EXPERIMENTAL STUDY ON BITUMINOUS PAVEMENT BY USING E-WASTE AND FLY- ASH

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Abstract

The objective of our study is to experiment the study of e-waste and fly ash in bituminous road concrete. And it deals with the development of modified bitumen from e-waste and fly ash as mineral filler with an aim to find an innovative technology for its effective use to produce bituminous mix used for road construction and to minimize these wastes in environment. As it increases the stability and it reduces the cost effective options as it reduces the usage of bitumen. Bitumen is partially replaced by e-waste and fly ash is used as mineral filler. It deals with the innovation of a modified mix. . And this method is cost effective and it is a method to utilize the waste produced in large amount.

Introduction

- Civilization produces lot of e-waste which are non degradable and they affects of environment.
- At present the disposal of waste plastic has become a major waste management problem in the world.
- In this work, focus has been given on the strength of flexible pavement and disposal of plastic in eco-friendly way

Objective

To deal with the problem here an attempt is made to study the use of e-waste as an alternative to conventional material like bitumen in layer of flexible pavement along with partial replacement of bitumen by e-waste and fly-ash

Scope

- The use of e-waste plastics mixture modifier ensures its safe, useful and environmental friendly disposal.
- Use of e-waste is expected to yield better and enhanced waste management and better city hygiene and environment.

Literature Review

- "Experimental Investigation on Bituminous Mixing Using Waste HDPE" by Divya Bhavana Tadepalli, Srikanth Kandula , SaiVivek Reddy.K & Sadgun Kumar.A.

- (International Journal of Innovative Research in Science,Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 4, April 2016)
- HDPE coating of aggregates increases abrasion and impact resistance of aggregates thus improving strength and wear resistance properties of the treated aggregates. Moreover polymer coating reduces its affinity for water and may improve stripping susceptibility.
- "Utilization of e-waste and polymer modified bitumen in flexible pavement" by Tapase Anand, KadamDigvijay and Mujawar Sahil
- (Journal of Environmental Research And Development Vol. 9 No. 3A, January-March 2015)
- It is concluded that 7.5% of bitumen replaced by waste plastic and 7.5% aggregate replaced by e-waste shows increased stability keeping all the other parameters within limits.
- It can be effectively used in practical applications.
- Analysis of Properties in Bitumen and Asphalt with Partial Replacement of Rubber Tyres" by VijayaSarathy R,Jose Ravindraraj B.
- (International Journal of Innovative Research & development May, 2015 Vol 4 Issue 5)
- After careful evaluation of the properties and taking various tests as per standards the results shown by 5% addition of rubber shreds has best suitability for blending it with bitumen.
- Rubberized bitumen gives more strength than ordinary bitumen as well as rubberized asphalt gives more strength than ordinary

Properties of Materials

Bitumen

- Bitumen which is a product of petroleum is widely used material in road construction.
- This is also called as asphalt.
- The bitumen ranges varies between different grades, where it is used as a glue or binder mixed for bituminous water proofing and for sealing flat roofs

Figure 1: Bitumen

Properties of Bitumen

- **Adhesion:** Bitumen has the ability to adhere to a solid surface in a fluid state depending on the nature of the surface. The presence of water on the surface will prevent adhesion.
- **Resistance to Water:** Bitumen is water resistant. Under some conditions water may be absorbed by minute quantities of inorganic salts in the bitumen or filler in it.
- **Ductility:** Ductility test is conducted to determine the amount bitumen will stretch at temperature below its softening point. A briquette having a cross sectional area of 1 in^2 is placed in a tester at 77 °F. Ductility values ranges from 0 to over 150 depending on the type of bitumen.

E-Waste

- E-Waste is a popular informal name for electronic products nearing the end of their "useful life".
- Computers, televisions, VCRs, stereos, copies and fax machines are common electronic products.
- Many of these products can be reused, refurbished or recycled.

Figure 2: E-Wastes

Figure 4: Melting of E-Wastes

Fly Ash

1. Fly ash is also known as flue ash is one of the residues generated in combustion and comprise the fine particles that rise with the flue gases.
2. Ash that does not rise is called Bottom Ash.
3. Fly ash can be used as a Stabiliser for soil due to its Pozzolonic effect or an inherent self hardening property.

Figure 5: Fly Ash

Classification of Fly Ash

- **Class F Fly ash:**
  - The burning of harder, older anthracite and bituminous coal typically produces class F fly ash.
  - This fly ash is pozzolonic in nature and consists of 20% lime (CaO).
- **Class C Fly ash**
  - Fly ash produced from the burning of younger lignite or sub-Bituminous coal in addition to having pozzolonic properties also has some self-cementing properties.
  - Class C fly ash generally contains more than 20% lime (CaO).

