International Journal of Engineering Research and Modern Education (IJERME)
Impact Factor: 7.018, ISSN (Online): 2455 - 4200
(www.rdmodernresearch.com) Volume 3, Issue 1, 2018

EXPERIMENTAL INVESTIGATION ON PREFABRICATED ROAD PANEL BY USING WASTE MATERIALS

M. Aravinth*, P. Arun Kumar, R. Aravind Kumar*** & S. Arun Kumar******

Department of Civil Engineering, Dhanalakshmi Srinivasan Engineering College, Perambalur, Tamilnadu

Cite This Article: M. Aravinth, P. Arun Kumar, R. Aravind Kumar & S. Arun Kumar, "Experimental Investigation on Prefabricated Road Panel by Using Waste Materials", International Journal of Engineering Research and Modern Education, Volume 3, Issue 1, Page Number 30-34, 2018.

Abstract:

Plastics are user friendly but not eco-friendly as they are non-biodegradable. Generally it is disposed by way of land filling or incineration of materials which are hazardous. The better binding property of plastics in its molten state has helped in finding out a method of safe disposal of waste plastics, by using them in road laying. Use of plastic waste (HDPE) and Crumb Rubber. This not only allows us to collect modifier raw material at low cost, but also provides a solution towards ecological menace posed by increased use of plastics (non-biodegradable). The use of waste materials like plastics and rubber in road construction is being increasingly encouraged so as to reduce environmental impact. The plastic wastes and rubber wastes could be used in road construction and the field tests withstood the stress and proved that plastic wastes used after proper processing as an additive would enhance the life of the roads and also solve environmental problems.

Introduction:

Road network is the mode of transportation which serves as the feeder system as it is the nearest to the people. In India, it is estimated that over 33 lakhs kilometers of road exists. The road transport carries close to 90% of passenger traffic and 70% of freight transport. So the roads are to be maintained in good condition. The quality of roads depends on materials used for construction. Pavements are generally of two types: flexible and rigid pavement. A flexible pavement is the one which has a bitumen coating on top and rigid pavements which are stiffer than flexible ones have PCC or RCC on top. The flexible pavements are built in layers and it is ensured that under application of load none of the layers are overstressed.

Plastics:

A plastic is a type of synthetic or man-made polymer; similar in many ways to natural resins found in trees and other plants. India's consumption of Plastics will grow 15 million tons by 2015 and is set to be the third largest consumer of plastics in the world. Various activities like packing consume almost 50-60% of the total plastics manufactured.

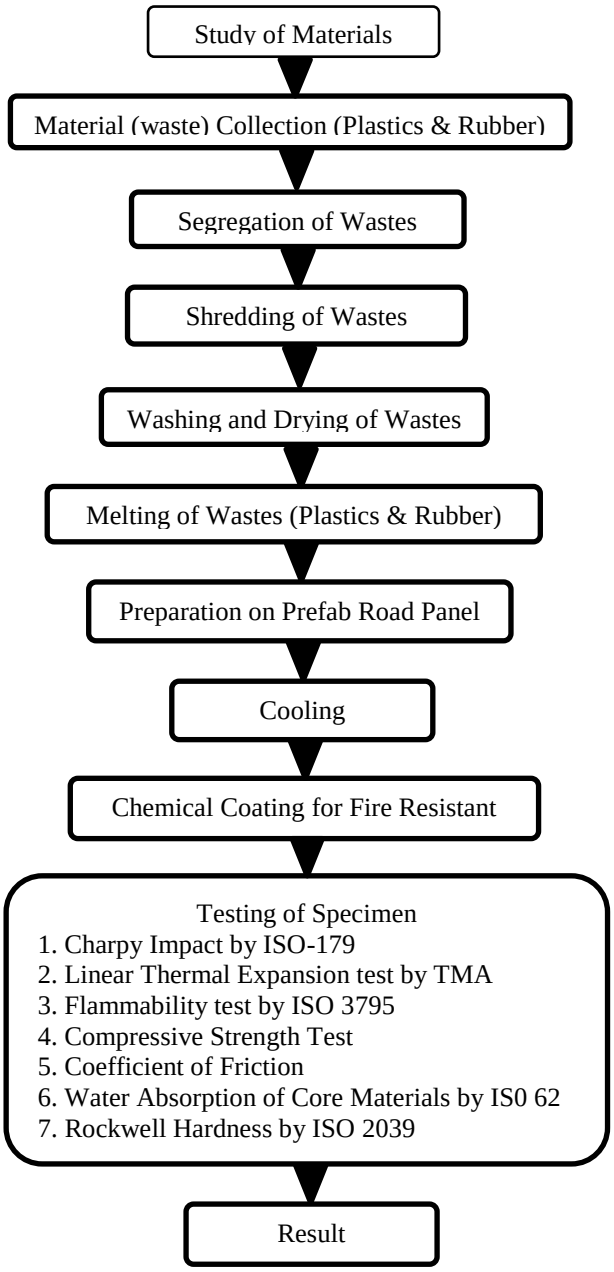
Sources of Waste Plastics:

