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From Waste to Art, Design and Construction[1]

Mehmet Uğur KAHRAMAN[a], Emine Nur OZANÖZGÜ[b]
[a] *İç Mimarlık ve Çevre Tasarımı Bölümü, Antalya Bilim Üniversitesi, Antalya, Türkiye*
[b] *İç Mimarlık ve Çevre Tasarımı Bölümü, Hacettepe Üniversitesi, Ankara, Türkiye*

ABSTRACT
When the space is considered as a social product, man-made issues and their alternative solutions might be brought right in to this space as building materials to build and decorate the surfaces or layers. In this context, the plastic packaging wastes and their recycling problem significantly be taken as the man-made issue while the shredded waste mixture in bond resin to mold a building material could surely be its solution. Thus, a spatial design for the society made out of man-made problem and its' alternative solution is a sustainable social product.

As it is usually mentioned, the major problem with the recycling of the plastic wastes is the diversity of the chemical structures of the different plastic materials which leads to a strict separation implementation in the recycling facilities according to the official numeric recycling labels by various methods. Knowing that the chemical structures are causing this recycling problem, another perspective is needed to solve the plastic pollution by thinking outside the box, eliminating the chemical dead end.

In this article, a recycled building material concept is highlighted for an alternative usage which is suitable for in and out door spatial designs regarding to the awareness of the growing plastic packaging waste issues, in an artistic way.
Keywords: Design, Space, Plastic, Recycling, Waste

INTRODUCTION

Since the first days of humanity, the way of living according to the requirements has changed over time. In order to meet the needs, the production perspective has also changed to design and develop new manufacturing methods in this process. At first, all the mankind who were content with nature while living a hunter-gatherer life, considered the opportunities offered by nature as a space and perceived it as an absolute space. Realizing that the concept of production that comes with the settled life was actually the fixture of collective living, mankind sowed the primitive seeds of mass production with the Neolithic Revolution which is also called the Agricultural Revolution. This has changed the whole lifestyle forever like eating habits and interactions with each other about 12,000 years ago. In time, city states are established with the increase in the population that has settled in and the establishment of city states is the breaking point of the concept of space from nature. In this new order, the space is built around the center formed by the state. This new place, which is regarded as a sacred place, is mostly in the hands of religious and political power. In the period following this process, the historical forces shattered the naturalness of the absolute space without stopping and established the space of accumulation on its ruins and thus the perception of historical space begins. The basis of this process is the change in the quality of private property and the distinction between the concepts of public and private.

As the population grew while the city states turned into empires and kingdoms, the concept of space has also been metamorphed. In the beginning, humanity, who was satisfied with

[1] This article is produced from PhD thesis of Mehmet Uğur Kahraman labeled "*Producing building material out of plastic packaging waste".*

the perception of absolute, sacred and historical space, has gone from a different perspective and shifted in to an early capitalist vision in order to meet the needs of the newly established crowded world order.

From a mechanical point of view, naivety in the nature-human relationship has been lost. Instead, a political, economic and production based spatial approach has begun to define the space which is disconnected from the nature. With this approach, the concept of abstract space, which is designed as opposed to absolute space, has emerged. The philosophical contradictions that emerge as the brutal capitalism surrounds the world are reflected in the perception of space as a contradictory space.

By putting aside the quality and adopting a quantity-oriented perspective, contradictions have become spatial and the contradictions specific to abstract space have deepened related to the recent developments in capitalism (Lefebvre 2014).

Nevertheless, collective production brought about mass production by nature. This has created a sense of space in itself. In other words, space has become a social product. However, the concept of space is not the only social product brought by the collective life. Beyond the space, the concepts of mass production and shipping have been brought to the agenda and with the new possibilities, the world has become smaller than previously thought. This process, which adds a brand new dimension to the concepts of import and export, has gone beyond the estimates with the widespread use of the Internet today. On the other hand, space is not the only value put forward in the concept of social product. The infinite amount of waste produced within this perception of space is also a result that comes with the social space. Since the result is inevitable, the imperative to control this outcome should be at the top of the priority list.

Regarding to this point of view, in this article; recycled building materials are highlighted for an alternative usage which is suitable for spatial design related implementations, proposing an alternative solution for the growing plastic packaging waste issues.

