American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-11, Issue-01, pp-36-41
www.ajer.org
Research Paper Open Access

A Small-Scale Recycling technology: Proposal of Plastic waste recycling Technic

Oussai.A*[1], Bartfai.Z[1] and Katai.L[1]
[1](*Hungarian University of Agriculture and Life science*
*Corresponding Author: **

***ABSTRACT** : This study examined PET (polyethylene terephtalate). In order to implement an environmental protection policy, the fight against pollution is necessary; especially in with regard to plastic waste. This is how this research was initiated. This study examined a method of recycling plastic waste, easy to implement. The tests carried out on the samples obtained by this recycling method are satisfactory. The results of the bending tests of the new material represent the optimal quality. This material is based on its increased resistance as long time under load, elongation property (800%) and high tensile strength (28 MPa).*

***KEYWORDS** Environment, Polyethylene Terephthalate, plastic waste, recycling method.*

Date of Submission: 01-01-2022 Date of acceptance: 10-01-2022

I. INTRODUCTION

Plastic has long been considered a manmade material with many benefits. It has lightweight properties and is easily shaped to the designer's desires. Its versatile properties have led to its widespread use. Since 2016–2017, plastic consumption has increased from 335 million tons to 348 million tons. This demand is expected to reach 485 million tons by 2030.[1]

The downside of plastic use is the waste generated and the environmental pollution caused because many plastics are not biodegradable and can take between 500 and 1000 years to decompose [2]. The pollution risks from the toxins released can impact groundwater quality, animal/human health, food-chain poisoning, and reduction in soil fertility [3]. Furthermore, if burnt in an open space, plastics produce carbon monoxide (a greenhouse gas). If disposed of in waterways, plastics can cause siltation and impede water flows, thereby creating a flood risk [4].

In 2018, processing plastic waste for energy used 43% of all of the collected post-consumer waste stream. Furthermore, the insufficient processing and management of plastic waste worldwide face the challenge of insufficient plastic waste treatment facilities at all stages of collection, separation, and disposal. By 2050, it is projected that about 12 billion metric tons of plastic litter will end up in landfills and the natural environment[5].

Over the past twenty years, waste in plastics represent an important part of municipal solid waste. In addition, they pose a serious problem because of their lifespan and because that it is conspicuous waste. Their management is therefore necessary from a point of view environmental, economic or social. The first ones processes put in place to treat them were landfill and incineration. However, the growth exponential amount of plastic packaging waste leads to provide other recycling channels. The materials of construction can represent an outlet interesting. Indeed, previous studies [6] have showed that it was possible to use plastic waste in concrete and mortars and even other types of waste such as recycled aggregates from demolition and / or construction.

In particular polyethylene terephthalate (PET) recycled, from packaging was used as a binder for the production of a composite material with high performance: polymer concrete. Plastic is transformed in the presence of glycols, into polyester resin unsaturated which is then mixed with sand and chippings. The polymer concrete obtained is very resistant in compression and bending with respect to the concrete of conventional Portland cement. It also presents the advantage of reaching 80% of its mechanical resistance from the first days of taking. But he is sensitive to temperature. Other authors have also used PET waste mixed with polyethylene waste high density (HDPE) as aggregates, as a substitute partial sand (5 to 20% of the total sand volume) in order to compare them to generally used glass fibers as structural reinforcement. Their study showed that a volume substitution exceeding 15% decreases the mechanical properties of new composites by compared to the reference mortar not containing waste [7].

This work aims to study the possibility of using waste plastic bottles (PET-polyethylene terephthalate) and tanks (LDPE-low polyethylene density) in concrete without any other transformation than grinding, in order to minimize the cost of the final material. The influence of the proportion of waste used on physical and mechanical characteristics of the new material has been studied and analysed.

To reduce plastic waste and be in tune with the objectives and the main lines that should be the future world around the axes of poverty eradication, environmental protection and sustainable development, our study will propose a recycling method.

