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Environmental Impacts and Recycling Processes of Waste Automobile Tires

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ABSTRACT

Recycling is the inclusion of wastes that can be recycled into the production process by transforming them into secondary raw materials after various physical and/or chemical processes. The natural resources are not infinite. Of course it will run out one day. For this reason, the recycling process has gained a serious dimension for countries due to both economic and environmental factors. Although the recycling process of thermoplastic materials is known and frequently used by the science and industry community, the recycling of rubber materials has remained in the background. However, with the increase in the number of automobiles around the world, the increasing amount of solid waste tires puts the society in trouble both economically and environmentally. In this research, there are data on the introduction of automobile tires, which are a very serious waste throughout the country, to the economy.

INTRODUCTION

The many countries and manufacturers have sought and developed various methods for recycling and reusing waste in order to prevent waste of resources and to cope with the energy crises that may arise. Not only developing countries but also developed countries need to stop wasting waste in order to make maximum use of their natural resources in the long term [1-4]. Moreover, they need to include economic value materials in the recycling process. In the recycling process, the cost of countries spent on imported scrap materials will also be eliminated and a significant contribution will be made to the national economy. The purpose of recycling is to prevent unnecessary use of resources and to reduce the amount of waste by sorting waste at its source. It is important to be involved in the recycling process after some parameters have been evaluated [5-7]:

- Utilization of waste generated in industry without harming the environment
- Economic value of recycled materials and areas of use
- Energy and raw material savings
- Chemical regeneration

Used or end-of-life automobile tires have reached a significant amount in the waste industry. These waste materials pose an environmental hazard. It is known that waste tires are mostly incinerated to eliminate this threat. Just to provide energy for a short time [8-10].

Automobile tires contain additives such as fillers, sulfur compounds and accelerators, as well as vulcanized rubber. The difficulty of recycling of automobile tires in the thermoset material class is the combination of natural rubber with cross-links by the vulcanization process. These cross-links give the material a new

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feature and make it difficult to recycle [11-13]. Therefore, waste tires are highly resistant to physical, chemical and biological degradation. This is an environmentally undesirable feature. In addition to the difficulty of recycling waste tires, not storing them in accordance with legal processes harms both people due to infectious and respiratory diseases and the environment due to air, water and soil pollution. Because waste tires stored in humid and watery environments prepare the ground for the growth of some microorganisms. Moreover, a possible fire will cause damage to the environment, not to mention [14-17].

Around the world, 800 million waste automobile tires are generated annually and this amount increases by 2% each year [18,19].

Most of the ingredients in table 1 are carbon based, ie petroleum product. Considering the oil struggles between countries, the recycling of waste automobile tires also gains importance [20].

The components of waste automobile tires are an important step in determining the recycling process. Waste tires are often burned to generate energy. It can be chemically treated for the recovery of rubbers. However, steel and other materials in the tire make the recycling process difficult and increase the cost.

The methods used in the recycling of waste tires:

- Reuse (direct evaluation)
- Coating (evaluation as a material)
- Granulate
- Decomposition with nitrogen
- Thermal evaluation
- Pyrolysis

Reintroducing the waste tires that have not expired to the market provides a great advantage in terms of storage area. In addition, these tires can be used directly in children's playgrounds, racetracks and harbors. It can even be used as a reef. It is also possible to reuse the waste tires by coating them under suitable conditions. Retreaded tires will travel the same way as new tires, and will cost less. Tires that are not recycled by the aforementioned processes are turned into granules with shredder machines and used as fuel or asphalt additive. In addition to shredding with shredder machines, cold shredding with liquid nitrogen is also a method. Although the cost of this method is high, it helps to break down rubber, steel and other materials easily and to obtain granules with a smoother surface that can be used in obtaining valuable materials [11,21,22].

Table 1: The waste automobile tire components.

Component	Amount %
Rubber	47.0
Carbon black	21.5
Metal	16.5
Additives	7.5
Textile fiber	5.5
Zinc oxide	1.0
Sulfur	1.0

Table 2: The components obtained as a result of tire pyrolysis.

Component	Amount %
Solvents	3.0
Oils	23.0
Steel	12.0
Fuel for the pyrolysis process	12.0
Excess gas	13.0
Ash	37.0

The pyrolysis is the breakdown of high temperature materials, it is a chemical process. Pyrolysis is a costly process in which valuable components used in the recycling of waste tires are recovered (Table 2) [23,24].

CONCLUSION

After all, the recycling process is a process that countries should be involved in considering their health, environmental and economic conditions. Depending on the increasing world population, the increase in automobile production and consequently the amount of waste tires increases the importance of recycling. Any form of waste tire can be included in the recycling process. In addition to economically very convenient processes, there are also expensive processes. The important thing is to define well in which area the waste is to be used.

