

REVIEW PAPER OF DESIGN AND FABRICATION OF LIQUID PLASTIC POTHOLE REPAIRING MACHINE

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Abstract: The waste plastic and its disposal is a major threat to the environment, which results in pollution and global warming. The utilization of plastic waste in bituminous mixes enhances its properties and also its strength. In addition it will also be a solution to plastic disposal & various defects in pavement viz., pot holes, corrugation, ruts, etc. the waste plastic used are poly-ethylene, poly-styrene, poly-propylene. The waste plastic is shredded & coated over aggregate & mixed with hot bitumen and resulted mix is used for pothole repair. This will not only strengthen the pothole and also increases its durability. The titanium-dioxide is used as a smoke absorbent material, which will absorb the smoke from the vehicles. Potholes are one of the most visible and annoying forms of distress associated with bituminous pavement deterioration from the point of view of a road user. Potholes have always been a problem for highway maintenance agencies because their repair is costly and time-consuming. This innovative technology will help to fill plastic waste in liquid form in pothole and patch the pothole for lifetime. It's economical and eco-friendly. In this paper, we have discussed about the machine design to fill pothole with plastic waste. At present nearly 56 lakhs tones of plastic waste is produced in India per year. The degradation rate of plastic waste is also a very slow process. Hence the project is helpful in reducing plastic waste in a useful way. In this project we have used plastic waste in different proportions with quarry dust, coarse aggregate and ceramic waste.

Keywords: Pothole, Pothole Repair Machine, Environmental Pollution, Plastic Waste Management, Atomization in pothole repair

I. INTRODUCTION

Vehicular traffic has been rapidly growing over the recent years with more privately owned vehicles taking to the streets each day. Today, trucks weigh significantly more than ever before and are capable of carrying much larger payloads. The situation is further exacerbated by the decline of railroads. These factors in conjunction with inclement weather result in a major challenge that transportation departments throughout the country face – road damage in the form of potholes. Potholes are not only the cause of significant damage to vehicle suspension systems but may, in severe cases, result in serious accidents and permanent injury. Year-round pothole repairs are also a major reason for the depletion of state funds. The United States alone spends billions of dollars every year on pavement maintenance. Thus there is an impending need for pothole repair techniques that are cost effective as well as long lasting. Plastic waste used in this work will be brought from the surrounding areas. Currently about 56 lakh tonnes of plastic waste dumped in India in a year. The dumped waste pollutes the surrounding environment. As the result it affects both human beings and animals in direct and indirect ways. Hence it necessary to dispose the plastic waste properly as per the regulations provided by our government. The replacement of plastic waste for cement provides potential environmental as well as economic benefits.

II. POTHOLE

2.1 Potholes – causes and repair methodology

“A pothole is any pavement defect involving the surface or the surface and base, to the extent that it causes significant noticeable impact on vehicle tires and vehicle handling. All potholes are the result of the interaction of water and traffic on pavement. Most are found on local road and street systems: 80% of the nation’s roads are local roads and are more apt to have “just grown” rather than being planned from the start and are much more likely to have water, gas and other utilities underneath.

2.2 Pothole formation

The development of potholes is due to the simultaneous presence of two factors, water and traffic. These factors may cause potholes in two basic ways. Fatigue failure occurs due to excessive flexing of the pavement. Water due to melting snow, rainfall, or bad drainage weakens the soil below the pavement. In this weakened condition, traffic on the pavement causes the pavement to start flexing. This flexing eventually leads to cracks followed by breakage. Thinner pavements are more prone to this type of potholing. Raveling failure occurs when water on the pavement washes away the adhesive asphalt films that hold the stone aggregate together. Traffic on such pavements causes a gradual raveling away of the stone particles. Such a condition occurs when water has a 3 chance to permeate a pavement that lacks sufficient density to prevent water penetration. The best way to minimize road damage is to follow a carefully planned preventive maintenance system. This includes the laying-out of well-planned roads, using proper resurfacing methods, ensuring adequate drainage facilities, regularly checking drains for blocks, and carrying out road repairs as soon as possible to prevent further deterioration. Despite the best measures taken by state transport authorities, the development of potholes is inevitable. Preventive maintenance can at best delay their occurrence. It is thus essential to simultaneously focus on

continuously improving pothole repair methods. It is often observed that potholes remain unattended throughout the rainy season, leading to a severe damage to roads and subsequently hindrance in movement of vehicular traffic.