This paper is structured as follows: Section 1 is an introduction providing the background and aim of this study. It is followed by a description of materials and methods in Section 2. The results of the tests are provided in Section 3 and discussed in Section 4. Conclusions and recommendations for future research are presented in Section 5

II. MATERIALS AND METHODSS

The sand (Figure 1) is extracted in the river which crosses the city of Belfort and which is called the Savieuse. We have acquired sand thanks to the PRADIER Granulats company which extracts it and sell it for laboratory work.The raw sand was sieved so as to obtain three types of sand:

- Sand I whose grain diameter is between 0.5 <d <1
- Sand II whose grain diameter is d <0.5
- Sand III consisting of the entire sand.

The samples were made with these three types of sand.

Fig.1. Sand produced by Granulats

The results from the above system are given in both tabulated and graphical forms. Daily, monthly, yearly and total plant production are the main output parameters from the system in addition to carbon dioxide (Co2) saving and system data. Some results are shown in Fig. 2.

Fig. 2. Polyethylene Terephtalate waste

The plastic used (Figure 2) comes from material packaging waste delivered to the FKF.Budapest laboratory. These plastics are mainly Low Density Polyethylene (PET). Table 1 give us some characteristics of PET.

Tab. 1. Different properties polyethylene terephthalate [8][9]

Property	value
Technical Name	Polyethylene terephthalate (PET or PETE)
Chemical formula	(C10H8O4)n
Melt temperature	500°F (260°C)
Typical Injection Meld Temperature	74 - 91 °C (165 - 195 °F) [9]
Heat Deflection Temperature	70 °C (158 °F) at 0.46 MPa (66 PSI) [8]
Tensile Strength	152 MPa (22000 PSI) *** W/ 30% Glass Fiber
Flexural Strength	221 MPa (32000 PSI) *** W/ 30% Glass Fiber
Specific Gravity	1.56
Shrink Rate	0.1 - 0.3 % (.001 - .003 in/in) [9]

We used a particular device (Figure 3) for the development of samples

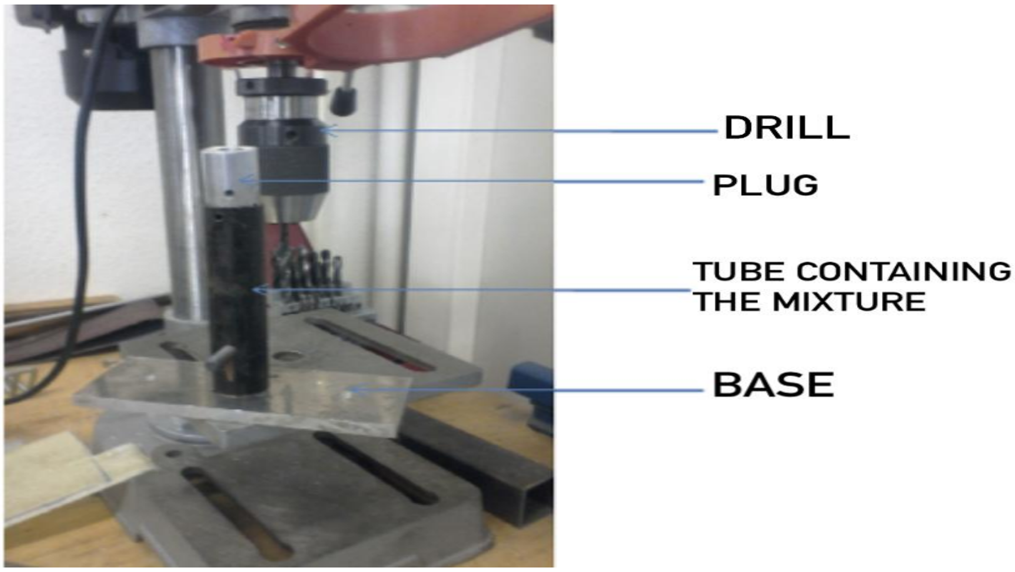

Fig. 3. Drilling machine

The plastic sand mixture is put in a tube (Figure 4-left) up to 170 ° C. All plastic sand, content a drill. The plastic represents 25% by mass of the total mixture. When the plastic is well melted and the sand is well mixed with the plastic, we put it in a mold. The mold is then brought under a thermopress (Figure 4-right).
This tube tube is gradually mixed thanks to Figure 4-B) preheated to 170 ° C, for 20 minutes.

