

Creation of Polymer Composites with Increased Performance Properties Based on Secondary Waste Raw Materials

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ABSTRACT

The article analyzes the classification of polymer waste. The structure of production, processing of polymers and use of finished products is revealed. Particular attention is paid to ways of processing composites. Each of them is also briefly described.

Polymer composite materials are materials based on polymers and fillers of inorganic and organic nature. The preparation of such materials is of fundamental importance: it makes it possible to significantly expand the range of polymeric materials and the diversity of their properties already based on polymers that have already been created and are being produced by industry. Physical and chemical modification of existing polymers, their combination with substances of a different nature, different structure is one of the promising ways to create materials with a new required set of properties.

Currently, there is no clear classification of polymer waste, but the current practical experience in their disposal allows us to divide polymer waste into four groups, each of which requires different economic organizational and specific technological measures to involve in processing:

1. Technological production waste that occurs during the synthesis and processing of plastics. That part of the waste, the chemical, physical and mechanical properties of which correspond to the norms of the technological process of this production, can be involved in recycling, and the rest of the waste that does not guarantee the high quality of products (with conventional recycling methods) is destroyed or transferred as secondary raw materials to other processing companies.
2. Industrial consumption waste - accumulated as a result of the failure of products made of polymeric materials used in various sectors of the national economy. These wastes are the

most homogeneous, slightly polluted, and therefore are of the greatest interest from the point of view of recycling. Typically, these wastes are crushed in a knife crusher and then passed through a single screw extruder for the purpose of homogenization, stabilization, coloring and granulation.

3. Polymer waste from the sphere of production and consumption contains waste of thermoplastics, which are formed during production and consumption as used products (for example, film materials in agriculture, packaging materials in trade, etc.). Such waste is usually highly contaminated, contains foreign bodies, have high humidity.
4. Public consumption waste is accumulated by the population, at public catering establishments, etc., and then ends up in city dumps; eventually they move into a new category of waste - mixed waste. The greatest difficulties are associated with the processing and use of the last waste. The reason for this is the incompatibility of thermoplastics that are part of household waste, which requires their step-by- step isolation.

Industrial processing of municipal solid waste predetermines the following scientifically based areas:

- its ecological and economic task;
- environmental education of the population;
- mechanized sorting of MSW, creation of waste sorting stations;
- selective collection of resource-valuable raw materials that are part of MSW;
- reprocessing of "raw" waste, the most resource-valuable components by recycling into secondary raw materials;
- manufacture of products, finished products from recycled materials for public utilities and urban infrastructure;
- use of the undersorted part of MSW in the form of composting, briquetting, biogas in order to reduce or completely abandon waste incineration;
- creation of mini -incinerators only for used medicines;
- identification of specific publications in the periodical press (easily accessible to the public) for the coverage of environmental problems.

Waste sources are industrial enterprises, agriculture, construction, etc. (industrial area). Each such enterprise concentrates means of labor and raw materials (or means of labor to raw materials) at local points. Therefore, such enterprises are local, compact sources of waste. Compact sources are also institutions and enterprises of the non-productive sphere, where material values are used to provide non-material services. In the process of storing material assets at bases and warehouses, their transportation and sale through trade enterprises (the sphere of circulation), they, not yet being used for their intended purpose, form waste, which is due to the properties, conditions of transportation and storage of material assets. Circulation enterprises are also compact sources of waste.

Production waste is the remnants of raw materials, semi-finished products and materials generated during the production of finished products from them, which have lost their consumer qualities and do not meet the standards.

Waste treatment is the remains of raw materials, semi-finished products, materials and finished products, which, in the process of moving from places of production to consumers, have lost their consumer qualities and do not meet the standards.

Consumption waste is a used container and packaging that, as a result of physical or moral wear

and tear, has lost its consumer qualities and cannot be used for its intended purpose.

Consumption waste is divided into waste that is generated as a result of the use of finished products for industrial purposes, and waste that is generated as a result of the use of finished products for cultural and household purposes.

Waste resources suitable for collection and use are wastes for which there is a recycling technology, and their disposal is economically feasible.

Secondary resources - this is the entire volume of waste generated in the national economy

Secondary polymers are part of the secondary resources that are formed in compact sources of their accumulation (markets, supermarkets, schools, etc.) and among the population. The structure of production, processing of polymers and the use of finished products from them includes the following stages: production of polymers; processing of polymers into finished products; distribution of finished products from polymers by directions of use; the use of polymer products in the national economy.

The technical and economic efficiency of the use of recycled polymeric raw materials depends on its technological properties, which can be largely preserved if its collection, storage and recycling are properly organized. The use of secondary polymer raw materials in the form of granules expands the raw material base of the regions.

There are several ways to process composites. Let's briefly characterize each of them.

Injection molding is a plastics processing method that consists in filling the mold cavity with a polymer melt under pressure and then fixing the shape of the product by cooling or curing it due to chemical reactions. This method processes thermoplastic, thermosetting polymers, thermoplastic elastomers and rubbers.

The injection molding process is widely used because it allows obtaining parts of complex shape with reinforcement, with elements of precise dimensions, and the production of three-dimensional parts can be controlled and predicted by injection molding more accurately than other methods.

The processing of polymeric materials on roll machines includes rolling, calendering, laminating, laminating, duplicating.

Rolling is a periodic or continuous process used for plasticizing, mixing and homogenizing, sheeting rubber, polymers and copolymers, various compositions based on them, as well as the introduction of various ingredients, such as: fillers, dyes and pigments, plasticizers, flame retardants, vulcanizing and other additives. This process consists in multiple passage of the polymer material through the gap between two hollow cylinders rotating towards each other.

Calendering is the process of forcing a polymeric material through a gap by heated hollow cylinders rotating towards each other, in which an endless sheet, roll material or molded product is formed.

In contrast to rolling, in calendering the polymer material passes through one gap between the rolls only once. To obtain the required surface texture and thickness of the calendered product, the polymer material is passed through several gaps. Depending on the purpose of the product and the type of material, the number of calender rolls can vary from 2 to 5.

Laminating is the process of obtaining rolled material by melting polymer granules or powder in an inter-roll gap and combining it with other films or a base on rolls of a laminating machine.

The production of multilayer roll materials is carried out on laminating machines. Laminating machines consist of rolls of various diameters and arrangements, in which there are melting, deflecting and duplicating rolls.

Lamination is the process of applying a polymer melt obtained on extrusion equipment from a flat die, in the form of a coating on various types of substrates (polymer films, fabrics, paper, cardboard, meshes) in the gap of the roll equipment. Laminators are used as such equipment. With the help of a laminator, duplication and laminating are carried out according to the thickness of the rolled material.

Duplication is the process of combining rolled and sheet materials of different nature under the influence of temperature and pressure. The gap between the rubber-coated roll and the heated polished calender roll receives the molded polymer material and another polymer material or base. Under the pressure of the rubberized roller and the effect of the temperature of the polished roller, the materials are combined.

Duplication can be done both with homogeneous materials having the same and different colors, and with various types of bases, such as paper, cardboard, felt, non-woven materials, mesh materials, fabrics.

Extrusion is a technological process for obtaining semi-finished products or products of various shapes by forcing a polymer melt through a forming head (die).

Thus, it can be concluded that there are several ways of processing composite materials and the choice of a specific processing method is determined based on the melt flow index.

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