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Use of polymer recycling products: effective solutions for modern construction

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ANNOTATION

The processes of plastic recycling, the peculiarities of obtaining recycling products and their effective use in modern construction are considered.

Key words: plastics recycling, recycling technologies, recycling products, secondary polymer construction products.

1. INTRODUCTION

The widespread use of polymer materials in various spheres of human activity has created a serious problem with their disposal, which already accounts for more than 60% of the total mass of solid household waste. Given the threat to the environment caused by soil and water pollution with polymer waste, polymer recycling is particularly relevant. Stability and resistance to biological destruction in natural conditions caused the accumulation of used products in landfills.

Waste pollutes the environment, because plastic is a toxic material that decomposes over a long period (about 150 years). The disposal of polymer waste helps to preserve natural resources, since most polymer materials are made by processing oil, gas or coal, which are classified as non-renewable resources [1, 2].

The process of recycling plastics makes it possible to reduce the production of new plastic several times. Recycling of polymer waste is an important component of the closed cycle economy (circular economy) [3].

Thus, plastic recycling is necessary to improve the ecology of our planet and economical use of its resources; reducing waste in landfills and creating a new source of raw materials.

2. PURPOSE

Consider the peculiarities of obtaining products of recycling of spent polymer materials and the conditions of their use for the creation of modern building products and structures based on them.

3. MAIN RESULTS

Due to economic and technological factors, modern polymer materials are widely used in various industries. The only property of polymers that is not foreseen during their manufacture is biodegradability. Therefore, such waste must be sent for recovery or disposal, especially if it is contaminated with hazardous substances. Plastic waste has been successfully utilized in global practice for many years, which automatically turns such waste into a valuable secondary resource.

Most of the plastic waste is high-density polyethylene (HDPE) and low-density polyethylene (LDPE) (about 30%), polypropylene (about 18%) and fibers - polyester, polyethylene terephthalate (PET) (about 14%).

The methods of oxidation, pyrolysis, gasification, methanolysis, glycolysis, and hydrolysis are used to decompose plastics. Moreover, thermal methods are used mainly to remove polymer waste contaminated with hazardous substances [4].

Processing of plastic waste using factory technologies can be considered the optimal method of their use. In Ukraine, the method of secondary processing of polymer materials by mechanical recycling has become the most widespread, because of which granulate suitable for the manufacture of new products can be obtained [5].

The process of recycling plastic waste can consist of the following stages: preliminary waste sorting and cleaning; grinding to certain sizes, re-sorting, washing from impurities, drying, agglomeration, and granulation [6].

If is necessary the resulting product mixed with stabilizers, dyes, fillers and other ingredients and subjected to granulation. Virtually all wastes consisting of one type of polymer can be mechanically recycled without degradation for quality of the resulting materials.

However, mechanical processing faces various challenges, such as thermomechanical decomposition and poor miscibility of different polymers. The main advantages of mechanical recycling are a simple technological process, the absence of environmental pollution by emissions of harmful substances. The disadvantages of the method are the high-energy consumption of the process, the difficulty of adjusting the grinding size, the need for careful sorting and cleaning of waste [2].

Regardless of the existing processing methods, during the secondary use of polymers, it is necessary to turn substandard polymer raw materials into a semi-finished product (granules) suitable for further processing into products. The choice of primary treatment technology depends on the source of waste generation and the degree of its contamination.

A wide range of methods of recycling polymer-containing waste allows you to use the obtained secondary product in various industries, including the construction industry (production of facing panels, roof tiles, pavement tiles, terrace boards, etc., as well as furniture and interior items). Insulating building materials (for example, polyester-based coatings) are made from "secondary granules"; transparent polyester films, containers for non-food products; geotextile; laminated coverings and linoleum.

Below are the characteristics and recyclability of the most common polymer materials. Moreover, the possibility of such polymer materials for recycling is conditionally divided into two groups: high - the polymer is easily identified, well sorted and can be recycled multiple times without loss of quality, medium - the polymer can be recycled, but requires additional cleaning,

sorting or special equipment procedures. There are limitations associated with the presence of additives, impurities or difficulties in separating different types of polymers,

PET (polyethylene terephthalate) is easy to recycle. Products received: building blocks, decorative panels, insulating plates. Application: construction of light wall structures, thermal insulation, cladding of facades. Advantages: lightness, low cost, good thermal insulation properties.

PVC (polyvinyl chloride) is characterized by average recycling ability (may contain stabilizers and plasticizers that complicate recycling). Products obtained: frame and filling of enclosing structures, films, pipes for lighting, linoleum, covering for floors, walls. Application: production of window frames, door elements, facade structures, partitions, wall cladding, creation of light installations, floor-covering Advantages: waterproof, flexible, durable, low cost, light and decorative.

PP (polypropylene) is easily recycled. Products received: sheet and tile facing materials, fibers, soundproofing panels, furniture, sanitary-technical products. Application: wall cladding, carpeting, furniture production, creation of acoustic ceilings, sanitary equipment. Advantages: resistance to wear, ease of care, decorativeness.

PS (polystyrene) is characterized by an average possibility of recycling (may be complicated due to the presence of additives). Products obtained: polystyrene building blocks, decorative elements (stucco). Application: thermal insulation, construction of light structures, production of decorative columns. Advantages: lightness, low cost, good thermal insulation properties.

HDPE (high-density polyethylene) good for recycling. Products received: pipes, fittings, containers for garbage collection, lighting systems (diffusers). Application: engineering systems for water supply and drainage, heating, manufacturing of LED lamps. Advantages: strength, chemical resistance, durability, corrosion resistance.

ABS (acrylonitrile butadiene styrene) is characterized by medium possibility of recycling (complexity of sorting and processing). Products received: decorative elements, lighting systems (lamp housings) and sanitary ware. Application: production of decorative cornices, moldings; housings of lamps and sanitary-technical equipment. Advantages: strength, impact resistance, chemical resistance, ease of processing, variety of colors.

PC (polycarbonate) is characterized by average recyclability (may contain stabilizers and plasticizers that complicate recycling). Products obtained: coating systems (transparent roofs, visors), soundproof panels Application: creation of translucent structures, soundproofing of premises. Advantages: resistance to weather conditions, ease of care, high strength, impact resistance, transparency, durability, corrosion resistance.

Although all the listed polymers can theoretically be recycled, the practical implementation of recycling can be accompanied by certain difficulties. Therefore, it is important to develop technologies for sorting and processing polymers, as well as to create effective systems for their collection and disposal.

4. CONCLUSIONS

Recycling processes are affected by the type of polymer, the presence of impurities, the type of additives and economic feasibility. At the same time, it is important to note the following: the presence of impurities (paper, metal and other types of plastic) greatly complicates the recycling process; the presence of dyes, plasticizers and other additives can affect the quality of the finished product after processing; the constant development of technologies allows to improve the processing processes of even complex polymer composites.

The advantages of using recycled plastics are solving environmental problems - reducing the volume of waste, preserving natural resources, cost-effectiveness - lower cost of materials compared to primary raw materials, a variety of design solutions: the possibility of creating original and aesthetic elements of the interior and exterior. Thus, the use of recycled polymers in construction and architecture is a promising direction that allows creating modern, functional and environmentally friendly buildings.

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