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Management and Effective Utilisation of MSW Using Low Cost Construction Materials

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ABSTRACT: In a current scenario management of Municipal Solid Waste is a serious problem in a developing country. Municipal solid waste contains a different types of wastes which includes polythene papers, use plastics, rubber, old automobiles, house hold waste, construction and demolition debris, sanitation residue, waste from streets, cans, aluminium foils, plastics, etc.,. In this modern world the rate of production of solid wastes are increased but they are not properly managed. From the data 6 million MSW are to be generated in 1947, it is to be increased 48 million in 1997. In India the total MSW generation is 62 millions/yr. In this MSW, the range of plastic is 5.6 million/annum. Nowadays the use of is increased a tremendous amount. There are several types of plastics. The MSW plastics contains large amount of PET bottle wastes, HDPE, Vinyl or PVC, LDPE. In this project I take tree types of wastes such as PET bottles, HDPE and LDPE. By using PET bottles to make a concrete blocks and by using HDPE and LDPE (plastic wrappers) to make a modified bitumen road. In this project the waste plastics are to be recycled and making low cost construction materials. The concrete blocks making by using PET bottles have high strength compared to conventional blocks and the modified bitumen roads have high stability value. Both reduces the construction costs in considerable amount and make the environment safely.

KEYWORDS: MSW, plastics, PET bottles, HDPE, LDPE, bitumen

I. INTRODUCTION

Urbanization is a worldwide phenomenon. This process of urbanization is very rapid; the urban population of India is likely to be 30 million in 2001 and 395 million by 2011 AD. The industrial revolution followed by the urbanization in the temperature countries, concentrated people in very high density and added new sources of wastes. These wastes are normally solid and result in landscape pollution. The term 'refuse' is often used interchangeably with the term 'solid-wastes'. Due to the population explosion huge quantities of S W are being research in to the environment. It is estimated that every human being released 500 – 1000 g of SW per day.

Solid waste can be classified into different types. They are given below,

- Household waste is generally categorised as municipal waste
- Waste from industry as hazardous waste
- Bio medical waste as infectious waste

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The volume of waste generation has to be estimated that each American generates wastes about 4000 times his bodyweight; each west European 1000 times; and each citizen of the developing countries like India about 150 times. The average per capita generation of MSW in Indian cities is 0.4-0.6 kg/day. Solid waste management is a good practice to segregate the waste at the initial stages when it is generated, rather than managing at a later stage which is difficult and costlier. Plastics have become an inseparable and integral part of human daily activities, the steady growth in its consumption may be attributed to its low density, strength, user friendly designs, fabrication capabilities, long life, lightweight, and low cost characteristics. The use of plastic waste in granular form, fibrous form, and powdery form, for purposes such as sand and natural aggregate replacement, reinforcement and in combination with other materials were investigated. These studies reported improved compressive and flexural strength; however, more research is required in this direction to ascertain the optimum level of substitution. Also, low bond characteristics of plastic wastes has been identified as a major hindrance to use them in concrete, given its smooth surface, there is therefore need to identify a surface roughening treatment for better bond properties.

II. LITERATURE REVIEW

1. **Vijaya S. Sangawar, Seema S. Deshmukh (2012)** “A short overview on development of the plastic waste management : environmental issues and challenges” in this paper reviews that the quantum of plastic waste in municipal solid waste is increasing due to increase in population, development activities and changes in the lifestyle. As plastic is non- biodegradable in nature, it remain in environment for several years and disposing plastic waste at landfill are unsafe since toxic chemicals leach out into the soil, underground water and pollute the water bodies. Therefore plastic waste disposal is the major problem for the civil authorities.

2. **Rajkumar Joshi, Sirajuddin Ahmed (2016)** “Status and challenges of municipal solid waste management in India: a review” this project gives the major parameters of MSWM, a review on waste generation, its characteristics, collection and treatment options in India. The abysmal state of and challenges in municipal solid waste management (MSWM) in urban India is the motivation of the present study.