TURKEY'S WASTE MANAGEMENT AND THE MATTER OF WASTE

Turkey's wide range of wastes produced by its industry and hence its production is officially organized by the Regulation on the General Principles of Waste Management published by the Ministry of Environment and Forestry. The waste concept according to this regulation is defined as "It covers any substance in the classes included in ANNEX-1 that is formed as a result of any activity, discharged or released to the environment '' and in the ANNEX-1 all these Wastes are listed in detail.

Solid wastes in this list are the main types of wastes that cause important problems from their generation to disposal. According to Armağan et al. (2006), the concept of solid waste covers all the unwanted solid materials that have fulfilled their function, but still have an economic value, which must be collected in accordance with the interests of society and disposed of by scientific steps and methods. In addition, in the definition of the Solid Waste Regulation in the Environment Law of the Ministry of Environment, No. 2872, solid waste concept is defined as "Solid substances and purification sludge which are desired to be disposed of by the producer and must be disposed of regularly with the peace of the society, especially in terms of environmental protection.".

In order to regulate the solid waste disposal process in line with these definitions, T.C. Regulation on Control of Solid Waste, put into effect by the Ministry of Environment in 1991; It has been regulated with the aim of eliminating technical and administrative deficiencies in issues related to separation, collection, transportation, recovery and disposal of waste at source. As it is understood from here, it is aimed to convert solid wastes into economic value by the state. Another goal is to develop and promote the awareness of

using solid wastes as a source of raw materials since the evaluations reveal the economic gains and savings provided by waste recycling.

Since 2005, with the implementation of many other regulations such as Hazardous Wastes Control (APAK) Regulation, Packaging Wastes Control Regulation; it is aimed to collect each product group separately at its source and brought to a standard in its own subject (Yetim 2014). Over the past years, in line with the researches, developments and new techniques which are introduced globally, the vision of the concept of solid waste has saliently changed. Consequently, the waste has turned into a man-made blessing rather than an unwanted substance which provides economical and industrial resources to the countries.

Unfortunately, Turkey is not able to use its own waste efficiently in terms of turning it into an economic and industrial resource. Even though the waste of Turkey cannot be recycled efficiently, high amount of solid waste is being imported from the developed countries every year. As of 2019, the amount of solid waste imported by Turkey from Europe (Figure 1). These wastes imported from foreign countries are burned or buried, since they cannot be fully recycled and used for the benefits of the country and this situation is causing both economic loss and a vital environmental problem. Moreover, this importer perspective is causing irreversible damages to the nature of the country by purchasing more waste instead of providing maximum efficiency from the existing waste stock and all these wastes are creating uncontrolled artificial areas in micro and macro scales instead of a conscious design.

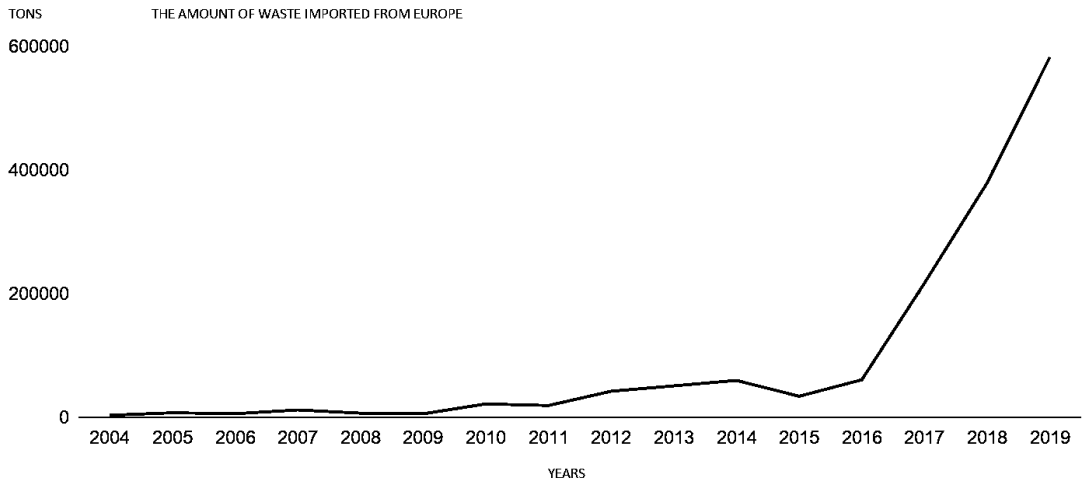

Figure 1: Turkey's waste imports through 2019 (URL 1)