Tests for Bitumen

- Binder Content = 4.69%
- Penetration Value = 4.69mm
- Softening Point Value = 42.5 deg
- Ductility Value = 80cm
- Flash point = 257deg C

Table 1: Comparison of Penetration value

S.NO	Percentage of E-Waste replacement	Penetration value for control mix (mm)	Penetration value for modified mix in (mm)
1	5	4.69	5.94
2	10	4.69	4.86
3	15	4.69	4.5
4	20	4.69	2.9

Table 2: Comparison of Softening Point Value

S.No	Percentage of E-Waste replacement	Soft Pointening Value for Control mix (mm)	Softening value for Modified mix(mm)
1	5	4.69	3.54
2	10	4.69	4.80
3	15	4.69	4.30
4	20	4.69	3.90

Figure 6: Binder Content Test

Figure 7: Softening Point Test

Figure 8: Binder Content Test

Test for Fly Ash

Specific gravity of fly ash, G = 2.4

Test for Pavement

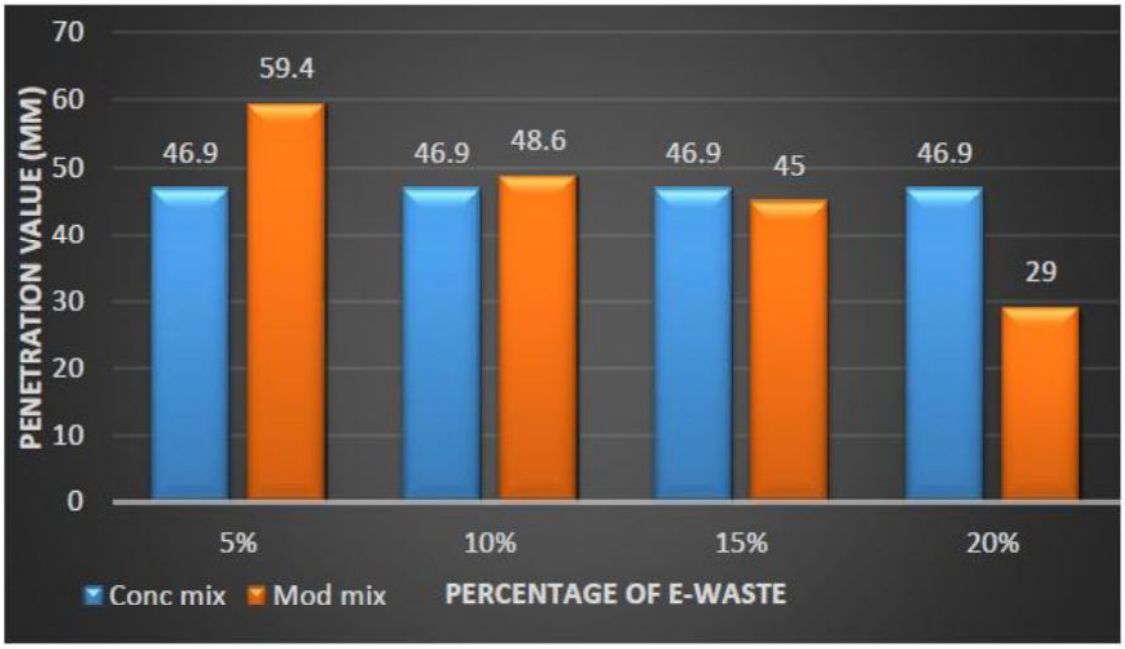
Marshal Stability Test Value (average value) = 850kg