3. **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.

4. **Sasane Neha .B. et al (2015)** “Application of waste plastic as an effective construction material in flexible pavement” stats polyethylene as one sort of polymers is used to investigate the potential prospects to enhance asphalt mixture properties. The objectives also include determining the best type of polyethylene to be used and its proportion. Two types of polyethylene were added to coat the aggregate High-Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE). The results indicated that grinded HDPE polyethylene modifier provides better engineering properties. The recommended proportion of the modifier is 12% by the weight of bitumen content. It is found to increase the stability, reduce the density and slightly increase the air voids and the voids of mineral aggregate.

5. **S. Rajasekaran et al (2009)** “Reuse of waste plastic coated aggregate” Marshall’s mix design was carried out by changing the modified bitumen content at constant optimum rubber content and subsequent tests have been performed to determine the different mix design characteristics and for conventional bitumen (60/70) also. This has resulted in many improved characteristics when compared with straight run bitumen and that too at reduced optimum modified binder content (5.67%).

6. **Z Muyen, T.N Barna, M.N Hoque (2016)**

“Strength Properties of Plastic Bottle Bricks and their Suitability as Construction Materials in Bangladesh” in this study looked into the strength properties of waste PET bottles filled with fine sand. Five different sizes (250, 500, 1250, 1500 and 2000ml) of waste PET bottle bricks were tested for compressive strength and the largest bricks gave a compressive strength of 17.44 MPa. The 1000 ml bottle brick filled cubes with 9 and 12 bottles were prepared and

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tested. The 9-bottle brick filled cubes gave a compressive strength of 35 MPa and the 12 bottle bricks filled cubes gave a compressive strength of 33.7 MPa.

7. **Simanshu P. Pandey, Sakshi Gotmare, Prof. S.A.Wankhade(2017) “Waste Plastic Bottle as Construction Material”** The paper intends to investigate the application of plastic bottles which is one of the urban wastes in building construction and that how it can lead to sustainable development. It also mentions some ways for self-standing and insulating them in thermal and sound point of view and some positive points which this material has versus others.

8. **Sina Safinia, Amani Alkalbani (2016) “Use of Recycled Plastic Water Bottles in Concrete Blocks”** The purpose of this study is to examine the possibility of using plastic bottles in concrete block. The plastic bottles were used to create voids at equal distance between them in the masonry units. The study utilized 500 ml plastic bottles placed inside concrete masonry units and analysed the compressive strength. The testing for compressive strength was determined according to the ASTM C140 standard. This study shows 57% difference in the strength by using plastic bottles compared to local concrete blocks.

9. **Arulmalar Ramaraj, M.T.P. Jothilakshmy Nagammal (2016) “Exploring the Current Practices of Post-Consumer PET Bottles and the Innovative Applications as A Sustainable Building Material – A Way Ahead”** in this paper intends to consolidate such initiatives addressing building systems, materials and artefacts. It discusses an overview of such applications and other intuitive trends which are emerging in Indian context.

10. **N.Mohana Priya, M.Nirmala, Dr.G.Dhanalakshmi(2018) “Replacement of Bricks with Plastic Bottles in Construction”**

The main objective of this paper is to use the waste plastic bottles and construction demolition waste in building construction which reduces the environmental pollution. As a result, the Eco-Brick shows 90% increase in load carrying capacity than conventional one. Eco-Bricks are stronger than the Conventional Bricks. Composite Eco-Bricks and Prism shows 12% increase in strength. Therefore, it can be used for low rise buildings and temporary structures.

