International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

Substituting Natural Fiber by Plastic Waste

Prashast Dheer[1], Satya Veer Singh[2]

[1]M.Tech Student, *Department of Civil Engineering, Rama University, (India)*
[2]Assistant Professor, *Department of Civil Engineering, Rama University, (India)*

Abstract - *This article reviews the literature reports base on agro waste plastic composites using different fiber as fillers and rein- for cements. Various processing methods and conditions; compression molding process, injection molding, and extru- Sion method are used in the composites productions. Characterization challenges associated with the agro waste plastic composites productions were also examined. Thus, the findings of this research review can be used as a data base for further inquiring into the agro waste plastic composites in a view to enhance the development of the sector.*

Plastic wastes are a major environmental concern that needs to be dealt with to minimize the amount of municipal solid waste and depletion of natural resources thus enhancing the sustainability concept for future generations. The objective of this study is to enhance the properties of plastic products using plastic wastes reinforced with treated natural fibers such as rice straw as well as carbonized rice straw, using a simple and efficient technology.

Keywords: Polymers-Matrix Composites (PMCs); Recycled Polymer; Natural Fibers; Fiber Reinforced Plastic; Agro Waste Plastic Composite; Characterization; Production

I. INTRODUCTION

In developing countries of the world, plastic waste has become a current challenge for the environmental engineers to solve. For an example developing country like India, statistics show that the exponential growth rate of India with 1,210,000,000 (1.21 billion) people is the second most populous country in the world, while China is on the top with over 1,350,044,605 (1.35 billion) people. The figures show that India represents almost 17.31% of the world's population, which means one out of six people on this planet live in India. Although, the crown of the world's most populous country is on China's head for decades, India is all set to take the numerous positions by 2030. With the population growth rate at 1.58%, India is predicted to have more than 1.53 billion people by the end of 2030. Being second most populous country in the world, India continuously keeps on adding waste material within its geographical boundaries. India has about 16% of the world population and 2.5% of world's land area. In an already densely populated country with even more densely packed urban centers, land for proper waste treatment, disposal and overall man-agreement is scarce. Recent and sustained economic growth increasing living standards of the people, in-creased manufacturing and production activities has led to increase to rapid rise in the waste generation rated. India produces around 42 Million tons of solid waste annually. There is wide difference in the waste generation rates in rural and urban areas. Even within the urban areas, the composition includes more paper and inert material and less of organic and compostable material as the city population and size increases Now with the above data we can calculate the per day generation of solid waste of India & also we can calculate the expected cost for its management which can be done by the processes minimization, recycling & disposal of the solid waste generated. These processes have been adopted by the most developed countries as the menu for developing solid waste management strategies. Depending upon a number of factors such as topography climate, population density (village to metro city), transportation infrastructure, socioeconomic and environmental laws of India it is important to make proper pre action plan to manage solid waste.

The market potential regarding the usage of plastic waste into other utilizations is huge due to the high amounts of its disposition which constitute the largest share of the global municipal solid waste (MSW). Plastics account for an increasing fraction of municipal solid waste around the world. In India, plastic in MSW makes up to 9% - 12% by weight of the total in addition to other wastes that may contain higher proportions of plastics. The majority of plastic waste generated is landfilled. However the continuous growth of worldwide plastic consumption due to its short life cycle compared to other products; roughly 40% have duration of life cycle smaller than 1 month, and the legalizations of many countries concerned with minimizing landfills content and incinerators led to a necessity of recovering plastic waste instead of disposing. Incineration and land filling alternatives were rejected by several countries due to their potential danger to the environment either by polluting air or land; which result in not closing the cradle to cradle loop and depleting natural resources. In the United States, plastic had a total amount of 19.2 million tons in 2001, accounting for about 8.4% of total municipal solid wastes. Thus, used plastics are becoming a potential worldwide source of raw materials. As a consequence the tendency towards recycling has increased resulting in attempts for plastic recovery. While in 2005, the United States recycled around 5.7% of the total plastics generated. On the other hand, some states in the US like Michigan have a high recycling rate that accommodates all the waste produced. In Brazil, potential in recycling have been raised where 15% of all plastics consumed are recycled and returned to industry. Even though the technologies and advancements with respect to

recycling plastics soared, there remains the unanswered question of cost. A study entitled "The Cost of Reducing Municipal Solid Waste" showed that the cost becomes an obstacle due to energy cost, transportation cost, sorting, labor cost but if done on a large scale it pays back. After recycling the waste, it could be reinforced with natural fibers such as rice straw to enhance the mechanical properties. Rice straw can work well with recycled polymer as reinforcing filler.

