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Research paper

Intellectual Property as Complex Innovation Projects Component

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Abstract

The materials presented the possibilities development of intellectual property complex innovation projects modern highly effective science-based problems of improving the use of wastes of different industries on a complex enterprise that can provide all its energy needs alone. Some features of the possibilities of solving evidence-based problems of development of mechanisms for identifying synergistic processes, their scientific justification improving the use of wastes of different industries on a complex enterprise. The problem of wastes utilization and recycling is present as complex synergetic processes research and analysis of energy- and resource saving processes for treatment of polymer wastes of various origin. The research focused on the study of issues such as the development of models of waste-modifying polymer. The investigation are focused in researching such problems as selection of scientific based methods of wastes to be utilized or recycled; the development of appropriated process flow sheets and choice of modifications additives and equipment for polymers waste recycling. The choice of appropriate plants with selected energy resources is very important for projects realization.

Keywords: *intellectual property, complex innovation projects, polymer waste, packaging, evidence-based methods, ecological safety, wastes conversion and recycling.*

1. Introduction

The process of further reforming and development of Ukrainian education is impossible without taking into account the peculiarities and some problems of the developed scientific and pedagogical experience [1–4].
Strengthening the competition for the right to be present with own product on the market of a particular production sector is a feature of modern industry [3–7].
At the same time, besides traditional material products intellectual property captures a significant place in the markets [8–11]. For the modern teaching methods, the availability of intellectual property objects is an obligatory component of the complex acquisition system by the methods of competence analysis of innovative industrial objects. First of all, it should be noted that at present intellectual property of Ukrainian higher educational establishments requires the provision of advanced competency-based education. The organization of qualitative education positively influences the intellectual potential of the state – Ukraine has a chance to actively join this process and conduct research in the development of standards, forms and methods of this education type [3, 12–15].
A major role is played by informatization of education and the priority of the education development is the introduction of modern information and communication technologies, which provide improvement of the educational process, accessibility and efficiency of education, preparation of the younger generation for life in the informative professional and social society [4, 16–19].
There is a problem of providing quality education for modern youth with the purpose of active participation in complex innovative interuniversity projects.
The main tasks in training organization are the creation and continuous updating of electronic courses, the development of didactic fundamentals of distance learning, and the training of coordinator teachers. The teacher has such duties as coordinating the cognitive process, adjusting the course, consultancy during the preparation of an individual curriculum, managing educational projects, etc. The teacher manages mutual assistance learning groups, assists students in their professional self-determination and development, for example, to identify literature [1–22].

2. The general statement of the problem and its connection with important scientific or practical tasks

To participate in complex innovative projects the student have the opportunity of free remote access to the university's internal network for getting consultations; information about the requirements for the reporting documentation; control classes; list of the recommended literature for the intellectual property(IP) creation. For example, the system of strategic management of IP objects represents an ordered set of interconnected elements that are in stable relations and ensure the functioning and development of these elements as a single whole.
Today it is needed to accentuate the clearest way to reflect the dialectic of scientific and pedagogical knowledge and the subse-

quent system of didactic principles groups, which are the basis for the learning process organization. It is a group of principles that determine the need of the ideological learning orientation.Their essence is that the content of training and participants activities in the educational process should allow to identify the methodology and to show it as the basis of getting the scientific knowledge and their application in practice of intellectual property documents issuing.