References

1. Yanga Y, Booma R, Irionb B, van Heerdenb DJ, Kuiper P, de Wit H. Recycling of composite materials. Chemical Engineering and Processing. 2012 Jan;51:53-68. doi: 10.1016/j.cep.2011.09.007
2. Shen L, Worrell E. Plastic Recycling. Handbook of Recycling. 2014 May;179-190. doi: 10.1016/B978-0-12-396459-5.00013-1
3. Pacheco EBAV, Masanet E. An overview of plastic recycling in Rio de Janeiro. Resources, Conservation and Recycling. 2012 March;60:140-146. doi: 10.1016/j.resconrec.2011.12.010
4. Lavee D. Is municipal solid waste recycling economically efficient? Environmental Management. 2007 Aug 9;40:926-943.doi: 10.1007/s00267-007-9000-7
5. Mondal MK, Bansal P. Recycling waste thermoplastic for energy efficient construction materials: An experimental investigation. Journal of Environmental Management. 2019 March;240:119-125. doi: 10.1016/j.jenvman.2019.03.016
6. Sanchez FAC, Pearce JM. Plastic recycling in additive manufacturing: A systematic literature review and opportunities for the circular economy. Journal of Cleaner Production. 2020 Aug 10;264:121-602. doi: 10.1016/j.jclepro.2020.121602
7. Grigore ME. Methods of Recycling, Properties and Applications of Recycled Thermoplastic Polymers. Recycling. 2017 Nov;2(4):24. doi: 10.3390/recycling2040024

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8. Godlewska J. Recovery and Recycling of Waste Tires in Poland. Procedia Engineering. 2017 Apr;182:229-234. doi: 10.1016/j.proeng.2017.03.173

9. Shu X, Huang B. Recycling of waste tire rubber in asphalt and portland cement concrete: An overview. Construction and Building Materials. 2014 Sep 30;67:217-224. doi: 10.1016/j.conbuildmat.2013.11.027

10. Adhikari B, Maiti DDS. Reclamation and recycling of waste rubber. Progress in Polymer Science. 2000 Sep;25(7):909-948. doi: 10.1016/S0079-6700(00)00020-4

11. Pickering SJ. Recycling technologies for thermoset composite materials-current status. Composites Part A: Applied Science and Manufacturing. 2006 Aug;37(8):1206-1215. doi: 10.1016/j.compositesa.2005.05.030

12. Akiba M, Hashim AS. Vulcanization and crosslinking in elastomers. Progress in Polymer Science. 1997 May;22(3):475-521. doi: 10.1016/S0079-6700(96)00015-9

13. Palmer J, Evans KE. Successful closed-loop recycling of thermoset composites. Composites Part A: Applied Science and Manufacturing. 2009 Apr;40(4):490-498. doi: 10.1016/j.compositesa.2009.02.002

14. Ajam L, Belgaied M, Jomaa S. Mechanical and environmental study of the valorization of waste tires in bituminous concrete applied in Tunisia. International Journal of Pavement Research and Technology. 2020 March 3;13:313-323. doi: 10.1007/s42947-020-0031-2

15. Presti DL. Recycled tyre rubber modified bitumens for road asphalt mixtures: A literature review. Constr. Buil. Mater. 2013 Dec;49:863-881. doi: 10.1016/j.conbuildmat.2013.09.007

16. Huang Y, Bird RN, Heidrich O. A review of the use of recycled solid waste materials in asphalt pavements, Resour. Conservation Recycling. 2007 Nov;52(1):58-73. doi: 10.1016/j.resconrec.2007.02.002

17. Attom MF. The use of shredded waste tires to improve the geotechnical engineering properties of sands. Environmental Geology. 2006 Dec;49:497-503. doi: 10.1007/s00254-005-0003-5

18. Wu B, Zhou MH. Recycling of waste tyre rubber into oil absorbent, Waste Management. 2008 May;29(1):355-359. doi: 10.1016/j.wasman.2008.03.002

19. Kaminsky W, Mennerich C, Zhang Z. Feedstock recycling of synthetic and natural rubber by pyrolysis in a fluidized bed. Journal of Analytical and Applied Pyrolysis. 2009 May;85(1-2): 334-337. doi: 10.1016/j.jaap.2008.11.012

20. Batır B. Used Tire Management Survey for Turkey. Master Thesis. Istanbul Technical University, Istanbul, Turkey. 2002

21. Pimenta S, Pinho ST. Recycling carbon fibre reinforced polymers for structural applications: Technology review and market Outlook. Waste Management. 2011;31(2):378-392. doi: 10.1016/j.wasman.2010.09.019

22. Kim JR, Kim SD. Combustion characteristics of shredded waste tires in a fluidized bed combustor. Energy. 1994 Aug;19(8):845-854. doi: 10.1016/0360-5442(94)90037-X

23. Agackesen H. Optimization of acidic desulphurization of waste tire derived pyrolytıc oil. Master Thesis. Afyon Kocatepe University. Afyonkarahisar, Turkey. 2018s.

24. Cunliffe AM, Williams PT. Composition of oils derived from the batch pyrolysis of tyres. Journal of Analytical and Applied Pyrolysis. 1998 Jan;44(2):131-152. doi: 10.1016/S0165-2370(97)00085-5s

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