Under these circumstances; if it is evaluated in the perspective of Third World countries according to the space definitions of Lefebvre (2014), the new absolute space of the humanity who left the natural absolute space in search of development, has now become the garbage mountains. Without an economic development; complex and expensive ways to solve this inevitable problem are not possible for these societies that are already in an economic bottleneck. Therefore, a different perspective and applicable methods should be developed. At this point, with the help of art and design, including the wastes in the elements that contribute to the space body and even the aesthetics of the space, and promoting it into a lifestyle will be the first steps to the solution to the waste problem.

PLASTIC PACKAGING WASTE INCORPORATION INTO THE ARTIFICIAL SPACE

Plastic packaging waste can be used in many areas from urban scale to indoor applications. The basic ways to incorporate plastic packaging wastes into space production are simply

divided into three categories. First method is to collect them from the source and use them without touching the existing form of the wastes and keep their integrity. Second method is to crumble the plastic packaging wastes into small pieces at the facilities to use them as additives to various material mixtures. Third method is the chemical processes such as freezing method which converts these plastic wastes into a plastic powder.

USING PLASTIC WASTES WITHOUT A PROCESS

On a city scale; these wastes can be included in infrastructure works such as vehicle roads, bicycle / running paths and sidewalks in terms of raw materials and bulk products for the urban reinforcement elements that can contribute to the urban aesthetics in an artistic interpretation. Artistic installations and sculptures can be included to the social spaces of the city and offer many artists the opportunity to interpret the agenda or express themselves. Thus, the relationship between art and society can be strengthened in uneducated consumer societies and also waste issues can be kept on the agenda (Figure 2).

