

Review Article

A Review on Studies and Research on Use of Plastic Waste

Sunil J. Kulkarni

Datta Meghe College of Engineering, Airoli, Navi Mumbai, Maharashtra, India

Received: 24/11/2015

Revised: 26/11/2015

Accepted: 26/11/2015

ABSTRACT

Minimization of waste material is important aspect of the modern growth and development initiatives. Plastic is used in various domestic and industrial applications. Use of plastic bags and bottles is very common. The disposal of plastic waste is major problem due to non biodegradable nature of plastic. The plastic can be used as feedstock for ethanol like products. It can be used for road construction and other construction related activities. The current review summarizes the research on use of waste plastic

Key words: recycle, composite materials, disposal, strength, fuel, pavements.

INTRODUCTION

Sustainable development is important aspect of modern development. The minimization of waste is key to many environmental problems. Many investigations are nowadays focused on use of waste material for various applications. Such wastes are being used for ethanol, starch, acetic acid and manufacturing of other chemical.^[1-3] Waste materials are being used as adsorbents for removal of organic matter.^[4-7] Removal of heavy metals and phenol was also carried out effectively by various investigators.^[8-10] Various raw and waste materials have been tried for bioethanol and biodiesel production.^[11-13] The waste plastic can be used for diesel production. Plastic waste is major problem faced by developing countries because of chemical nature of plastic and amount of plastic which is used and then dumped. This plastic can be used with road construction material to strengthen the road. This can solve the problem of the plastic disposal

and road development. The present review aims at summarizing the research on use of waste plastic for different applications.

RESEARCH AND STUDIES ON REUSE OF PLASTIC WASTE

Eneh carried out studies on application of recycled plastics and its composites in the built Environment.^[14] He discussed the application of recycled waste plastic and its composite materials in the built environment. In his studies, he compared the benefits of its use to that of new or ‘virgin’ materials. According to him, recycled plastic materials and composites should replace new materials in the built environment. Rokade investigated use of waste plastic and waste rubber tyres in flexible highway pavements.^[15] He prepared the semi dense bituminous concrete (SDBC) mix using Marshall Method of bituminous mix design. In his studies, the various mix design characteristics like Marshal stability value, flow value, bulk density,

air voids (Vv), voids in mineral aggregate (VMA), voids filled with bitumen (VFB) were found out. The results showed that with 5% bitumen content higher value of Marshall Stability value and greater density was achieved.

Poweth et.al. carried out research on use of plastic waste in road construction.^[16] Their research was aimed at proposing a new method of disposal of plastic, quarry dust and tyre waste by using them in the sub grade of pavements. For this purpose, they conducted tests including specific gravity, grain size analysis and CBR test. They observed that, as the percentage of plastic waste increases, the maximum dry density decreases, thereby decreasing the CBR value. Also, increase in percentage of quarry dust resulted in increase of maximum dry density and CBR value.

Sarker et. al. carried out investigation on conversion of waste plastic into useful chemical products.^[17] In their investigation, the fraction of a liquid produced by the thermal degradation process of waste plastics, containing about 29%, naphtha chemical, was subjected to thermal reactions. They used waste plastic material such as high-density polyethylene (HDPE-2), low-density polyethylene (LDPE-4), poly propylene (PP-5) and polystyrene (PS-6). The waste plastic was first converted to slurry, then thermal liquefaction was done at 370–420°C of the slurry followed by distilling, recovering and condensing. Nkwachukwu et.al. discussed sustainable development and plastic recycling in developing countries.^[18] Their study indicates that due to poor facilities and awareness, most of these plastics, are currently disposed of in unauthorized dumping sites or burned uncontrollably in the fields. Their paper outlined environmental concerns of so many applications of plastics.

Rai et.al. carried out research on waste plastic mix concrete with plasticizer.^[19] They prepared a number of concrete

mixes in which sand was partially replaced by waste plastic flakes in varying percentages by volume. They tested plastic mix concrete with and without super plasticizer at room temperature. They observed that the reduction in workability and compressive strength, due to partially replacement of sand by waste plastic, was minimal and can be enhanced by addition of superplasticizer.

Bhageerathy et.al. investigated application of biomedical plastic waste in bituminous road construction.^[20] According to them the quantum of plastic in solid waste is increasing and it is important to recycle it. They also found that the deteriorating quality of roads was another area of concern. They tested autoclaved medical plastic waste in the form of shredded syringes in road construction. They investigated the performance of the bituminous mix modified with bio-medical plastic waste. They also determined the properties of Plastic Coated Aggregate (PCA). They found that PCA had better properties compared to normal mix. Sharma and Soni carried out review on production of alternative diesel fuel from waste oils.^[21] The main focus of their paper was finding alternative fuel resources and utilizing them to eliminate their negative effects. They analyzed the properties of the oils derived from waste plastic pyrolysis oil, used engine oil and waste tire oil. They concluded that the produced diesel from plastic pyrolysis oil, waste engine oil and waste tyre oil, are technically suitable, economically viable and less responsible to pollute environment.