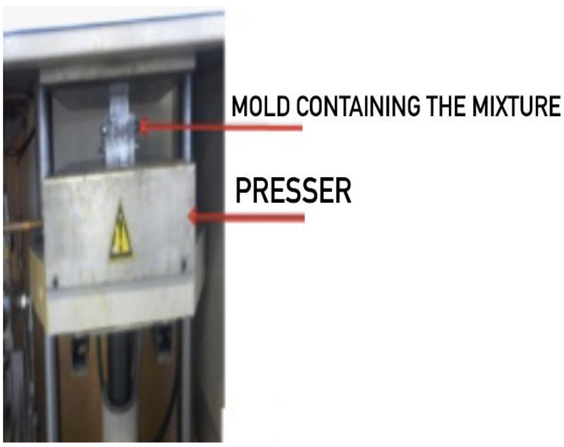

Fig. 4. Hot air gun (left side) and thermopress (right side)

III. RESULTS

We obtained different types of samples depending on the method. First method was when we make the plastic sand mixture in a mold, followed by thermo-compression. We obtain a non-homogeneous mixture (Figure 5).

Fig. 5. Non-Homogeneous samples

It is therefore impossible to extract samples with this method. In this method the absence of mixing justifies the condition of the samples. There is a segregation of plastic and sand.
Second method We used a particular device (Figure 3) for the development of samples, then We obtain very homogeneous samples (Figure 6).

Fig. 6. Homogeneous samples with 3 different types of mixture , pure sand , sand with d<0,5 mm and 0,5<d<1 mm