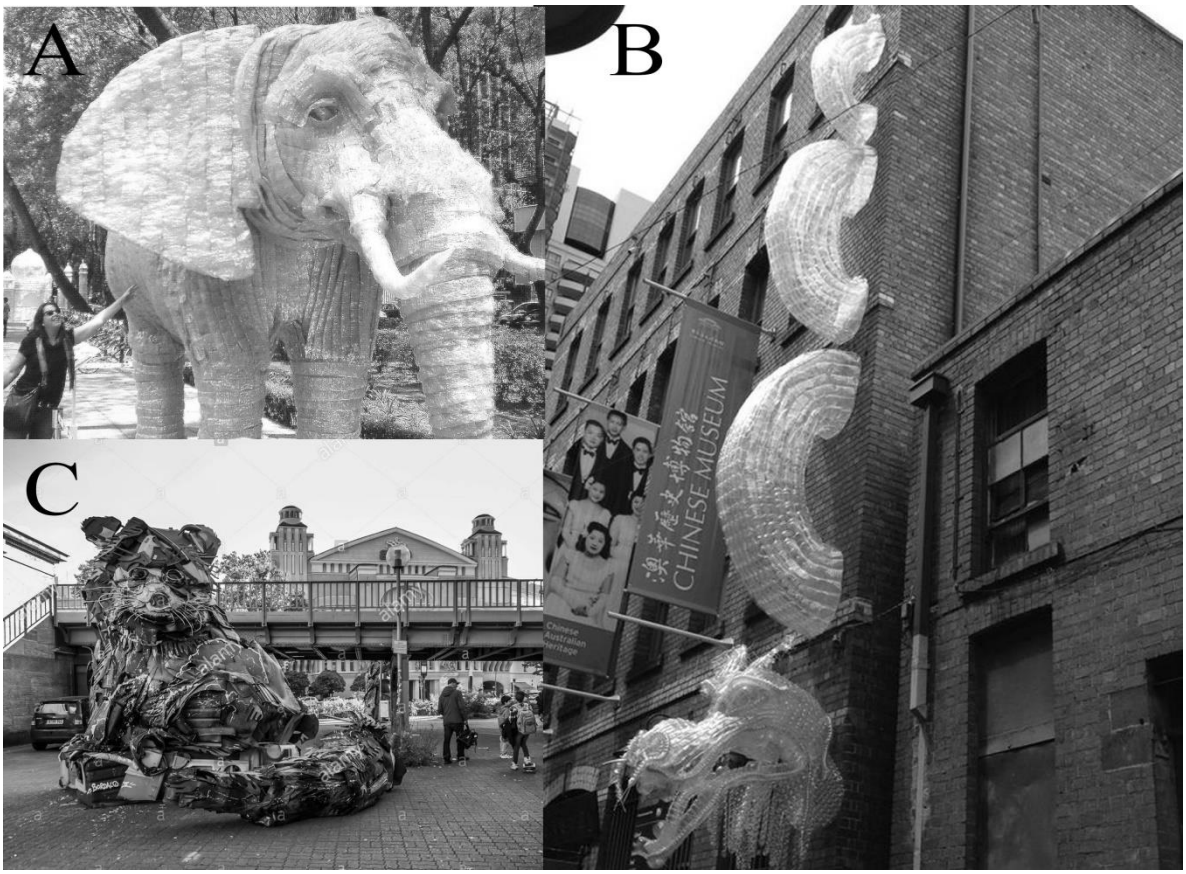

Figure 2: (A) A PET Elephant Figure, **(B)** A PET Dragon Figure, **(C)** A Red Panda Figure Made by plastic and other materials mixture (URL-2, URL-3, URL-4)

Especially some plastic wastes like PET bottles, can be used as building materials without a processing infrastructure and its huge cost. They even leaded to a brand new cheap building method which is preferred in underdeveloped countries or experimental approaches around the world. For example, in countries such as Africa, where people have major problems like hunger, poverty, impossibilities and difficult living conditions, PET bottle brick costs are lower than the costs of concrete and standard brick with a 1/3 lower construction cost and 20 times more durable and long-lasting conformation option which enables many local projects to be realized (URL-4) (Figure 3).