Chavan carried out research on use of plastic waste in flexible pavements.^[22] She cut plastic waste into a size such that it passes through 2-3mm sieve using shredding machine. The aggregate mix was heated and the plastic was effectively coated over the aggregate. The plastic coated mix was used with bitumen for road construction. They observed that use of the

innovative technology will not only strengthen the road construction but also increase the road life as well as will help to improve the environment. She concluded that using plastic waste in mix will help for reduction in need of bitumen by around 10%. Wayal and Wagle carried out research on use of waste plastic and waste rubber in aggregate and bitumen for road materials.^[23] In their research they used polymer and crumbed rubber as a binder with respect to aggregate and bitumen. They tested the material for crushing value, impact value, abrasion value, and specific gravity, bitumen penetration value, ductility, softening point. They found that the use of waste plastics and rubber tyres in the form of powder for flexible pavement material is one of the best methods for easy disposal of wastes.

Sasane et.al. also investigated application of waste plastic as an effective construction material in flexible pavement.^[24] According to them, use of plastic as an innovative technology not only strengthened the road construction but also increase the road life. They observed that the increase of waste plastic in bitumen increases the properties of aggregate and bitumen. They also found that coating of polymer on the surface of the aggregate resulted in many advantages. It improved the quality of flexible pavement. Raut et.al. carried out review on use of waste plastic bottles as construction material.^[25] According to them, cost of the houses can be brought down by using waste plastic material along with construction material. Also according to them, the bottle houses are bio-climatic in design, which means that when it is cold outside is warm inside and vice versa.

Abatneh and Sahu carried out preliminary study on the conversion of different waste plastics into fuel oil.^[26] Their work was aimed at the conversion of waste plastics into fuel oil. Their work was focused on thermal cracking of waste plastic to change them into usable

resources. They observed that the reduction in the yield of the oil was due to the effectiveness of the reactor seal which means the gases which are going to be condensed are leaking out. They also observed that the temperature at which the first droplet of oil was obtained, is determined for the respective plastic type being cracked. Swami et.al. carried out investigation on use of plastic in bituminous road.^[27] According to them, the use of waste plastics on the road has helped to provide better place for burying the plastic waste without causing disposal problem. It also provided better roads.

Majka and Pielichowski investigated waste plastics for efficient flood protection systems.^[28] In their article, they presented a new idea of plastics waste management, based on the production of composite materials with improved properties for flood protection systems. The concept of waste polymer reuse, which gives a new light for recycling and many new applications was presented by them.

CONCLUSION

The problem of plastic waste can be minimized by reuse of plastic. Waste plastic can be used for synthesis of products like ethanol. The use of plastic for road construction is widely investigated area. The strength of the roads constructed with plastic mixed bitumen was found to be more than that constructed with usual material. The conversion of plastic waste into fuel oil was also successfully carried out by few investigators. It can be concluded that use of waste plastic can minimize the disposal problem and add to economical aspects of fuel synthesis and various construction activities.

REFERENCES

1. Sunil J. Kulkarni, Nilesh L. Shinde, Ajaygiri K. Goswami, A Review on Ethanol Production from Agricultural Waste Raw Material, International