Natural fibers have the advantages of low density, low cost, and biodegradability. However, the main disadvantages of natural fibers in composites are the poor compatibility between fiber and matrix and the relative high moisture sorption. Therefore, chemical treatments using acids or alkalis are considered in modifying the fiber surface properties. This improves the thermal stability of fibers, compatibility and interfacial bond stress. The treatment also removes any impurities of the fiber. Fiber treatment through carbonization is a treatment for rice straw fibers in which heating without air occurs. The pore structure and adsorption properties of carbonized fibers are strongly used in several applications due to improved mechanical properties. The steps of carbonization include thermal treatment of raw fibers in an inert atmosphere followed by an activation step with CO_2 or steam at the same temperature used. In chemical activation, the raw fibers were impregnated in a solution of phosphoric acid and heated at 900˚C in an inert atmosphere. This chemical treatment leads to a high porosity, which enables a high adsorption capacity for micro pollutants. Moreover, it produces numeric acidic surface groups involved in the adsorption mechanism of dyes and metal ions.

2. Composition of Municipal Solid Waste

The biodegradable portion dominates the bulk of Municipals Solid Waste. Generally the biodegradable portion is mainly due to food and yard waste. With rising urbanization and change in lifestyle and food habits, the amount of municipal solid waste has been increasing rapidly and its composition changing.

2.1 Objective

Plastic wastes are a major environmental concern that needs to be dealt with to minimize the amount of municipal solid waste, depletion of natural resources and enhancing the sustainability concept for future generations. The objective of this work is to enhance the properties of plastic waste through reinforcement with natural fiber such as rice straw**,** using a simple and effective technology. Rice straw will be treated using acids, alkali and carbonization treatment. The mechanical properties of plastic wastes reinforced with treated rice straw will be investigated using flexural, tensile stress tests. The synthesized recycled composites will be compared with the recycled polymer without reinforcement to observe the effect of reinforcement on the mechanical properties of the composite.

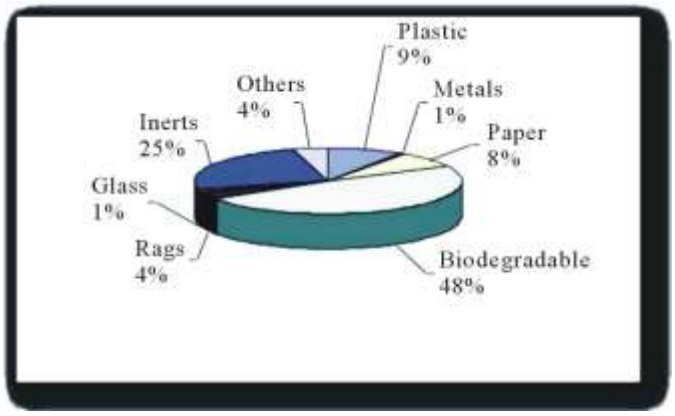

Figure 1 Pie chart for the various category of waste generated.

3. Materials and Methods

Plastic waste was collected from different hospitals of the city. For sorting and shredding of waste SL Plastic Industries In Kanpur Industrial Estate Kanpur, India were approached. Different categories of plastic were separated from waste. 64% of the waste was LDPE, 32% was HDPE and 4% Polypropylene.

All three types of waste was shredded (Figure 1(a)), mixed together and then heated (Figure 1(b)). Semi solid form of plastic obtained was cut at regular intervals and further pulverized first manually (Figure 1(c)) then by Jaw crusher

(a) (b) (c)

Figure 2. (a) Shredded plastic waste (b) Plastic heating pipe (c) Aggregate pulverization.

3.1. Experimental Programme

Following tests were performed on aggregates:

- Specific Gravity & Water Absorption (AASHTO T 85 ASTM Designation: C 128-88)
- Aggregate Impact Value Test (BS 812-112:1990)
- Aggregate Crushing Value Test (BS 812-110:1990)
- Loss Angeles Abrasion Test (AASHTO designation: T96| ASTM C 535-12)

- Soundness of Aggregate Test (AASHTO T 104 and ASTM C 88)

4. Results

4.1. Specific Gravity and Water Absorption

Specific gravity of plastic aggregates was less than natural aggregates. Low density of LDPE, HDPE and polypropylene was main reason for this decrease in density. Water absorption of plastic aggregates on the other hand was very high. Branched molecular structure of LDPE was the reason of this high water absorption.