LDPE	Carry bags, sacks, milk pouches, bin lining, cosmetic and detergent bottles.
HDPE	Carry bags, bottle caps, house hold articles etc.
PET	Drinking water bottles etc.,
PET PP	Bottle caps and closures, wrappers of detergent, biscuit, vapors packets, microwave trays for readymade meal etc.,
PS	Yoghurt pots, clear egg packs, bottle caps. foamed polystyrene: food trays, egg boxes, disposable cups, protective packaging etc
PVC	Mineral water bottles, credit cards, toys, pipes and gutters; electrical fittings, drinking water bottles etc., tire, folders and pens, medical disposables; etc

Crumb Rubber:

Crumb rubber is actually small pieces of waste tyre scrapped from light motor vehicles and whose disposal is a serious menace. The annual available capacity for procured tyres retreading is 4.8 million for bus and truck tyres and 4.5 million for car and jeep tyres. The crumb rubber is made by shredding scrap tire, which is a particular material free of fiber and steel.

Methodology:



Study of Materials:

Materials used for our project and the methodology adopted is discussed below:

- ✓ Plastics
- ✓ Crumb Rubber

Thermosetting Plastic Material:

Typical Composition of Tire Rubber

They undergo great changes when subjected to high temperatures for quite sometimes. They are said to be baked and no longer can melt or be dissolved. They are less elastic, more brittle and lose their elasticity when subjected to prolonged heating. So they cannot be remoulded in different shapes once they are set and hardened. They are used, when insulation is to withstand high temperatures without melting or losing its shape and mechanical strength.

S.No	Component	Weight %
1	Rubber Polymer (SBR)	62.1
2	Carbon Black	31.0
3	Extender Oil	1.9
4	Zinc Oxide	1.9
5	Stearic Acid	1.2
6	Sulphur	1.1
7	Accelerator	0.7

Melting of Material (Plastics and Rubber):

For common commercial grades of medium- and high-density polyethylene the melting point is typically in the range 120 to 180 °C (248 to 356 °F). The melting point for average, commercial, low-density polyethylene is typically 105 to 115 °C (221 to 239 °F). Rubber begins to melt at approximately 180 degrees Celsius. At low temperatures, around 5 C to 6 C, there is a risk that rubber hardens because of crystallization. The optimum temperature for rubber is 20 C. The materials of plastics and rubbers are melted corresponding temperature by using gas stove. The materials are completely liquid state the pre fab road panel are prepared required size and shape.

Preparing of Prefabricated Road Panel:

- ✓ The materials are completely melted on corresponding temperature pre fab road panel are prepared the size of 30 cm × 30 cm.
- ✓ The thickness of pre fab road panel is different from based upon the CBR value of sub grade.

Cooling:

After preparing a prefab road panel is cooled by using various methods. The mould must be cooled relatively quickly, so that that the newly formed component is set properly. There are several cooling methods, both direct and indirect, that can effectively cool the mould and the plastic. Water can be coursed through pipes surrounding the mould, which indirectly cools the mould and plastic. Direct methods include using pressurized air or carbon dioxide directly on the mould and plastic. The cooling is done the steel frame is removed.

Chemical Coating for Fire Resistant and Prevent Weather Effects:

Chemical coating for surface of prefab road for fire resistant and prevent weather effects ensure safety road user and avoid the accidents.

Result and Discussion:

In present study disposal of waste material (Plastics and Rubber) is a major problem. Plastic waste is a non-biodegradable. Burning of these waste rubber tires and plastics causes highly environmental pollution. India is highest user plastics and rubber in the present world which is the waste material. To use of waste material in road construction really impressive job, this material dumped into land leads to wastage of land.

- ✓ Stronger road with increased Marshall Stability Value.
- ✓ Better resistance towards rainwater and water stagnation
- ✓ No stripping and no potholes.
- ✓ Increase binding and better bonding of the mix.
- ✓ Reduction in pores in aggregate and hence less rutting and raveling.
- ✓ No effect of radiation likes UV.
- ✓ The strength of the road is increased by 100%.
- ✓ The load is withstanding property increases. It helps to satisfy today's need for increased road
- ✓ The cost of road construction is also decreased.
- ✓ The maintenance cost of the road is almost nil.
- ✓ Disposal of waste plastic will no longer be a problem.
- ✓ The use of waste plastics on the road has helped to provide the better place for burying the plastic without causing disposal problem.