The researchers have shown that the prerequisite for the knowledge formation is the activity, in which performance and in which results analysis, the human psyche activates information about the essential reality properties and builds theirs model. Ensuring the necessary level of the identified projects management is also connected with the subsequent compliance of the received results with the proposed requirements to the articles and patents content. First of all, this is the definition of the work content and the division of the scope of the innovation project components results implementation – these are actions to correct the received scientific information data in terms of innovation.In order to improve the work on the students scientific and technical creativity in conducting complex projecting, one must take into account the main criteria and objectives of scientific research: the aim and its connection with important scientific and practical problems, in particular, with innovations in the student`s specialty field; an analysis of recent research and publications on the scientifically-based methods choice for the selected topic; allocation of unresolved parts of the general problem in the field of innovative research; clear formulation of goals in tasks for the topic development, taking into account the expansion of the study field; presentation of the main material of the received task with the full results justification and its graphical interpretation; conclusions from the work in order to identify the patentability of the development and its further implementation; organization of a seminar on studying techniques on the basis of NTU "KhPI" and others. To correctly identify the inventions, it is important to understand the content of the basic concepts that are used in the process of detecting inventions and in patent examination. The product as a technology object is a material object as a result of human activity. The process as a technology object is the action or set of actions done on products and other material objects with the help of at least one product and aimed achieving a certain technical result. This process particularly is the manufacture and processing of the product and controlling its quality, transforming matter, energy, data, measuring parameters, diagnosing, controlling the process that is the object of technology [1–6, 10–12].

The analysis of pedagogical literature allows to note some general tendency in approaches to the main didactic principles allocation and their classification by different researchers. Identification and definition of the hierarchy are obligatory components for developing the didactic principles of complex interuniversity projects: consciousness and activity; systemicity and consistency; scientific quality; accessibility; theory and practice relations etc. This tendency consists of attempts to reach the definition and formation of didactic principles as a result of the structural composition consideration of the pedagogy theory with taking into account the complexity of its object.

3. Presentation of the main research material with full justification of the received scientific results

The intellectual property objects have some general features, as well as significant differences, varying degrees and periods of legal protection. In our case, the results of intellectual activity are technical and technological problems solution; varieties of technical developments; knowledge and skills on ecological safety and legal norms of the selected developments, their economic efficiency in the chosen control systems, products manufacturing methods, software and other results of the mental process.In the development of interuniversity comprehensive projects with students in the chosen innovation spheres [1-6], it is necessary to significantly increase the requirements for the effectiveness of students' creative activity, to increase the role of creative relations between teachers and students in educational institutions, as well as new requirements for the amount of knowledge and content of training for graduates of higher education establishments. They should become the basis for the further independent work, give impetus to the student for an active individual creative process in intellectual activity (IA).

For example, lecturers conduct tasks structuring for students of different study fields, taking into account the overall purpose of the project; provide new forms of study like scientific articles and patents for use as an information source, as well as the results of experimental studies in the form of charts, illustrations, diagrams, presentations, etc.

The algorithm for the preparation and implementation cooperation of a complex project includes the following actions for the intellectual property objects further development: comprehension and analysis of the problem; search for possible solutions; generalization of the accumulated data and their analysis; obtaining of calculated dependencies, realization of calculations and analysis of the results; introduction as an innovative project component - all components cooperation and adaptation in the project.

From the results of the analytical, theoretical and experimental research we performed, it became known that the determination of the changes in the physico-chemical (1 1′), molecular (4), rheological (3 3′) and physical-mechanical (2 2′) properties gave some connections with the subsequent utilization of polymer container and packaging according to the functional scheme. (Figure 1).

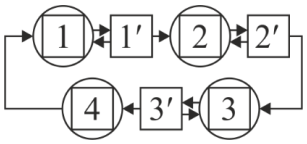

Fig. 1: Determining the changes in the container`s features and packaging during exploitation

It should be noted that polyethylene in the process of exploitation gains new features: we defined the quantity of oxygen-retaining groups: 1 – ester, 2 – carboxyl, 3 – hydroxyl; 4 – amount of gel fraction; δ_p – destructive stress during stretching; ε – the relative elongation at break which further in the processes of recycling, for example, polyethylene, gives the nonisothermicity of its melt, but also new synergetic features for obtaining secondary polymer materials. The problem of wastes utilization and recycling is present as complex research and analysis of energy- and resource saving processes for treatment of polymer wastes of various origin [3, 6, 10, 11].