4.2. Soundness Test

Any type of polythene, whether HDPE or LDPE is generally inert to chemicals. The reason for this is lack of polarity in polythene molecules. HDPE in comparison to LDPE is more resistant to chemicals actions because it's low permeability. Low permeability comes because of high molecular weight of HDPE.

4.3. Density and Percent Voids of Asphalt Samples

Due to lesser density of plastic aggregates, asphalt samples made of replaced plastic aggregates showed lower densities with increasing plastic aggregates percentage. As most of the bitumen was used in filling pores of plastic aggregates, less bitumen was available to fill asphalt void. This increased percent voids in asphalt mixes.

4.4. Stability and Flow Results

Stability of the mixes showed increasing trend up to 20% replacement than sudden decrease in stability was observed

This decrease in stability may be because of higher porosity of plastic aggregates. Most of the binder was used in filling the pores of plastic aggregates leaving behind insufficient quantity of bitumen to make stronger bond. As the compressibility of plastic aggregates was greater than natural aggregates, asphalt samples having plastic aggregate had higher flows Flow values increased with increasing plastic aggregate percentage but decreased at 25% replacement. This decrease was due to decrease in stability of mixes at 25% replacement.

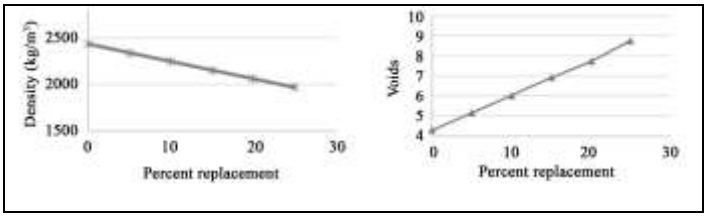

Figure 3. (a) Density of asphalt mixes; (b) Voids in asphalt samples.

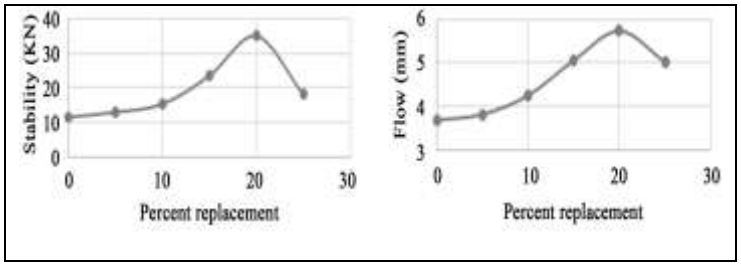

Fig 4 (a) Marshall stability of asphalt mixes; (b) Flow of asphalt mixes.

5. Conclusions

1- The investment for an on-site waste management system in an individual health care setting is very high. In contrast, an integrated common treatment & disposal facility cost a maximum of Rs. 8 to 22 /kg/day with an added benefit of no capital investment being required. The company could have profit about 35% making it a sustainable venture if they use natural fibers as packaging material instead of plastic The natural fibers are environmentally sound it will also give good market cost to the farmers

2- There is no proper solid waste management system for Kanpur city. Mostly people throw the waste in their streets, where it is either picked up by scavengers or dumped there for years. In relatively developed areas of the city, scavengers collect the waste and dump it in an open area usually at a distance from densely populated area. Existing landfills of the city are not well designed. Open burning of waste on the dumpsites is observed. Major portion of the waste generated by the city is plastic. Plastic waste can be converted to aggregates by proper manufacturing setup.

References

1. L. F. Diaz, A. Chiumenti, G. Savage and L. Eggerth, "Managing the Organic Fraction of Municipal Solid Waste," *Biocycle*, Vol. 47, No. 10, 2006, pp. 50-53.

2. US Environmental Protection Agency, "Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts and Figures for 2003," US Environmental Protection Agency, Washington DC, 2005.

3. K. Palmer, H. Sigman and M. Walls, "The Cost of reducing Municipal Solid Waste. Resources for the Future,"

4. S. P. Chandak, "Waste Biomass Workshop," UNEP S. 2010. http:/www.cshd.dap.edu.ph/unep_biomass A. E. O. Elkhalifa, D. M. R. Georget, S. A. Barker

5. Vigil, S.A., Theisen, H. and Tchobanoglous, G. (1993) Integrated Solid Waste Management: Engineering Principles and Management Issues. McGraw-Hill Higher Education, USA.