Today, plastic and rubber waste treatment is largely hazardous to the environment as most of the plastic and rubber are burnt resulting in toxic gasses being released in the environment. By effectively managing the collection, separation and processing of plastic and rubber waste, the environmental damages can be limited by eliminating the waste from our streets. We can have international standard roads and pavements which are litter free. Here are economies and advantages which would accrue to various communities if the plastic road project implemented on a wide scale.

Table: Total Test Result

S.No	Test	Test Result	Standard Value
1	Charpy Impact Test by ISO-179	No breaking	Based on Material
2	Linear Thermal Expansion by TMA (10^-6 in/in/ ℃)	153	150-155
3	Flammability by ISO 3795 (℃)	293	270-300
4	Compressive Strength Test (N/mm^2)		Based on Material
	Size:10 ×10×2.5 cm	8	
	Size:10 ×10×5 cm	20.88	
	Size:10 ×10×7.5 cm	23.55	
	Size:10 ×10×10 cm	35.11	
5	Coefficient of Friction	Static mu =0.35	Based on Material
		Kinetic mu=0.27	
6	Water Absorption of Core Materials by IS0 62	0.01 %	Based on Material
7	Rockwell Hardness by ISO 2039	92	90-95

Conclusion:

The generation of waste plastics and rubber is increasing day by day. The major polymers, namely polyethylene, polypropylene, and polystyrene show adhesion property in their molten state. Hence, the use of waste plastics and rubber for pavement is one of the best methods for reuse of waste plastics and rubber. The prefabricated road reduces construction time and costs. As well as reduce the cost and manpower at site. The use of the innovative technology not only strengthened the road construction but also increased the road life as well as creating a source of income. 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. It is hoped that in near future we will have strong, durable and eco-friendly roads that will relieve the earth from all type of plastic waste.

Advantages:

- ✓ A lightweight prefabricated construction
- ✓ Faster construction (months shorter) and less maintenance time
- ✓ Higher quality and a longer lifespan (homogeneous and prefabricated)
- ✓ 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 (traffic) safety and water drainage
- ✓ Everything on and around the road can be prefabricated (road markings, guardrails)

References:

1. Netherlands Company Introduces Plastic Roads That Are More Durable, Climate Friendly than Asphalt. Think Progress. Retrieved 2015-11-16.
2. Say Hello to the Latest Technology in Civil Engineering: Plastic Road - Industry Tap. Industry Tap. Retrieved 2015-11-16.
3. EnviroNews Archives - Plastics Recycling and the Need for Bio-Polymers. Isebindia.com. Retrieved 2015-10-20.
4. The streets of Vancouver are paved with ... recycled plastic. www.gizmag.com. Retrieved 2015-11-16.
5. What Happens to All That Plastic? Retrieved 2015-11-16. Jump up use of plastic waste in road construction.ppt". Google Docs. Retrieved 2015-10-21.
6. A. Yilma and N. Degirmenci, "Possibility of using waste tire rubber and fly ash with Portland cement as construction materials", Waste Management, vol. 29, no. 5, (2009), pp. 1541-1546.
7. Chitzan, C. L. Huang and C. C. Shern, "Recycling waste tire powder for the recovery of oil spills", Resources, Conservation and Recycling, vol. 52, no. 10, (2008), pp. 1162-116
8. V. K. Gupta, et al., "Enhanced heavy metals removal and recovery by mesoporous adsorbent prepared from waste rubber tire", Chemical Engineering Journal, vol. 197, (2012), pp. 330-342
9. Guidelines for the Use of Plastic Waste in Rural Roads Construction. pmgsy.nic.in. Retrieved 2015-11-16.
10. Jamshedpur's Plastic Roads Initiative Is A Lesson For All Indian Cities! indiatimes.com. Retrieved 2015-11-16.
11. Microplastic Waste: This massive (tiny) threat to sea life is now in every ocean. The Independent. Retrieved 2015-11-16.
12. Abdelaziz Mahrez, Mohammed Rehan Karim, (2003), "Rheological evaluation of ageing properties of rubber crumb modified bitumen", Journal of Eastern Asia Society for Transportation Studies.
13. Carl Thodesen, Feipeng Xiao, Serji Amirkhanian, (2009), "modeling viscosity behavior of crumb rubber modified binders", Construction and Building Materials.
14. Carl Thodesen, Khaldown Shatanawi, Serji Amirkhanian, (2009), "effect of crumb rubber characteristics on crumb rubber modified (CRM) binder viscosity", Construction and Building Materials.
15. Jain, P.K., Kamaraj, c., (2009), "performance study of rubber modified bitumen in structural layers of flexible pavement-a case study", Highway Research Journal, Indian Roads Congress, vol.2-1, pp. 1-9.