The investigation are focused in researching such problems as organization of waste collection, transportation and identification of wastes according to adapted polymers classification (Figure 2–4); selection of scientific based methods of wastes to be utilized or recycled; the development of appropriated process flow sheets and choice of modifications additives and equipment for polymers waste recycling as renewable energy sources.

The choice of appropriate plants with selected energy resources is very important for projects realization [1–6, 11, 15–18]. It is clear that such waste requires the application of special scientifically-based methods of processing, specific in each case, taking into account the society interest in the polymer waste processing, as a factor in improving resource and energy conservation, as well as further development of the environmental safety [8-16]. It is also necessary to develop the society and state position about reducing the technogenic impact on the environment.

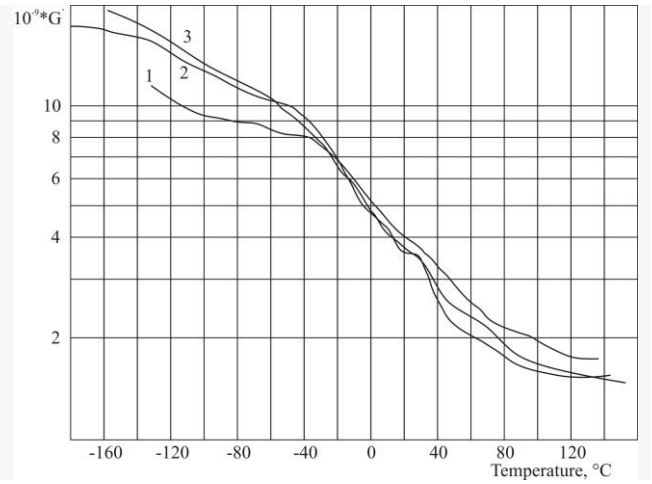

Fig. 2: $G' = f(T)$ dependence and recycled polyethylene with different amounts of gelfraction, %: 1 – 17; 2 – 34; 3 – 42

The research aimed to study such issues as the development of modern high-performance models of synergistic recycling-modification of polyolefin polymeric solid particles in order to produce innovative secondary polymers [7-13, 19-22] and the development of intellectual property objects.
The factors of choice were taken into account:

1) scientific justification of polymers identification, classification, recycling or utilization methods;
2) development of necessary technological schemes and equipment for the processing of polymer waste;
3) enterprises selection for utilization-modification types and energy resources for implementation of these design decisions.Each of the recycling cycles of the polymeric fraction of solid waste requires a scientifically based innovative approach, so we consider the solution of the recycling-modification of solid waste problem in the general case as a single complex of innovative projects requiring adequate management of integrated production [3, 6–12] taking into account the properties of raw materials at each stage.
With higher energy costs, buildings, transportation networks, and manufacturing would be redesigned to use less energy. A large portion of the transition to renewable energy will likely be accomplished not by providing new energy sources, but rather by redesigning systems to consume less energy. This would be spurred by the higher costs of renewable energy, since energy conservation is optimized where the marginal cost of energy conservation equals the marginal cost of renewable energy. To develop an object of intellectual property - a scientifically-based technology for the production of secondary raw materials or a stage of utilization-modification on its basis, it is necessary to study the changes in composition and structure, for example, of polyethylene, which occur during the process of primary processing and its use, especially as the result of prolonged exploitation of the pellicle (Figure 3, 4).