The key disadvantages of delayed repair of potholes are

- (i) Economic loss due to higher fuel consumption
- (ii) Enhanced pollution
- (iii) Need of more material due to repair of larger size potholes
- (iv) Sometimes reconstruction.



Figure 2.1 - A Pothole Cause by Fatigue Failure and Changing Weather

III. PLASTIC WASTE

Bitumen is a useful binder for road construction. The steady increase in high traffic intensity in terms of commercial vehicles, and the significant variation in daily and seasonal temperature demand improved road characteristics. Any improvement in the property of the binder is needed. Waste plastics on heating soften at around 130°C.

Table 1

TYPES	SOURCES
Low density polyethylene (LDPE)	Bags, sacks, bin lining and squeezable detergent bottles etc.
High density polyethylene (HDPE)	Bottles of pharmaceuticals, disinfectants, milk, fruit juices, bottle caps etc.
Polypropylene (PP)	Bottle cap and closures, film wrapping for biscuits, microwave trays for ready-made meals etc.
Polystyrene (PS)	Yoghurt pots, clear egg packs, bottle caps.
Foamed Polystyrene	Food trays, egg boxes, disposable cups, protective packaging etc.
Polyvinyl Chloride (PVC)	Mineral water bottles, credit cards, toys, pipes and gutters; electrical fittings, furniture, folders and pens; medical disposables; etc.

Different Types and Sources of Waste Plastic (Polymer)

Thermal gravimetric analysis has shown that there is no gas evolution in the temperature range of 130-180°C. Moreover the softened plastics have a binding property.

Table 2

Polymer	Softening temperature in deg.c	Decomposition temperature deg.c	Ignition temperature °C
PE	100-120	270-350	>700
PP	140-160	270-300	>700
PS	110-140	300-350	>700

Thermal Behaviour of Polymers

IV. OBJECTIVES

Objective of this project is to have an economical and easy system for repair of potholes. The repair pothole is being done because of the following reasons:-

- i) Preserving a road in good condition through periodic repair is significantly cheaper than allowing it to degrade and then rebuilding it.
- ii) Maintenance of rural road network.
- iii) To reduce cost of pothole repair.
- iv) To produce environment friendly mixes.
- v) To develop labor friendly method.
- vi) To avoid imports to save foreign exchange.
- vii) Sustainable patch pothole repairs.