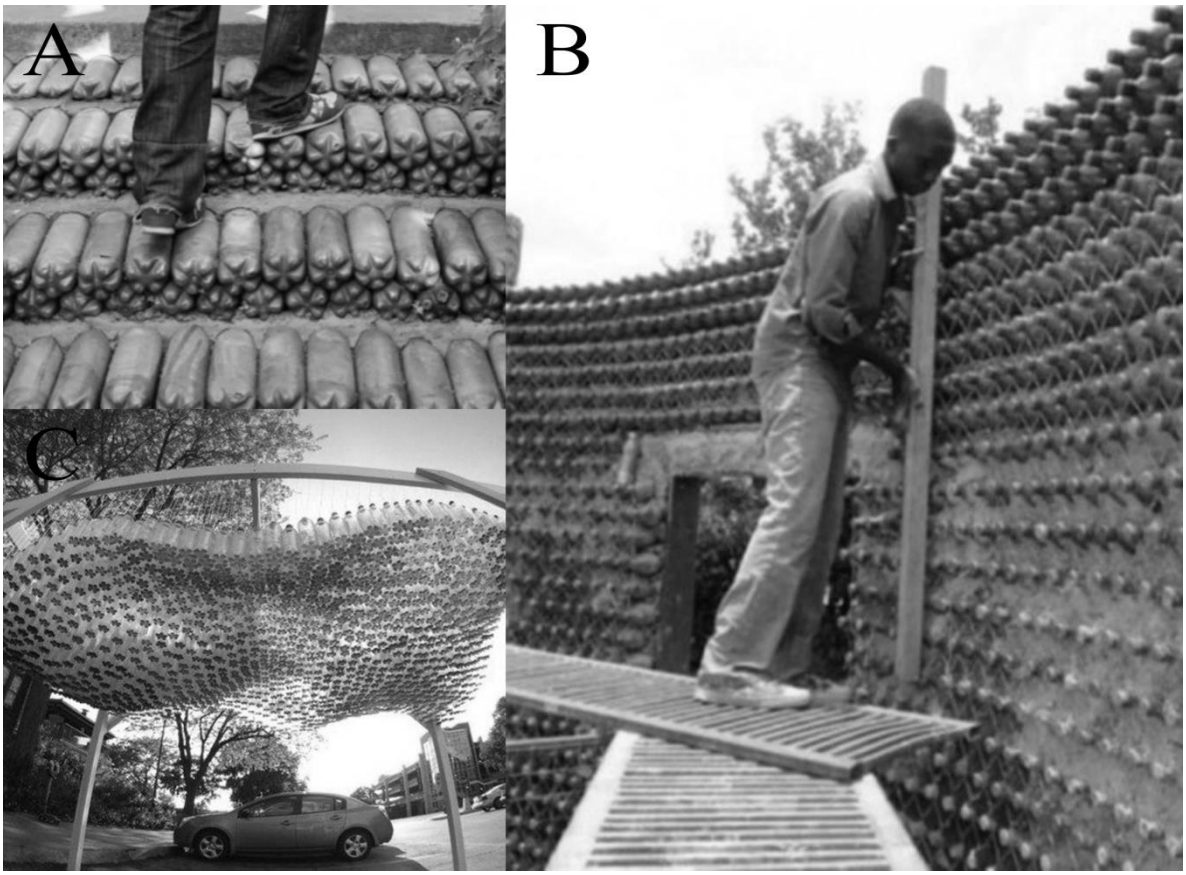

Figure 3: (A) PET steps filled with cement/Argentina **(B)** PET Brick masonry, **(C)** Decorative canopy constructed by putting colored water inside (URL-6, URL-7, URL-8)

CRUMBLING THE PLASTIC PACKAGING WASTES INTO SMALL PIECES

To crumble the plastic packaging wastes, first of all they have to be collected from the source. Then they have to be taken to a facility for the crumbling process. Before the process at the source or at the facility, a strict separation of plastic genres has to be done to apply the suitable method of recycling to get an appropriate bulk material for the certain usages. As an example for the use of recycled plastic wastes in the infrastructure; the roads which are implemented by Volker Wessels Company in Rotterdam/ Netherlands can be given. (URL-8) (Figure 4).

Another way to use recycled plastic is to include them in to the mixture of the ordinary road construction materials or suitable implementations. An asphalt, concrete or paving materials are capable of containing from 5 to 20 percent or more of granular recycled plastic supplements or even replacing the rock aggregate component of the mixture (Giriftinoğlu 2007).

Plastic packaging wastes can also be used as architectural construction elements. In this context, it is possible to use them in two different conditions; processed and unprocessed. As processed, they can be converted into filling material by comminution. From this perspective, plastic wastes incorporated into concrete can be used as filling material during the construction. As the waste plastic fiber ratio increased, flexural toughness increased gradually. In addition, the use of waste plastics in the building sector contributes to the prevention of environmental pollution (Karademir 2017).

Figure 4: A Plastic Road in Netherlands Made From Recycled Plastic Material (URL-9)

On the other hand, the studies have been made on the evaluation of HDF production by adding different properties of polymers in plastic wastes to wood fibers, which are thought to be significant additives for fiber board industry. Accordingly, it is observed that by utilizing different plastic wastes in HDF production, an alternative raw material source as an additive for high density fiberboard production could actually be created (Külçe 2016). These plastic packaging wastes can be included into the interior design as design elements. In this context, these wastes can be used as flooring and surface coatings as a filling material when they are processed. They can also add value to the interior spaces in terms of lighting design or divider and decorative elements (Figure 5).