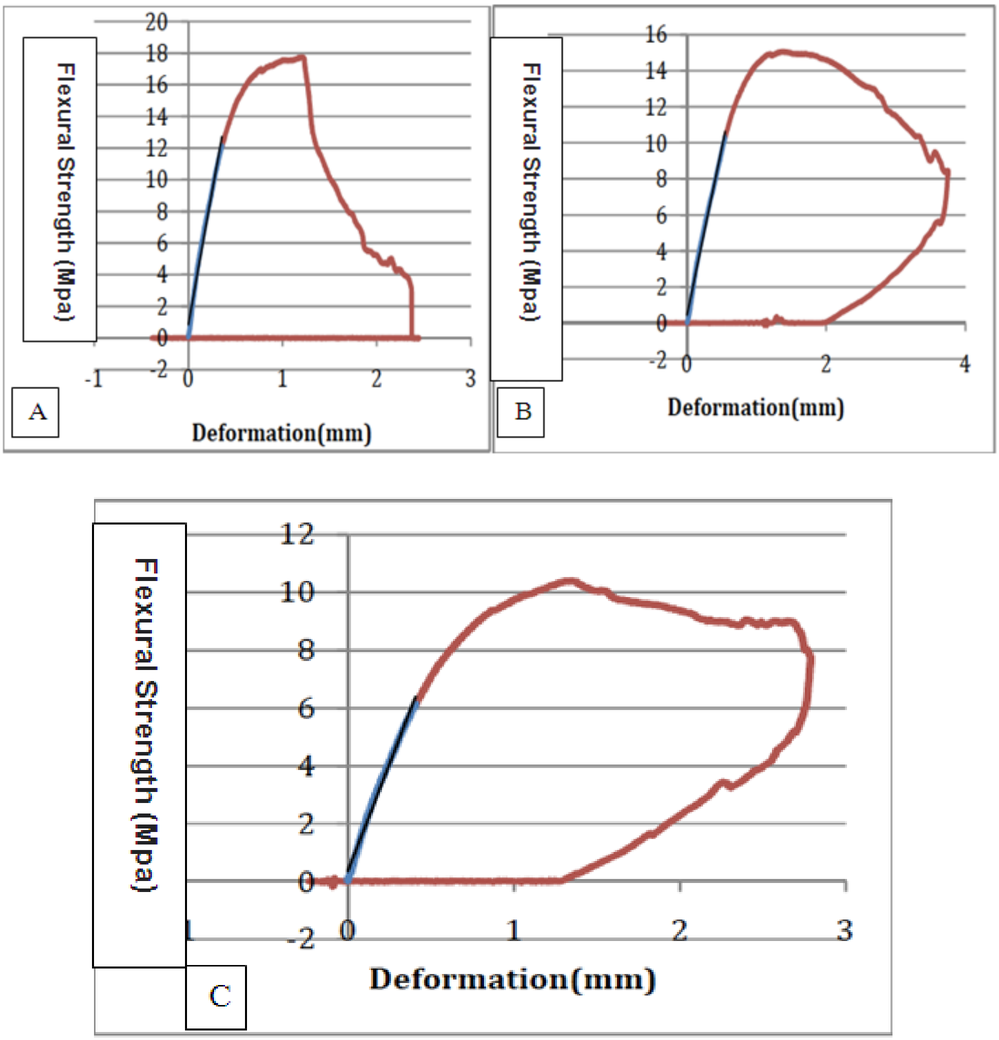

Fig. 7. 3-point flexural strength curve: A (sand with d <0.5)); B (sand with 0.5 <d <1); C (whole sand)

We notice by analysing these curves that the resistances evolve according to the particle size. The larger the grain size is thin the more the flexural strength increases.

We obtain respectively 10; 15 and 18 MPa for sand with 0.5 <d <1, whole sand and sand with d <0.5. (D being the grain diameter of the sand).

This change in flexural strength is explained by the fact that coarse grains in a mixture promote contact between grains thus creating areas of weakness in the material. This material can then be recommended in construction. It even has a flexural strength greater than the compressive strength.

IV. CONCLUSION

This recycling method should be adopted because it allows us to obtain a very homogeneous material. The three-point bending test, carried out on the samples, gives satisfactory results. In order to broaden the field of application of the materials obtained, further work must be carried out. The incorporation of filler should be considered.

Bibliography

REFERENCES

[1]. The association of plastic recycler (APR): available online: https://plasticrecycling.org/images/pdf/recognition-program/Procedure (accessed on october 2021)

[2]. How Long It Takes for Some Everyday Items to Decompose. Available online: http://storage.neic.org/event/docs/1129/how_long_does_it_take_garbage_to_decompose.pdf (accessed on 27 May 2020).

[3]. Verma, R.; Vinoda, K.; Papireddy, M.; Gowda, A. Toxic Pollutants from Plastic Waste—A Review. Procedia Environ. Sci.2016, 35, 701–708. [https://www.sciencedirect.com/science/article/pii/S187802961630158X?via%3Dihub]

[4]. Van Emmerik, T.; Schwarz, A. Plastic debris in rivers. Wiley Interdiscip. Rev. Water 2020, 7, e1398. [https://wires.onlinelibrary.wiley.com/doi/10.1002/wat2.1398]
[5]. Geyer, R.; Jambeck, J.R.; Law, K.L. Production, use, and fate of all plastics ever made. Sci. Adv. 2017, 3, e1700782.DOI: 10.1126/sciadv.1700782
[6]. Communication from the commission to the european parliament, the council, the european economic and social committee and the committee of the regions.(https://eur-lex.europa.eu/legal-content/en/txt/html/?uri=celex:52018dc0028&from=pt)
[7]. Mortar and concrete composites with recycled plastic: A review (DOI: 10.1016/j.stmat.2018.11.003)
[8]. Mathweb . Deflection temperature testing of Plastic : http://www.matweb.com/reference/deflection-temperature.aspx
[9]. Polyethyle Terephtalate (PET)compounds : https://www.rtpcompany.com/technical-info/data-sheets/series-1100/

Oussai.A, et. al. "A Small-Scale Recycling technology: Proposal of Plastic waste recycling Technic."*American Journal of Engineering Research (AJER)*, vol. 11(01), 2022, pp. 36-41.