MECHANISM OF MODIFICATION OF POLYMER WASTE

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ABSTRACT

Incineration in waste incinerators is not an economical method of disposal because it involves pre-sorting the waste. There is an irreversible loss of valuable chemical raw materials during combustion and pollution of the environment with harmful substances in the exhaust gases.

Keywords: *Pyrolysis, Friedel-Krafts, catalytic thermolysis, polycondensation, dimethyl terephthalate, ethylene glycol, Polyethylene terephthalate, composite materials.*

АННОТАЦИЯ

Сжигание в мусоросжигательных заводах не является экономичным методом утилизации, поскольку предполагает предварительную сортировку отходов. Происходит необратимая потеря ценного химического сырья при сжигании и загрязнении окружающей среды вредными веществами с выхлопными газами.

Ключевые слова: *Пиролиз, Фридель-Крафтс, каталитический термолиз, поликонденсация, диметилтерефталат, этиленгликоль, полиэтилентерефталат, композиционные материалы.*

INTRODUCTION

An important role in the processing of secondary polymer raw materials is given to thermal decomposition as a method of converting IPS into low molecular weight compounds. An important place among them belongs to pyrolysis. Pyrolysis is the thermal decomposition of organic matter to obtain useful products. At lower temperatures (up to 600 ° C) mainly liquid products are formed, and above 600 ° C gaseous products up to carbon black [3].

Pyrolysis of PVX with PE, PP and PS wastes in the presence of the Friedel-Krafts catalyst and when the mixture is treated with hydrogen at T = 350 ° C and pressures up to 30 atm allows the production of many valuable chemicals. products

with a yield of up to 45%, such as benzene, toluene, propane, cumene, alpha-methylstyrene, etc., as well as hydrogen chloride, methane, ethane, propane [4].

DISCUSSION AND RESULTS

Another method of converting recycled polymer raw materials is catalytic thermolysis, which involves the use of low temperatures. In some cases, soft regimes allow the production of monomers, for example, during the thermolysis of polyethylene terephthalate, polystyrene, etc., the monomers formed can be used as raw materials in polymerization and polycondensation processes. Rare monomers in the United States, dimethyl terephthalate and ethylene glycol are obtained from used polyethylene terephthalate containers, which are again used for the synthesis of polyethylene terephthalate of a certain molecular weight and structure required for glass production. From an economic and environmental point of view, the most optimal methods of recycling polymer raw materials are recycling and recycling into new types of materials and products. Re-application used packaging includes its return to the production cycle after collection and appropriate processing (washing, drying, etc. operations), as well as obtaining permission from the sanitary authorities for reuse in direct contact with food. This route is mainly suitable for Polyethylene terephthalate bottles [5].

Waste recycling is widespread in many countries around the world. Thus, mixed wastes from polymeric materials can be recycled and converted into products for various purposes (building panels, decorative materials, etc.). A national program has been adopted and is being implemented in the United States, where the use of polyethylene terephthalate containers is particularly high, according to which the recycling rate of PET bottles will increase by the beginning of the 21st century. 25-30% (compared to 9-10% in the early 90s). The program envisages the implementation of four stages: - organization of collection of used dishes from the population; - sorting of collected raw materials [6].

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The basis of waste recycling, for example, in Germany is the "Secondary System", which includes the sorting and processing of certain types of secondary raw materials, from which in the materials and packaging enterprises. To facilitate waste collection and recycling, a system has been set up to accept used packaging and recycle it with the Green Dot (Der Grune Punkt) environmental label [8]. This symbol indicates the recycling or reuse of this packaging and is given to specially selected packages, which is the basic principle of the Dual System. Typically, it undergoes modification to efficiently process polymers. There are the following methods of modification of polymers: - chemical. Physicochemical (introduction of various additives of organic nature, for example, technical lignins, incinerators, thermoplastic elastomers, waxes, etc.), creation of composite materials;

Physical (introduction of inorganic fillers: chalk, oxides, graphite, etc.) and technological (change of processing regimes). The introduction of polyorganosiloxanes together with the initial additives and subsequent homogenization of the processed raw material allows to recover very obsolete materials and restore the required level of their technological properties. Depending on the environment used and the mode of processing, graft copolymers or spatially structured systems are formed with the formation of siloxane crosslinkers. Their high strength in polysiloxanes and low molecular weight density provide elasticity of the material along with improved mechanical properties, thermal stability, weather and chemical resistance [9]. The mechanical properties of secondary polyacrylate from obsolete products can be significantly improved by heat treatment of raw materials with different heat-conducting agents (water, mineral oil, etc.) simultaneously with IR radiation. Heat treatment in the heat carrier is carried out according to the

principle of annealing and includes heating, holding and cooling operations. However, the level of physico-mechanical parameters is determined depending on the type of heat carrier, the mode of heat treatment and the drying time, which can range from 1.5 to 2.5 hours [10]. Most of the proposed methods are based on a radical chain mechanism of interaction between the active groups of the added additive or filler and the oxidized parts of the base polymer. Of all the available methods, composite materials from recycled polymer raw materials are of the greatest practical interest. One of the functional modifiers can serve as a natural polymer - lignin, which recycles pulp and paper waste and wood by hydrolysis. It is a metabolic product of wood and other plants accumulated during lignification in the middle layer and cell wall, accounting for 30% of its total mass (the remaining 70% is cellulose and hemicellulose) [11].