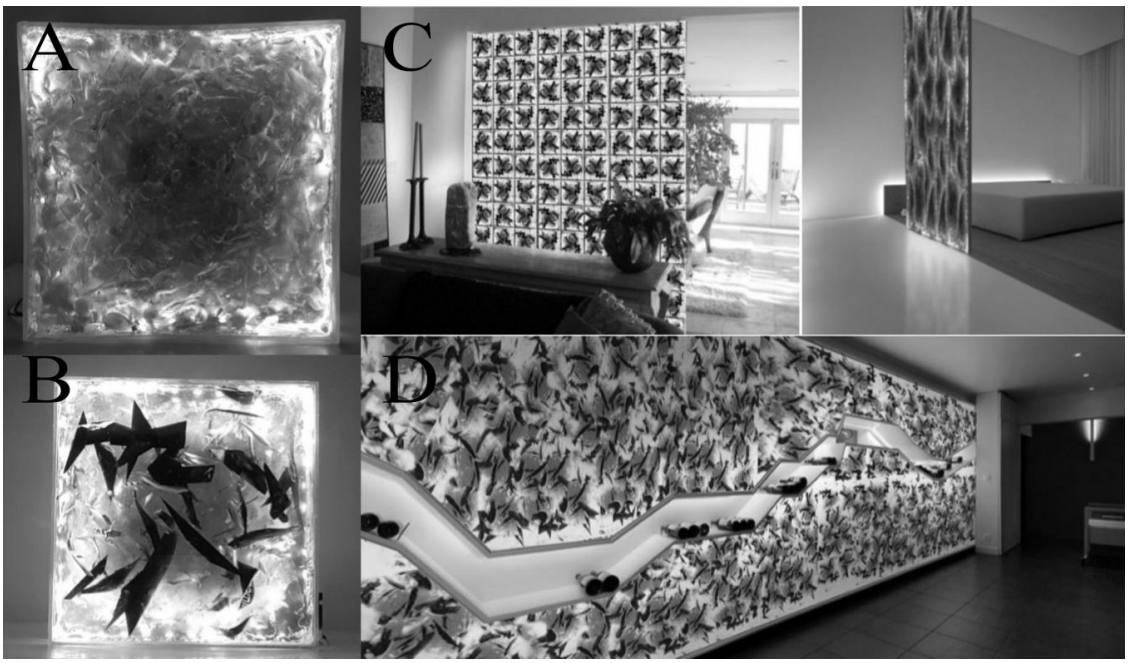

Figure 5: (A) LED backlit display (Textured Surface), **(B)** LED backlit display (Surface with no Texture), **(C)** Modular and one-piece separator wall application illustration, **(D)** Self-illuminated wall application illustration (Mehmet Uğur Kahraman's archive 2015)

CHEMICAL PROCESS (FREEZING)

The physical characteristics of film plastics and plastic bags are causing an insoluble recycling problem about breaking down these flexible plastic wastes into little pieces at the recycling facilities and most of the time, they are flapping around in the wind and traveling distances which cannot be underestimated. Unfortunately, a significant amount of plastic packaging wastes is in this condition and flapping around and yet, with the help of sun and various weather conditions, these plastic wastes are being disintegrated in the nature in time and they are moving through the oceans and seas all around the world. These wastes are also getting blended with the soil elsewhere in the nature and eaten by the animals. Therefore, researchers come across with the remains of harmful plastics in the food chain both in the seas and on the lands. On the other hand, an ordinary plastic bottle may be consisted of a 'PET' body, a 'HDPE' lid and a 'PVC' packaging film and there are many other plastic packaging wastes out there in different combinations which means different chemical boundaries in a simple plastic waste. This is a major problem for the fully efficient plastic recycling concept.

Nevertheless, in cryogenic grinding (freezing) method, when the plastic wastes are chilled by dry ice, liquid carbon dioxide or liquid nitrogen, they can be finally grounded to powder suitable for electrostatic spraying and other powder processes (Junghare et al. 2017) (Figure 6) which means these plastic packaging wastes can be added into the building material mixtures to create artificial spaces without a separation according to the plastic genres.

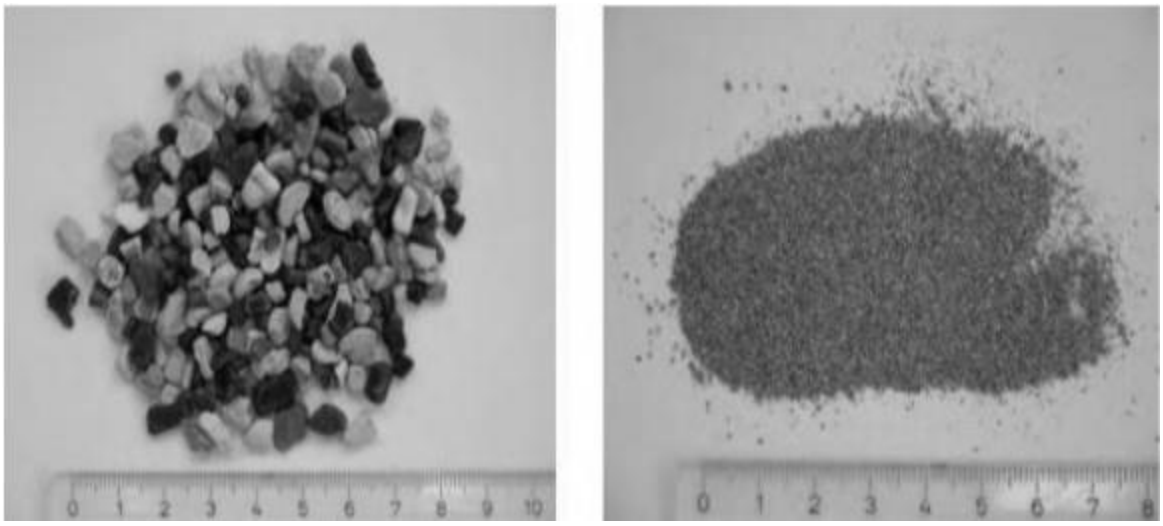

Figure 6: Grain size before and after grinding (Junghare et al. 2017)