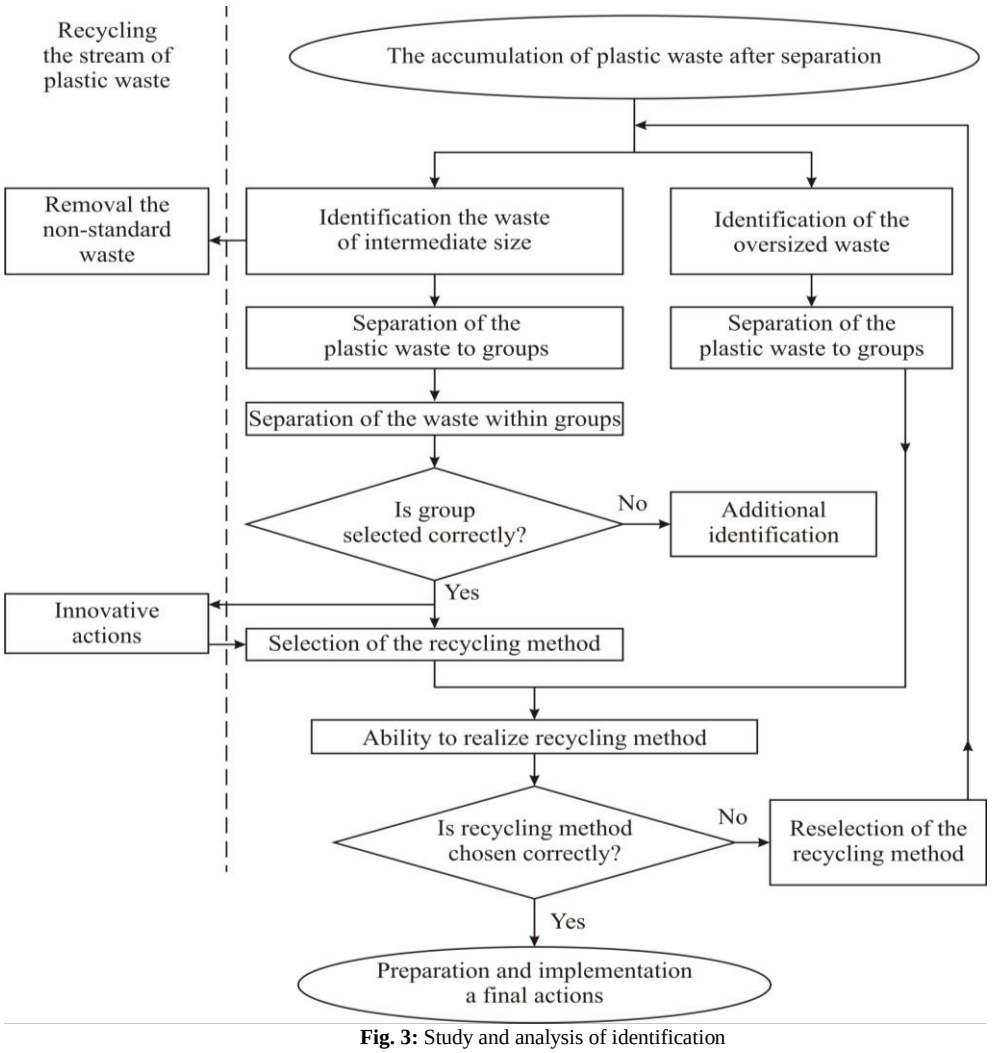

Fig. 3: Study and analysis of identification

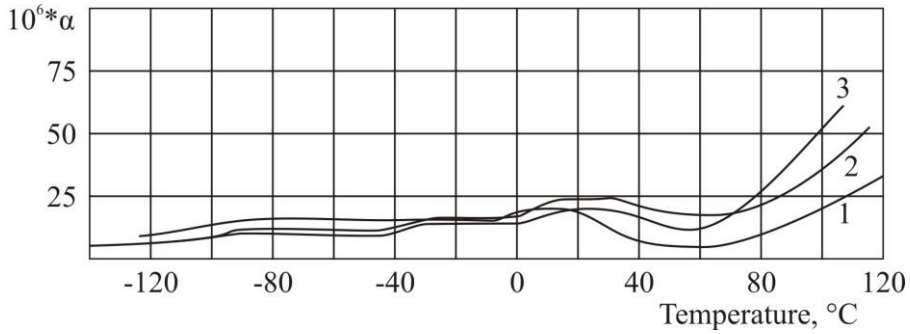

Fig. 4: $\alpha_T = f(T)$ dependence and recycled polyethylene with different amounts of gel fraction, %: 1 – 17; 2 – 34; 3 – 42

The efficient utilization of Polymer Solid Waste requires the synergetic study of processes in polymers during the use of original product and on the stage of its waste recycling. The approach to study the polymer degradation based on analysis of chemical reactions of photoconductive degradation in the polymer film is proposed. It enables to determine the properties of polymer after its use and develop the efficient technic of its recycling.