By its chemical nature, lignin belongs to polyfunctional phenols, which are the main class of polymer stabilizers, and has a sufficiently effective light and heat stabilizing effect on oxidized and oxidized polymers. During processing, polymers are exposed to high temperatures, shear stresses and oxidation, which leads to changes in the structure, technological and operational properties of the material. Thermal and thermal-oxidation processes have a decisive influence on the change in the structure of the material.

PVX is one of the most stable industrial carbon chain polymers. PVX decomposition reaction - dehydrochlorination already begins at temperatures above 100 ° C and at 160 ° C the reaction proceeds very rapidly. As a result of thermal oxidation of PVX, aggregative and deaggregative processes occur - cross-linking and destruction.

The destruction of PVX is accompanied by a change in the initial color of the polymer due to the formation of chromophore groups and a significant deterioration in physical, mechanical, dielectric and other performance properties. As a result of cross-linking, linear macromolecules are branched and eventually interconnected into three-dimensional structures; however, the solubility of the polymer and its processing ability are significantly impaired. In the case of plasticized PVX, cross-linking reduces the compatibility of the plasticizer with the polymer, increases the migration of the plasticizer, and irreversibly deteriorates the performance properties of the materials.

In addition to taking into account the impact of operating conditions and the frequency of recycling of secondary polymer materials, a reasonable ratio of waste and new raw materials in the composition intended for recycling should be evaluated.

When extruding products from mixed raw materials, there is a risk of rejection due to the stickiness of different solutions, so it is recommended to squeeze virgin and recycled PVX on different machines, but powdered PVX can almost always be mixed with recycled polymer. An important feature that determines the main capacity of PVX waste recycling (allowable processing time, service life of recycled material or product), as well as the need for additional strengthening of the stabilizing group is the thermal stability time. In some cases, it is recommended to use an abrasive tool to remove the damaged layer by processing the material into products no less than those derived from the original materials.

The pneumatic method is used to separate the polymer from the metal (wires, cables). In general, insulated plasticized PVX can be used as low voltage wire insulation or injection molded products. The experience of the milling industry, based on the use of the induction method for the removal of metal and mineral additives, can be applied to the method of separation by magnetic properties. To separate the aluminum foil from the thermoplastic, heating in water at a temperature of 95-100 ° C is used. To make labels or adhesives brittle, it is recommended to immerse unsuitable containers with labels in liquid nitrogen or oxygen at a temperature not exceeding -50 ° C, which allows them to be easily crushed and separated into a homogeneous material such as paper.

An energy-saving method for dry preparation of plastic waste using a densifier. The method is recommended for the processing of artificial leather (IR) waste, PVX linoleum and includes a number of technological operations: grinding, separation of textile fibers, plasticization, homogenization, compression and granulation; attachments can also be added. The lining fibers are separated three times - after grinding the first blade, after squeezing and after grinding the second blade. Injection molding produces a recyclable molding mass that still contains fibrous components that do not interfere with processing, but serve as a material-reinforcing filler. The issue of environmental protection is relevant in many countries around the world, and people understand that the environment cannot accept our waste indefinitely. Therefore, it remains for us to take a careful approach to solving this problem, reducing the amount of waste, recycling them as much as possible and obtaining secondary raw materials. If you pay attention to the amount of polymer waste in the modern world, it is very large, so you need to start recycling it.

Some entrepreneurs have enriched them by creating a profitable business in plastic recycling. The issue of recycling plastics and other polymers is in demand today in all the cities and villages where it is inhabited. Let’s take a look at how

polymers are processed, more specifically, what equipment is needed for this. It is important to understand that modern recycling lines are completely different technologies that were introduced decades ago. Many companies offer us a wide range of polymer processing equipment, but an aspiring entrepreneur should know which features are most important when purchasing. With the right processing equipment, you can significantly increase the profitability of your business and eliminate competitors.

CONCLUSION

Polymers are found in large quantities in our daily lives, which are the product of big cities. Plastic waste can be collected in the amount of several tons in one city. Most people don't even think about where ordinary plastic bottles or other polymer products in the landfill go. Theoretically, this does not bother anyone, although not everyone knows that plastic does not melt on its own, it will survive for centuries, gradually disintegrate and cause significant damage to the environment. Every day, the consumption of plastic-containing products, objects and solutions in the world is increasing, and it is difficult to imagine what will happen to the planet in 100-200 years if plastic waste is not recycled.

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