- Journal of Scientific Research in Science Engineering and Technology, 2015,1(4),231-233.
- 2. Veena Ramachandran, Nisha Pujari, Tanmay Matey, Sunil Kulkarni, Enzymatic Hydrolysis for Glucose-A Review, International Journal of Science, Engineering and Technology Research (IJSETR), 2013, 2(10), 1937-1942.
 - 3. Veena Ramachandran, Nisha Pujari, Tanmay Matey, Sunil Kulkarni, Enzymatic Hydrolysis of Cassava using wheat Seedlings, International Journal of Science, Engineering and Technology Research (IJSETR), 2014,3(5), 1216-1219.
 - 4. Kulkarni, Sunil J., and Dr Jayant P. Kaware, Removal of Cadmium from Wastewater by Groundnut Shell Adsorbent-Batch and Column Studies, International Journal of Chemical Engineering Research, 2014, 6(1), 27-37.
 - 5. Kulkarni Sunil, Kaware Jayant, Adsorption for Phenol Removal- A Review, International Journal of Scientific Engineering and Research (IJSER), 2013, 1(2), 88-96.
 - 6. Sunil J. Kulkarni, Removal of phenol from Effluent in Fixed Bed: A Review, International Journal of Engineering Research and General Science, 2014, 2(5), 35-38.
 - 7. S.J. Kulkarni, Dr. J. P. Kaware , Isotherm and Kinetics of Phenol Removal by Adsorption-A Review, International Journal of Research (IJR), 2014, 1(8), 287-293.
 - 8. D.N. Jadhav, A.K. Vanjara , Removal of Phenol from Wastewater using sawdust, Polymerized sawdust and sawdust Carbon, Indian Journal of Chemical Technology, 2004, 1,35-41.
 - 9. Sunil J.Kulkarni, Dr. Jayant P. Kaware, Batch Adsorption Process for Phenol Removal using Leaf Litter: Solute Uptake, Kinetic and Isotherm Studies, International Journal of Environmental Engineering Research, 2014, 3(2), 23-28.
 - 10. Sunil J. Kulkarni and Dr. Jayant P. Kaware, Removal of Cadmium from Wastewater by Groundnut Shell Adsorbent-Batch and Column Studies, International Journal of Chemical Engineering Research, 2014, 6(1), 27-37, 2014.
 - 11. Masoud Vazirzadeh, Reza Robati, Investigation of bio-ethanol Production from Waste Potatoes, Annals of Biological Research, 2013, 4(1), 104-106.
 - 12. Joginder Singh Duhan, Ashok Kumar and Sunil Kumar Tanwar, Bioethanol Production From Starchy Part Of Tuberous Plant (Potato) Using *Saccharomyces Cerevisiae* MTCC-170, African Journal of Microbiology Research, 2013, 7(46), 5253-5260.
 - 13. Jasmine Koshy and Padma Nambisan, Pretreatment Of Agricultural Waste With *Pleurotus* Sp. For Ethanol Production, International Journal of Plant, Animal and Environmental Sciences, 2013, 2(2), 244-249.
 - 14. Anselm E. O. Eneh, Application Of Recycled Plastics And Its Composites In The Built Environment, Best International Journal Of Management, Information Technology And Engineering, 2015, 3(3), 9-16.
 - 15. Rokade S, Use Of Waste Plastic And Waste Rubber Tyres In Flexible Highway Pavements, 2012, International Conference On Future Environment And Energy Ipcbee Vol.28(2012), IACSIT Press, Singapoore, 105-108.
 - 16. Mercy Joseph Poweth, Solly George, Jessy Paul, Study On Use Of Plastic Waste In Road Construction, International Journal Of Innovative Research In Science, Engineering And Technology, 2013, 2(2), 633-638.
 - 17. Moinuddin Sarker, Mohammad Mamunor Rashid, And Mohammed Molla, Waste Plastic Conversion Into Chemical Product Like Naphtha, Journal Of Fundamentals Of Renewable Energy And Applications, 2011, 1 ,1-6.
 - 18. Onwughara Innocent Nkwachukwu, Chukwu Henry Chima, Alaekwe Obiora Ikenna And Lackson Albert, Focus On Potential Environmental Issues On Plastic World Towards A Sustainable Plastic Recycling In

- Developing Countries, International Journal Of Industrial Chemistry, 2013, 4(34), 1-13.
19. Baboo Rai, S. Tabin Rushad, Bhavesh Kr, And S. K. Duggal, Study Ofwaste Plasticmix Concrete With Plasticizer, International Scholarly Research Network, 2012,vol. 2012,1-5.
 20. Bhageerathy K. P, Anu P. Alex, Manju V. S, Raji A. K, Use Of Biomedical Plastic Waste In Bituminous Road Construction, International Journal Of Engineering And Advanced Technology, 2014, 3(6),89-92.
 21. Manish Chand Sharma, Neelesh Soni, Production Of Alternative Diesel Fuel From Waste Oils And Comparison With Fresh Diesel:-A Review, The International Journal Of Engineering And Science, 2013, 3(4), 54-58.
 22. Miss Apurva J Chavan, Use Of Plastic Waste In Flexible Pavements, International Journal Of Application Or Innovation In Engineering And Management, 2013, 2(2), 540-552.
 23. Dr. Abhaykumar S Wayal, Mudassir. D. Wagle, Use Of Waste Plastic And Waste Rubber In Aggregate And Bitumen For Road Materials, International Journal Of Emerging Technology And Advanced Engineering, 2013, 3(7),301-306.
 24. Sasane Neha .B., Gaikwad.Harish, Dr. J R Patil And Dr. S D Khandekar, Application Of Waste Plastic As An Effective Construction Material In Flexible Pavement, International Research Journal Of Engineering And Technology,2015, 2(3),1943-1948.
 25. Aditya Raut, Mohammad Salman Patel, Nilesh B. Jadhwar, Uzair Khan, Investigating The Application Of Waste Plastic Bottle As A Construction Material- A Review, Journal Of The International Association Of Advanced Technology And Science, 2015, 16(16),1-16.
 26. Yasabie Abatneh, Omprakash Sahu, Preliminary Study On The Conversion Of Different Waste Plastics Into Fuel Oil, International Journal Of Scientific & Technology Research, 2013, 2(5),226-229.
 27. Mrs.Vidula Swami, Abhijeet Jirge, Karan Patil, Suhas Patil, Sushil Patil, Karan Salokhe, Use Of Waste Plastic In Construction Of Bituminous Road, International Journal Of Engineering Science And Technology, 2012, 4(5), 2351-2355.
 28. Tomasz M. Majka, Krzysztof Pielichowski, Application Of Waste Plastics For Efficient Flood Protection Systems, 1st Word Sustainability Forum, 1-30 November 2011,1-10.

How to cite this article: Kulkarni SJ. A review on studies and research on use of plastic waste. Int J Res Rev. 2015; 2(11):692-696.