Figure 9: Moulds

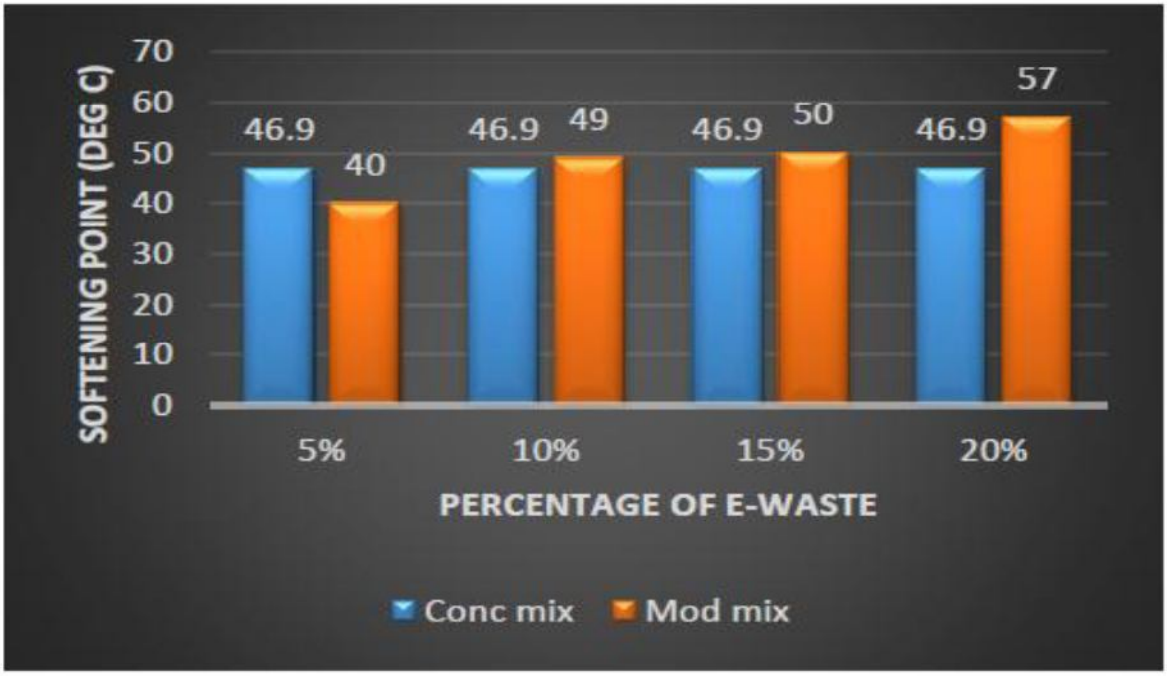
Fig 10: Performing Marshal Stability Test

Results

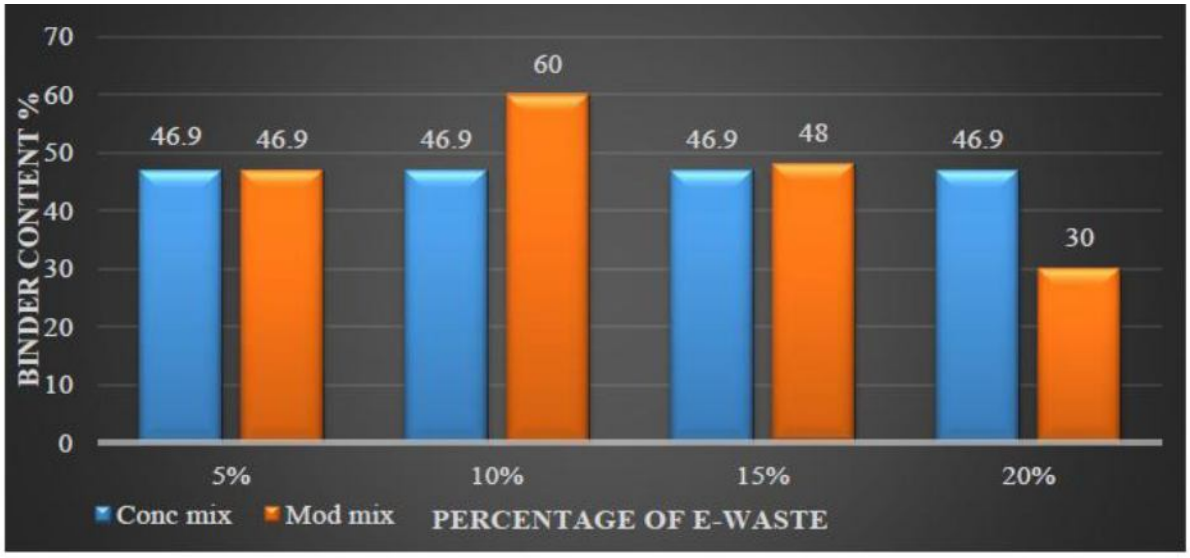
Penetration value Vs Percentate of E-Waste



Softening Point Value Vs Percentage of E-Waste



Binder Content Value Vs Percentage of E-Waste



Conclusion

- The bituminous concrete mixed have been found 10 to 15% of e-waste was found to be optimal.
- The use of e-waste in road construction will serve two purposes
- It will reduce the cost
- It will contributes towards efficient waste management.
- Fly as a mineral filler will increase the stability of the bituminous road.

References

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