III. OBJECTIVES

- To prepare the Marshall Stability samples with plastic waste and without plastic waste
- To perform Marshall Stability test on the samples prepared.
- To reduce the disposal problem of plastics.
- To develop an efficient way and to effectively utilize the waste plastics.
- To reduce the dumping area of waste plastics.
- To produce cost-effective materials which a common person can afford easily

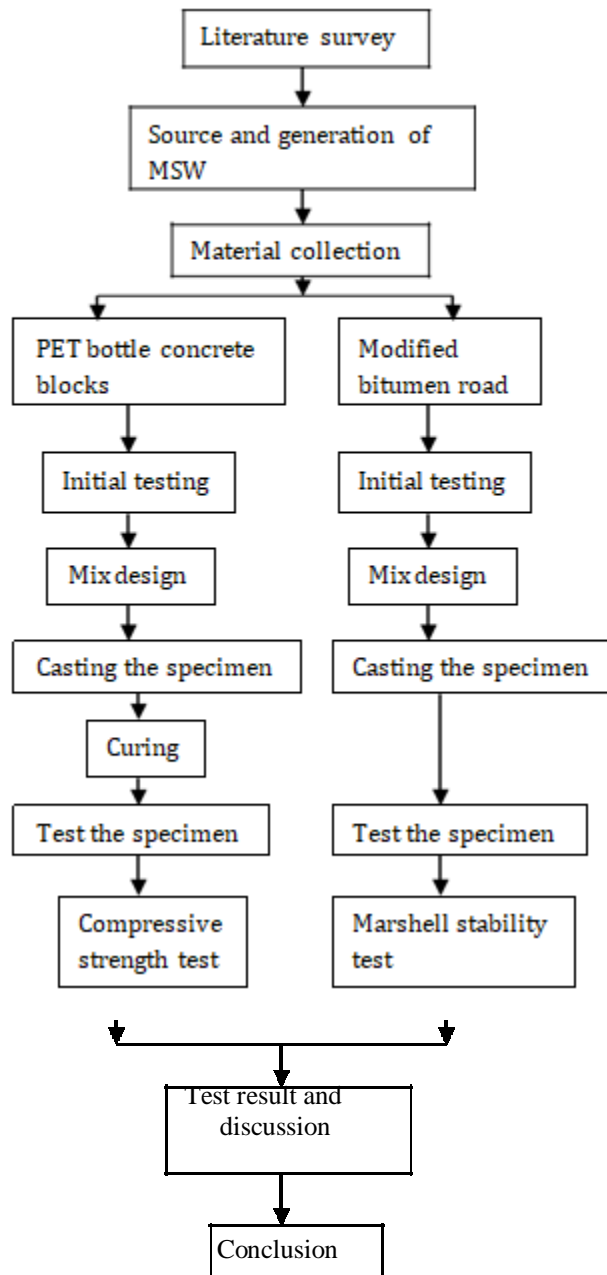
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IV. METHODOLOGY



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V. TESTS

5.1 PET bottle concrete blocks

1. Test on cement

- Finess modulus - 4.33%
- Specific gravity - 3.12
- Setting time
 - Initial setting time - 35
mints
 - Final setting time - 9 hrs
- Standard Consistency value – 28%

2. Test on fine aggregate

- Finess modulus - 2.67%
- Specific gravity - 2.81

3. Test on coarse aggregate

- Finess modulus - 7.35%
- Specific gravity - 2.43
- Water absorption – 1.059%

5.2 Modified Bitumen Road – initial test formaterials

1. Test on aggregate

- Impact value - 26.8%
- Water absorption - 5%
- Specific gravity - 2.87

2. Test on modified aggregate (5% plastic coated aggregate)

- Specific gravity - 2.71
- Water absorption – 0

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- Impact value– 15.78%
- 3. Test on modified aggregate(10% plastic coated aggregate)
 - Specific gravity – 2.68
 - Water absorption – 0
 - Impact test – 11.28%
- 4. Test on Bitumen
 - Average penetration – 34.6 cm
 - Average ductility value – 77.4 cm

VI.RESULTS AND DISCUSSION

6.1For PET bottle bricks

Table 6.1 – Compressive Strength for Concrete

Number of Sand filled PET Bottles	Compressive strength N/mm ²		
	7 days	14 days	28 days
0	10.40	18.32	30.72
4	11.45	21.49	31.05
6	13.79	22.29	33.5
8	14.75	25.97	35.9

