

DESIGN AND FABRICATION OF POTHOLE REPAIRING MACHINE USING PLASTIC WASTE IN MIXES

¹Prof. Amit Patil, ²Madhukar Bhalchandra Sawant, ³Vighnesh Vijay Salunke, ⁴Kirti Sanjiv Goyal, ⁵Rituraj Gautam Jadhav

¹Professor, ^{2,3,4,5}Students

Department Of Automobile Engineering
Saraswati College of Engineering, Kharghar, Navi Mumbai, India

Abstract: At present nearly 56 lakhs tones of plastic waste is produced in India per year so the main aim of this project was to reduce plastic waste and to create a machine which is small, lightweight and easy to operate in rural and urban areas. Day by day our environment is polluted by large amount of plastic wastes. However there are several plastic waste recycled & reused, they are not done effectively. In order to prevent the environment pollution caused by plastic waste. 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. Pothole 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 project will help to fill plastic waste in liquid form in pothole and patch the pothole for lifetime.

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. 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 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. Thus there is an impending need for pothole repair techniques that are cost effective as well as long lasting. But due to repeated loading and weathering on roads, a pothole may be caused which may affect the human life very badly. A pothole is a structural failure in a road surface, caused by failure primarily in asphalt pavement due to the presence of water in the underlying soil structure and the presence of traffic passing over the affected area

II. DEFINITION OF POTHOLE

A pothole is a structural failure in a road surface, usually asphalt pavement, due to water in the underlying soil structure and traffic passing over the affected area. Water first weakens the underlying soil; traffic then fatigues and breaks the poorly supported asphalt surface in the affected area. Continued traffic action ejects both asphalt and the underlying soil material to create a hole in the pavement.



Fig. 1 -Pothole

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.

III. POTHOLE FORMATION

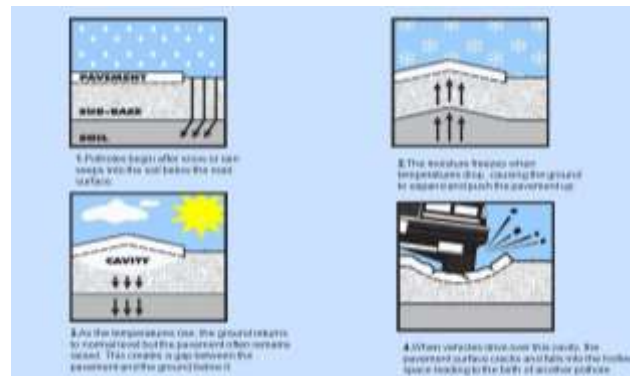


FIG 2: FORMATION OF POTHOLES

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. Ravelling 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 ravelling 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

- Economic loss due to higher fuel consumption
- Enhanced pollution
- Need of more material due to repair of larger size potholes
- Sometimes reconstruction

IV. CAUSES OF POTHOLE

Potholes can also (less frequently) result from diverse, non-structural causes such as-

- Diesel (or other chemical) spillages.
- Mechanical damage to road surfaces from vehicle rims and/or accidents and fires.
- Damage caused by falling rocks in cuttings.
- Animal hooves on the road surface in hot weather.
- Poor road design over certain sub grades (expansive, collapsible, dispersive)
- Lack of bond between the surfacing and WBM base.
- Insufficient bitumen content.
- Insufficient pavement thickness to support traffic during freeze/thaw periods without localized failures.
- Insufficient drainage
- Failures at utility trenches and castings (manhole and drain casings)
- Pavement defects and cracks left unmaintained and unsealed so as to admit moisture and compromise the structural integrity of the pavement.

V. OBJECTIVES

Objective of this project is to have an economical and easy system for repair of potholes.

- i) Maintenance of rural road network.
- ii) To reduce cost of pothole repair.
- iii) To produce environment friendly mixes.
- iv) To develop labour friendly method.
- v) To reduce plastic waste.

VI. PROJECT DETAILS

We designed a manually operated machine which will clean the pothole on the road, and will discharge the required amount of concrete to fill the pothole and to do a levelling process on the discharged concrete using the roller. Therefore the pothole on the road may be filled completely and hence the accidents occur due to the pothole may be reduced. So our project is to make a machine which helps the society in promoting the road safety and to reduce the difficulties in patching the pothole and also reduce the usage of human power, and hence saves the time.