CONCLUSION

When the concept of absolute space is considered in today's world, there is no chance for ordinary people to choose, and this absolute space can actually be considered as the country of citizenship. Transforming this space in a positive or negative direction is in the hands of people who belong to that absolute space. At this point, human evolution through goodness has created yet to be understood byproducts. Besides one of the basic rules of Physics is "Nothing comes from nothing" which explains that it is not possible to create something without an existing source. In this case, mankind has manipulated the nature and created its own resource to create artificially.

In this context, according to Lefebvre (2014), there are six defined spaces which are absolute, consecrated, historical, abstract, contradictory and differential spaces. By the last decades of the human evolution, humanity has come to add "The Artificial Space" both literally and theoretically.

Beyond the philosophical side of it, within all these waste issues and environmental chaos, plastic is not our enemy in the process of human evolution. Moreover, developments in the plastics and related sectors will dramatically change the rules of the game on the waste recycling and more efficient ways can be designed in the future world. Recycled and rethought plastics can build new lands of technology over the new world order.

REFERENCE

Armağan B., Demir, İ., Demir, Ö., Gök, N. (2006). Katı Atıkların Ekonomide Değerlendirilmesi, İstanbul Ticaret Odası, 23.

Ministry of Environment, Environment Law No. 2872, Regulation of Solid Waste.

Ministry of Environment (1991). Regulation on Control of Solid Wastes

Giriftinoğlu, Ç. (2007). The Use of Plastic Waste Materials in Asphalt Pavements, M.Sc. Thesis, Istanbul Technical University, Istanbul.

Greenpeace, 2019. Data From the Global Plastics Waste Trade 2016-2018 and The Offshore Impact of China's Foreign Waste Import Ban.

Junghare, H., Hamjade, M., Patil, C.K., Girase, S. B. and Lele, M. M. (2017). A Review on Cryogenic Grinding. International Journal of Current Engineering and Technology, Special Issue-7, 420-423 pp.

Karademir, C. (2017). Utilization of Waste Plastics in Concrete. M.Sc. Thesis, Dokuz Eylül University, İzmir.

Külçe, T. (2016). Çeşitli Plastik Atıkların HDF Üretim Sürecinde Kullanım Olanaklarının Araştırılması, M.Sc Thesis, Kastamonu University, Kastamonu.

Lefebvre, H. (2014). Mekânın Üretimi, (Çev. I. Ergüden), Sel Yayıncılık, 2. Baskı, İstanbul.

URL-1: https://www.greenpeace.org/turkey/basin-bultenleri/turkiyede-plastik-atik-ithalati-son-15-yilda-173-kat-artti/, access date: 02.02.2021.

URL-2: https://tr.pinterest.com/pin/572168327630003449/?lp=true, access date: 17.01.2020

URL-3: https://tr.pinterest.com/pin/445082375655287416/, access date: 17.01.2020

URL-4: https://www.instagram.com/p/BZMSxqDBZyT/, access date: 17.01.2020

URL-5: http://www.bbc.com/news/world-africa-14722179, access date: 17.01.2020

URL-6: http://www.beagleybrown.com/wp- content/uploads/2010/08/Steps.jpg, access date: 17.01.2020

URL-7: http://usercontent1.hubimg.com/5771354_f520.jpg, access date: 17.01.2020

URL-8: http://www.thisiscolossal.com/wp-content/uploads/2012/05/bottle- 6.jpg, access date: 17.01.2020

URL-9: https://www.theguardian.com/world/2015/jul/10/rotterdam-plastic- roads-trial-netherlands, access date: 02.01.2020

Yetim, A. (2014). Geri Dönüşüm Sektörünün Dünyadaki Genel Görünümü ve Türkiye'deki Durumu, Ar&Ge Bülten, 11-16 pp.