% of plastic	Sample No	Stability Value(kg)	Flow value(mm)	Bulk Density	Air voids (%)	VFB
0	1	1427	2.8	6.62	8.19	62.83
	2	1390	3	5.5	10.7	64.8
	3	1448	2.8	5.9	8.42	59.5
5	1	1631	3.3	5.52	4.4	68.28
	2	1590	3.6	4.8	5.7	65
	3	1743	3.5	5.3	5.5	66.4

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10	1	1937	3.8	3.86	1.85	72.2
	2	2039	4	3.1	3	74.02
	3	1886	3.9	2.56	2.27	73

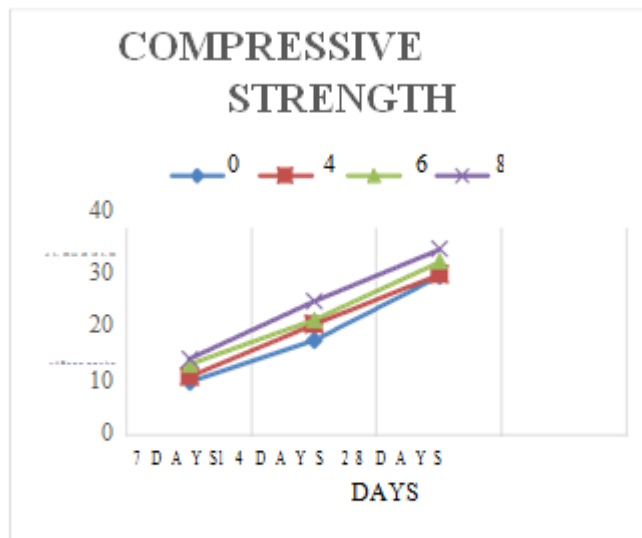


Chart 6.1 COMPRESSIVE STRNGTH

The tests are conducted with 0, 4, 6, 8 bottles at the days of 7, 14, 28 days. The compressive strength is high in concrete blocks with 8 bottles. The chart 6.1 shows the increasing of compressive strength at 7, 14, and 28 days. Hence this test result gives that the compressive strength increase when increasing the bottles are to be immersed.

6.2 For modified bitumen road Marshall Stability Test

The tests are conducted with 0%, 5%, and 10% plastic modified mix with three samples on each percentage. From, the test results we know that the plastic modified bituminous have more strength when compared to normal bituminous mix. The modified also reduces the voids so the strength can increased. The plastic modified bituminous has increased amount of voids filled by bitumen.

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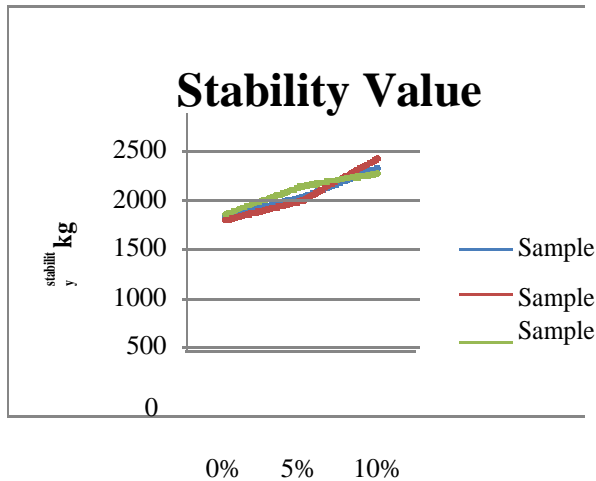