VII. MATERIAL SELECTION

The mixing container is the main material in this project. The selection of proper container material for heat transfer is important. The property include thermal conductivity, light weight, recyclable and corrosion resistance. The second important material in this project is the material used to make mixes to patch pothole. The material used for mixes have different properties and there binding properties also varies for different roads. The material used should contain some of the important property like strength, stiffness, good binding and more lifetime. As per some research paper the mixes used should be in proper proportion and the main factor is selection of proper material need to make mixes for patching pothole.

VIII. COMPONENTS

The components used for project are as follow-

- Induction Heater (0 - 250 °C)
- DC Motor with gear and adapter connected to give AC supply
- Frame(mild steel(20"x32" inches)
- Container for plastic storage (5kg)
- Container for tar storage(5kg)
- Aggregate container of (5 kg)
- Roller(118N)
- Blower
- Control unit
- Temperature sensor

The material used to make mixes consist of

1. Tar and bituminous
2. Shredded Waste Plastic
3. Aggregate 6mm Or Below 12mm

IX. CONSTRUCTION

The project construction is design simple compare to other machine present in the market to repair pothole. The project construction is simple. The project consist of an aluminum container which is used to mix and heat the mixes. the container of 11kg which is converted into a mixer by installing a DC gear motor of high torque with blade attach to the motor and an induction heater at the bottom of the container. We selected aluminum because heat transfer rate is high. The DC motor is given AC supply by connecting an adapter to the motor. Three plastic container of 5kg each are install at three different place on the machine. One container consist of aggregate of 12/6mm and is install at the top of the mixer and a PVC pipe connection with valve is given to the storage container and outlet is directed in the mixer to direct the flow of aggregate in the mixer. Other two container consist of waste shredded plastic and tar which are install behind the mixer and are pour manually in the mixer. A roller of 118N force is attached to the frame its weigh is 12 kg. Apart from all this part the machine consist of a blower, temperature sensor and a control unit. The project cost is less compare to the other imported from abroad. The machine can be taken anywhere easily.

X. WORKING



FIG 3-POTHOLE REPAIRING MACHINE USING PLASTIC WASTE IN MIXES

The working of the machine is quite simple and is carried out in four operation and they are as follow –

1. Cleaning-

The pothole is first clean by means of a blower.

2. Heating and mixing –

The tar is first pour manually in the mixer and power supply to heater is ON. The tar take probably 25 minute to melt completely .The melting temperature of tar is about 100°-150° C. The temperature is noted by using temperature sensor. Once the tar is melt completely the aggregate container valve is open and the aggregate is let into the container once the required amount of aggregate is filled in the container the motor is switched ON and thus the mixing operation start, after this the waste shredded plastic of 40 micron is pour manually into the mixer .Due to high temperature the plastic melt and get mixed with the tar and aggregate mixes. The aggregate of 12/6mm are used in this machine for smooth mixing of the mixes.

3. Patching-



Fig -POTHOLE PATCH BY USING PLASTIC WASTE

The mixer outlet is pointed about the pothole and the mixes made is pour into the pothole. A maximum of 4 to 5 pothole can be patch at a time .After patching the pothole the mixes get cooled within 10 minute-15 minute. After filling mixes in the pothole some amount of cement is sprinkle on the top to reduce the stickiness.

4. Rolling-

The rolling operation is perform by the roller by applying a force of 118 N. Some time there is no need of roller because the mixes get level with the road surface automatically.

This were the operation for bituminous road but if we want to patch pothole on concrete road than the rolling operation will be cancelled and the tar mixes will be replace by concrete mixes .The working of the project is multipurpose because by changing mixes material the machine can be used to make bricks and patch pothole on both concrete and bituminous road and for making bricks we used sand and plastic waste. The mixes material proportion is 50% tar, 20% waste plastic and 30% aggregate. The machine work fully on AC supply. The machine working is easy so no need of skilled worker.

XI. CONCLUSION

After performing test of the project we conclude some of the following point and some addition in project design

- Proper proportion of material used to make mixes for patching pothole
- A specific type of plastic mainly of 40 micron like plastic bags etc. to be used
- This machine can also be used to make pavement from plastic waste.
- On concrete road the mixes made from plastic had to be change due to different binding properties.
- This machine is used to patch bituminous road by using plastic so toxic gases are produced during heating.

- The machine can be installed in a mini van and can be taken anywhere and can be used mostly in rural and urban areas.

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