ABSTRACT

of the dissertation work of Kydyralyieva Aigul Shazhalievna on the topic "Development of technology for waste disposal of polypropylene, polyethylene terephthalate in order to obtain new composite polymer materials" submitted for the degree of Doctor of Philosophy (PhD) in the specialty 6D072100-"Chemical technology of organic substances"

The relevance of the topic. The problem of recycling recycled polypropylene is of particular importance due to the fact that a significant amount of polypropylene is formed when it is used as a container for bottling lubricating oils. In addition, substandard polypropylene is formed directly during its manufacture, and it also must be disposed of. Secondary polypropylene itself does not have noticeable physical and chemical properties, therefore one of the effective and cost-effective ways to improve its properties is to introduce various fillers of organic or inorganic origin into it. The introduction of fillers makes it possible to impart additional strength, electrical, thermophysical, chemical and other properties to composite materials. The introduction of modifiers into polypropylene makes it possible to increase the profitability of production by reducing the thickness of coating materials, which, with the correct selection of fillers, will have increased physical and mechanical characteristics.

Polyethylene terephthalate, which is part of the polymer composition developed in this dissertation, is a filler that practically does not have any chemical activity. It should be noted that the disposal of used products based on polyethylene terephthalate or plastic containers is also associated with serious costs, since the accumulation of this material in huge quantities annually leads to environmental pollution. Used plastic does not completely degrade, but breaks down into miniature segments, which in turn end up in soil and water horizons, thereby causing serious environmental damage to the environment.

In this dissertation, the problem of recycling secondary polymer materials polypropylene and polyethylene terephthalate is solved comprehensively by obtaining new materials for anticorrosion protection of petroleum and petroleum products storage facilities.

The purpose of the research is to develop a technology for recycling waste polypropylene and polyethylene terephthalate in order to obtain new composite polymer materials.

Research objectives are:

- selection of objects, research methods and provision of material base for research;
- obtaining composites in the melt based on polyethylene terephthalate, modified vermiculite and montmorillonite;
- technology for producing anticorrosion coating for oil storage tanks based on recycled polypropylene, polyethylene terephthalate and cotton tar;
- development of an anticorrosion coating composition based on recycled polypropylene, vegetable, mineral fillers and cotton soapstock;

- mathematical modeling of the main parameters of the process of obtaining an anticorrosion coating based on recycled polypropylene and polyethylene terephthalate;

- field testing of new composite anticorrosion coatings for petroleum and petroleum products storage facilities and assessment of their economic efficiency.

Objects and methods of research. The main objects of research were recycled polypropylene, polyethylene terephthalate, cotton tar and soapstock, sevilen, mineral fillers, as well as the resulting composite materials for anticorrosion coatings for petroleum and petroleum products storage facilities.

The experimental base for carrying out research in this dissertation includes physical, physico-chemical, and chemical methods, through which the properties of the initial components and final products were assessed. When performing experimental tasks and for the reliability of the results obtained, the following methods were used: analysis of variance; mechanical and rheological tests; testing of notched samples, optical microscopy; obtaining a mixture in an extruder, using IR and UV spectroscopy, light and electron microscopy.

Main provisions submitted for the defense:

1) Obtaining composites in the melt using polyethylene terephthalate based on modified vermiculite and montmorillonite; modified vermiculite at a concentration of more than 5% increases the strength of the composite;

2) The technology for obtaining a three-layer anticorrosion coating for oil storage tanks based on secondary polypropylene, polyethylene terephthalate and cotton tar, a polymer anticorrosion composition, includes components in the following composition, wt.%: sevilene - 10-12; secondary polypropylene – 18-20; gossypol resin - 10-15; crushed polyethylene terephthalate – 18-20; uayt -spirit - the rest;

3) Development of an anticorrosion coating composition based on secondary polypropylene, vegetable, mineral fillers and cotton soapstock. The formation of a complex of gossypol with sevilene at temperatures above 200°C occurs due to the carbonyl group of sevilene and the aldehyde group of gossypol at the site of the 8,8' carbon atom due to the formation of hydrogen bonds;

4) Mathematical optimization of the process of obtaining an anticorrosion coating based on secondary polypropylene and polyethylene terephthalate;

5) Anticorrosion coating based on secondary polypropylene, polyethylene terephthalate with the addition of cotton tar. The adhesion of the coating to the steel was 150 N/cm at a temperature of 20°C. The area of coating peeling after 30 days of testing at cathodic polarization of 1,5 volts was 0,60 - 0,80 cm^2. When the composite concentration is up to 10%, the surface relief changes and the uniformity of the coating is maintained;

6) Field testing of new composite materials, including anticorrosion coatings for the bottom of oil storage facilities and assessment of their economic efficiency. The production profit will be 46,604,000 tenge per year, profitability - 47%, provided that 10 jobs are created at this enterprise.

