed as well as in developing countries. Considerable work has been done in various countries for the disposal of some of these waste products and utilization of some other products and there is a long list of published literature dealing with different aspects of these challenging problems. Attempts are still being made by various organizations and researchers to find methods for effective utilization of some of these waste materials. Of these, the efforts to find useful applications of some of the waste products in highway construction have given encouraging results. The work done in India, particularly at the Central Road Research Institute (CRRI), New Delhi on the use of waste materials like Fly-ash and Slag in road construction is note worthy. Possible waste materials are shown in Table 1.



## Table 1 POSSIBLE USAGE OF WASTE PRODUCTS IN ROAD CONSTRUCTION

WASTE PRODUCT	SOURCE	POSSIBLE USAGE
Fly ash	Thermal power station	Bulk fill, filler in bituminous mix, artificial aggregates
Blast furnace slag	Steel industry	Base/ Sub-base material, Binder in soil stabilization (ground slag)
Construction and demolition waste	Construction industry	Base/ Sub-base material, bulk-fill, recycling
Waste tyres	Automobile industries	Rubber modified bitumen, aggregate
Plastic	Plastic industries and general waste	As a binder in bitumen

## 4. PLASTIC AND ITS IMPORTANCE

Plastic can be considered as a potential re-use material.

## 4.1 What are plastics?

Plastics are macromolecules, formed by Polymerization and having the ability to be shaped by the application of reasonable amount of heat and pressure or some other form of force.



Figure 1. Picture showing waste plastic collected in Pune city





## 4.2 Why plastics - the importance of plastics in modern society

Plastic have molded the modern world and transformed the quality of life. There is no human activity where plastics do not play a key role from clothing to shelter, from transportation to communication and from entertainment to health care. Plastics, because of its many attractive properties, such as lightweight, high strength and ease of processing, meet a large share of the materials needs of man, and that too at a comparatively lesser cost and causing lesser environmental implications. From practically zero during the beginning of the 20<sup>th</sup> century, human kind today consumes more than 150 million tons of plastics per year.

Plastics possess a unique combination of properties. Plastics can be super tough, rigid as well as flexible, transparent as well as opaque and can allow permeation or act as a barrier material.

Growing population and material consumption has put severe pressure on our natural resources and fragile ecosystems. The material needs of our population are growing and plastics offer a cost effective alternative.

Plastics are employed in myriad applications where they actually conserve natural resources. For example, asceptic packaging of food in barrier packaging films will save refrigeration cost and saving capital and energy. Edible oils and milk are packaged in flexible packages eliminating the use of tin and glass containers. Rigid HDPE barrels are used for bulk chemical storage instead of steel drums. Apart from conserving natural resources, use of plastics in these applications saves transportation fuel as plastics are substantially lighter than tin, glass or steel.

Safe drinking water in PET bottles is a very common sight now-a-days. They provide confidence to consumer on the quality of water and help reduce water-borne diseases. Advance polymeric membranes help purify water from viruses and bacteria. They also provide potable drinking water from sea and blackish water through a process of desalination.

The fact that plastics are made from hydrocarbons derived from petroleum, which is non-renewable, has raised questions concerning its sustainability. Nevertheless, the consumption of petroleum hydrocarbon for the production of plastics is less than 5%, the balance being consumed as fuels and energy source. Consequently, the concerns about sustainability of plastic material is somewhat exaggerated. On the contrary, processing of many natural materials (glass, paper, wood, metals) consume far more energy and thus lead to greater consumption of fossil fuels. Additionally, research and development work currently in progress globally will provide future opportunities to make some of the plastics from biomass and other renewable sources. Thus, plastic manufacture will become even more sustainable in the years to come. It is fair to say that plastics replace several naturals, which are either scarce, consume more energy for processing or cause damage to the eco-system during their production Thus use of plastics makes positive contribution to the sustainability of earths resources.

Another issue that is often discussed is whether because of their non-biodegradability, plastics will cause damage to our eco-system

The signature of all natural materials made by biological process is that they are biodegradable and bio-assimilable. The long life and desirability of plastics, which have made them, a material of choice for many applications is seemingly a disadvantage when it comes to their disposal. However, when handled properly, plastics do little damage to our environment. Plastics have the advantage that they can be easily reprocessed and recycled.

Plastics offer the unique advantage that one can recover the fuel value contained in the hydrocarbon polymer after its use. Plastics can also be made environmentally degradable, especially for packaging applications. There are expectations that in the near future plastics will be made even biodegradable and compostable so that waste plastics can be handled the same way as wet food waste and agricultural waste. The overall eco-friendliness of plastics becomes apparent when one evaluates the total "life cycle", namely, an analysis of raw materials, energy, effluents, and methods of disposal etc. of a material from its origin to its final disposal.

## 4.3 Plastics scenario

Plastics have become common man's friend. It finds its use in every field. Nearly 50% of the plastic consumed is used for packing. The most used plastic materials for packing are carry bags, cups, thermocoles and foams. These materials are manufactured using polymers like Polyethylene, polypropylene and polystyrene. The tubes and wires are made out of poly vinyl chloride. These materials, once used are either thrown out or littered and ultimately get mixed with Municipal Solid Waste (MSW). As the plastics are non-biodegradable, their disposal is a problem and they cause social problems contributing for environmental pollution.

## 4.4 Present status of the plastics waste roads

We can now reuse the waste Plastic in the road construction by the following process called Dry Process. In the dry process aggregates are heated to a temperature of about 160°C - 175°C then the plastics strips (obtained by cutting large quantity of waste plastic) is added to the hot aggregates. The plastic melts and forms a coating over the aggregate resulting in the formation of polymer layer. The bitumen when heated to a temperature of 160°C is added to the plastic-coated aggregates. The road is laid at the temperature of 140°C.



## 5. CONCLUSIONS

Transportation contributes to the economic, social and cultural development of any country. In India, thousands of plastic wastes are generated every year. Among many options plastic can be reused as a material for road construction. Since, plastic is a non-biodegradable material, its re-use in roads will make environment safer place. More experimental investigation will lead to a concrete solution on this problem. To address problems like mixing methods, load capacity of pavement several tests on plastic and bitumen are needed. In summary, plastic can be reused as road material with proper tests and methods.

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