V. LITERATURE REVIEW

- i) Fransis Hveem (1942) "Optimum quantity of bitumen inroads" who was a project engineer of California Department of Highways, has developed the Hveemstabilometer in 1927. He did not have any previous experience on judging, the required mix of its colour, hence he decided to measure various mixture parameters to find the optimum quantity of bitumen [Vallerga and Lovering 1985]. He had used the surface area calculation concept, (which was already in use, at that time for the cement concrete mix design), to estimate the quantity of bitumen actually required.
- ii) Ruzbeh Adi Minocher Homji (2005)-In the highway infrastructure, a large number of originates materials and technologies have been invented to determine their suitability for the design, construction and maintenance of these pavements. Plastics and rubbers are one of them. Also considering the environmental approach, due to excessive use of polythene in day to day business, the pollution to the environment is enormous. The use of plastic materials such as carry bags, cups, etc. is constantly increasing day by day. Since the polythene are not biodegradable, the need of the current hour is to use the waste polythene in some beneficial purposes. The use of these materials as a road construction proves eco-friendly, economical and use of plastic gives strength in the pavement.
- iii) Vatsal Patel et al (2014) "Utilization of plastic waste in road" described that the effect of wax in bitumen can be reduced by adding EVA (Ethyl Vinyl Acetate), aromatic resin and SBS in the waxy bitumen. The addition of 4% EVA or 6% SBS or 8% resin in waxy bitumen effectively reduces the Susceptibility to high temperatures, bleeding at high temperature and brittleness at a low temperature of the mixes.
- iv) Anzar Hamid Mir (2015) "Plastic waste in pavement construction" studied the visco-elastic nature of binders and found that the complex modulus & phase angles of the binders, need to be measured, at temperatures and loading rates which different resemble climatic and loading conditions.
- v) Kurmadasu Chandramouli et al (2016) "Plastic waste: its use in the construction of roads " reported that asphalt concrete using polyethylene modified binders were more resistant to permanent deformation at elevated temperature and found improvement in stripping characteristics of the crumb rubber modified mix as compared to unmodified asphalt mix.
- vi) Sikhsha Swaroopa Kar (2016) - Many a times, potholes are repaired by non-scientific antiquated techniques and non-standard materials. It is often seen on roads that potholes are filled in haste by debris/soil, which is usually washed away with the first rain. It leads to a pavement that cannot be repaired and can be made functional only by reconstruction. Therefore, scientific approach involving utilization of standard materials and techniques is essential for long lasting repairs of potholes and patches.
- vii) Potholing presents a major challenge for all national and state agencies involved in the maintenance of roads and pavements. This has motivated a significant amount of research for the development of higher-quality materials and better techniques to combat road damage and increase road-repair life expectancy.
- viii) In 1987, the U.S. Congress established a 5-year applied research program called the Strategic Highway Research Program (SHRP). The SHRP functioned as a unit of the National Research Council, with its goal being to improve the performance, safety, and efficiency of the nation's highway system. Relevant projects of the SHRP are reviewed in this chapter. In addition, this chapter also reviews previous work done in the field of pothole detection and automated road repair vehicles

VI. CRITICAL REVIEW

Different authors have studied recycle technique for waste plastic recycle by melting it at a certain temperature and using it for potholes repair, pavement, bricks etc. Some authors have added some additive to strengthen the bond of plastic. The used mixes to fill pothole are causing pollution, not so reliable, no longer life and take time more time to settle down. The road made from asphalt mix release toxic waste and the road also get dirty, while the cement take more time of 12 to 15 days to get dry. The pothole repair machine used nowadays are costly and bigger and cannot be use to patch a pothole in crowded area and narrow road. There maintenance cost is also high and there design is compact and hard to understand. The machine take more time so traffic jam occurs. By adding so material to plastic the strength of plastic can be increase as per need .Utilization of plastic waste is a big need of country like India where the graph of plastic waste is increasing day by day. So many author have made various research in the field of use of plastic waste in road construction.

VII. PROJECT DETAILS

The project construction is simple compare to other machine present in the market to repair pothole. The project construction is simple. The project cost is less compare to the other imported from abroad. The machine can be taken easily anywhere. The machine consist of following parts

- i) Heater.

- ii) Dc motor.
- iii) Horizontal mixer container with nozzle.
- iv) Worm and worm wheel gear in gearbox.
- v) Two bearings on both side of container.
- vi) Two storage container for storing plastic and sea sand.
- vii) Frame with 4 wheel of size 25inch x 18inch.
- viii) Horizontal shaft with blade welded on it.

VIII. SCOPE OF PROJECT

- i) To eradicate potholes.
- ii) To minimize the global warming, greenhouse gases and pollution.
- iii) The lifespan of the roads can be increased.
- iv) Eco-friendly in nature.

IX. CONCLUSION

- i) The use of the innovative technology not only strengthened the road construction but also increased the road life as well as will help to improve the environment and also creating a source of income.
- ii) Plastic roads would be a boon for India's hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with big potholes.
- iii) The durability of the roads laid out with the shredded plastic waste is much more compared with roads with asphalt with the ordinary mix. Roads laid with plastic waste mix are found to be better than the conventional ones.
- iv) The binding property of plastic makes the road last longer besides giving added strength to withstand more loads. While a normal 'highway quality' road lasts four to five years, it is claimed that plastic-bitumen roads can last up to 10 years.
- v) The cost of plastic road construction may be slightly higher compared to the conventional method. However, this should not deter the adoption of the technology as the benefits are much higher than the cost.
- vi) It is hoped that in near future we will have strong, durable and eco-friendly roads which will relieve the earth from all types of plastic-waste.

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