Chart 6.2 Stability Value

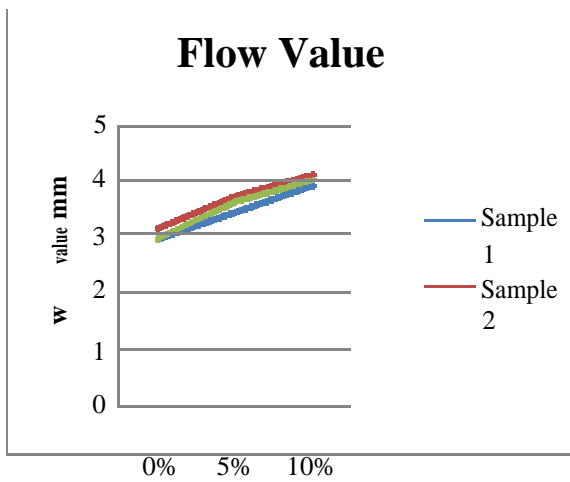


Chart 6.3 Flow value

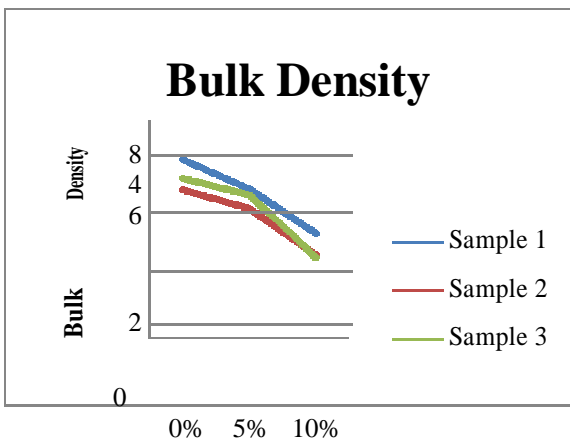


Chart 6.4 Bulk Density Value

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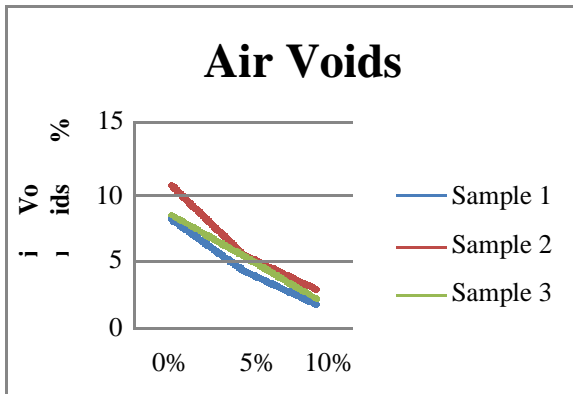


Chart 6.5 Air Voids Value

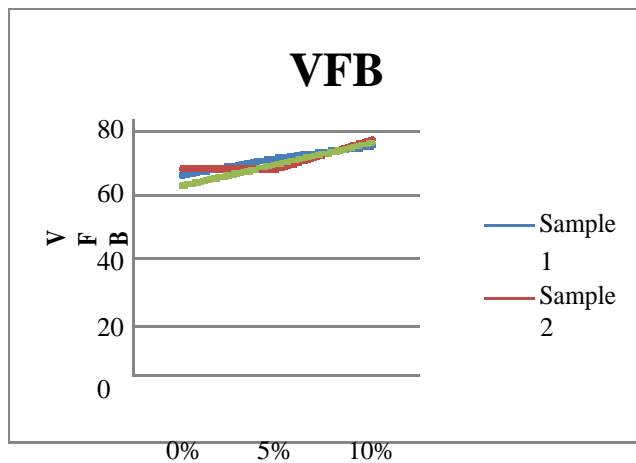


Chart 6.6 VFB value

VII. CONCLUSION

Urbanization contributes enhanced municipal solid waste (MSW) generation and unscientific handling of MSW degrades the urban environment and causes health hazards. The MSW plastics contains large amount of PET bottle wastes, HDPE, Vinyl or pvc, LDPE. In this project the waste plastics are to be recycled and making low cost construction materials. The concrete blocks making by using PET bottles have high strength compared to conventional blocks and the modified bitumen roads have high stability value. From this low cost constructions are to be made with low cost which has high strength and stability and also they make the environment friendly.

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