The main research results:

- technology for obtaining new composite polymeric materials by extrusion method with the participation of modified bentonite the Darbaza deposit, secondary polyethylene terephthalate and polypropylene, as well as vermiculite;

- results of physical, chemical and mechanical properties of materials based on the obtained polymer compositions for oil and petroleum products storage tanks;

- the composition of the resulting polymer coating to protect the bottom of oil storage tanks from corrosion and the possibility of obtaining new corrosion-resistant materials at a temperature of 200°C based on sevilen, secondary polypropylene, gossypol resin, secondary crushed polyethylene terephthalate and uayt -spirit;

- prescription modification of secondary polypropylene and polyethylene terephthalate with the addition of soapstock, tar, vegetable and mineral fillers. When adding tar, sevilen can bind with free fatty acids at the site of the vinyl acetate groups of sevilen, and in the case of soapstock, with the aldehyde groups of gossypol at the site of carbon atom 8,8' due to the formation of hydrogen bonds;

- anti-corrosion coating based on secondary polypropylene, polyethylene terephthalate and gossypol resin, whose adhesion to steel was 150 N/cm at a temperature of 20°C;

- Utility model patents: №7919 «Anticorrosion composition for the outer surface of an oil storage tank», №8044 «Method for producing polymer compositions using the polyethylene terephthalate waste stage»;

- mathematical modeling of the main parameters of the process of obtaining an anticorrosion coating based on secondary polypropylene and polyethylene terephthalate, assessing the economic efficiency of using the coating.

Justification of the novelty and importance of the results obtained:

- methods and technology for obtaining new composite polymer materials with waste disposal of polypropylene and polyethylene terephthalate have been developed;

- it has been established that modified vermiculite introduced into the polymer mixture in an amount of 1%-5% forms a composite of a combined structure; the amount of modified vermiculite in the composite increases the strength to a value of 1235 MPa;

- a polymer composition was obtained by modifying recycled polypropylene and polyethylene terephthalate. It has been shown that when modified with tar, a hydrogen bond is formed between the carbonyl groups of sevilene and the hydrogen of the carboxyl groups of fatty acids, and in the case of modification with soapstock, a bond is formed between the carbonyl groups of sevilene and the hydrogen of the aldehyde group of gossypol at carbon atom position 8,8[1].

- it was established that the adhesion of the composite to steel at a temperature of 20°C is 150 N/cm, the peeling area of the coating after 30 days of testing at cathodic polarization of 1,5 volts was 0,60-0,80 cm^2. An increase in the concentration of secondary polypropylene and cotton tar in the mixture by more

than 10% changes the surface topography and increases the roughness of the composite.

The theoretical and practical significance of the work. The theoretical significance lies in establishing the possibility of obtaining composite anticorrosion materials based on secondary polymer materials polypropylene and polyethylene terephthalate by modification. It has been established that with polymer modification in the presence of mineral fillers and cotton tar and sevilen, the resulting composite increases adhesion to the metal surface.

Recycling of secondary polymer materials polypropylene and polyethylene terephthalate in order to obtain new polymer composite materials is of practical importance for oil production and storage enterprises. Recycling waste polymer products based on secondary polypropylene and used polyethylene terephthalate will reduce the degree of environmental pollution and improve the environmental situation in the regions of Kazakhstan.

Compliance of the dissertation with the directions of scientific development or state programs. The dissertation work was carried out in accordance with the state budgetary Scientific Research B-22-03-05: on the topic «Development of methods and technologies for obtaining highly effective multifunctional gel-forming polyelectrolytes, surfactants, composite polymer materials based on industrial and household waste» NJSC «South Kazakhstan University M. Auezov», at the department «Technology of inorganic and petrochemical production».

The doctoral student's personal contribution to the preparation of each publication:

16 scientific papers were published on the topic of the dissertation, including in international scientific publications included in the Scopus database – 2 in journals recommended by the Committee for Quality Assurance in the Field of Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan – 3; in collections of international and republican conferences - 9 articles, 2 utility model patents were obtained.

1. In the article «Study of modification of sodium montmorillonite from the Darbazinsk deposit» in the «Rasayan Journal of Chemistry», research methods of Darbaza bentonite were carried out.

2. In the article «Technology for the production of composite polymer materials based jn recycled polypropylene and polyethhylene terephthalate with the addition of modified sodium montmorillonite» in the «Rasayan Journal of Chemistry», research results were obtained.

3. In the article «Anticorrosion coatings based on recycled polypropylene and fillers» in the journal «Oil and Gas», experimental data were obtained and discussed.

4. In the article «Production of elastomeric corona electrets for sealing groups of oilfield equipment» in the journal «Oil and Gas», experimental data were obtained and discussed.

5. In the article «Obtaining anti-corrosion compositions based on recycled polypropylene and polyethylene terephthalate» in the «Chemical journal of Kazakhstan», a discussion and experimental data were obtained.

The author's contribution to the preparation of each publication is given in the dissertation.

Structure and scope of the dissertation. The dissertation is presented on 117 pages, including 6 pages of appendices, contains 22 tables and 36 figures. The content of the dissertation consists of an introduction, literature review, objects and methods of research, research results, their discussion and conclusion.