The development of recycling technic is demonstrated on examples of recycling the polyethylene film. The methods of polymer chemical foaming and injection moulding are considered. The influence of different factors on process intensity and quality of secondary polymer is investigated experimentally and correlations are obtained. It is enables to develop technologies of modern high-efficiency methods for the processing of polymer solid wastes into products in the industry (Figure 5, 6).

The synergetic processes of recycling and modification of the secondary polyethylene composition from the SB are studied according to the rheological curves (Figure 5: δ_s, Pa – shear stress; V_s, s^{-1} - shear rate). A characteristic feature is an almost directly proportional voltage dependence on the shear rate, which indicates the possibility of facilitating the processing of the material and allows it to be carried out in a wider range of technological parameters.

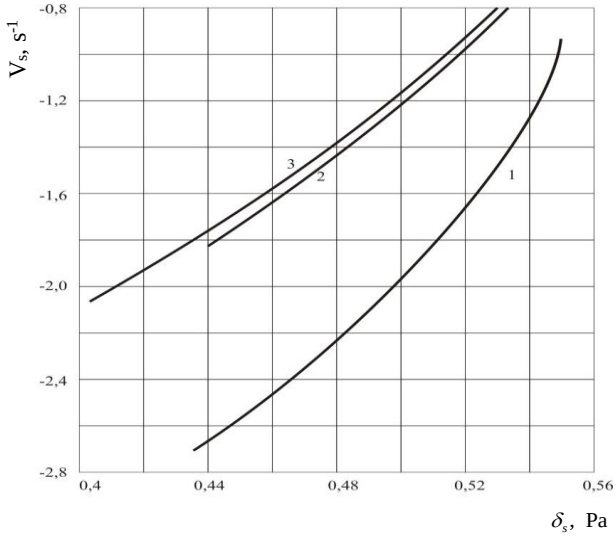

Fig. 5: The curves of compositions: 1 – SPE; 2 – SPE + 1 % SB; 3 – SPE + 2 % SB

Synergistic processes of recycling-modification (as component intellectual of complex innovation projects) of the composition of secondary polyethylene (SPE) with barium stearate (SB) were studied and analyzed by the change in

rheological curves presented in Fig. 6. A characteristic feature is the practically directly proportional dependence of the shear stress (τ = 0.4 ÷ 0.56 Pa) on the shear rate (D = -2.8 ÷ -0.8 s^{-1}), which indicates the possibility of facilitating material processing and allows it to be carried out in more wide range of technological parameters.

It was established a general increase in technological properties (P – productivity, %) with the introduction of a modifier (C – 0 – 5 %), which leads to an increase in productivity during the granulation process (Fig. 5), as well as to improving the quality of products.

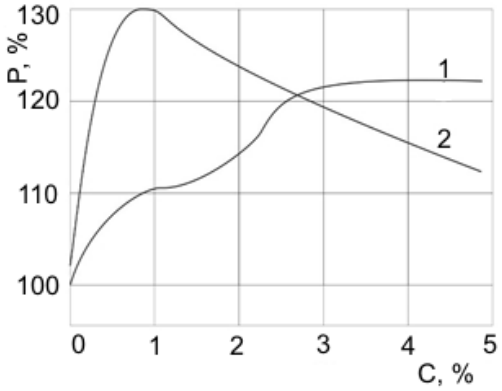

Fig. 6: The productivity of the granulation process of compositions: 1 – SPE + SB; 2 - SPE + polyethylhydrosiloxane

A characteristic feature of the intellectual property objects development for complex energy mix companies can be an integrated energy efficiency indicator, which means efficient (rational) use of all energy resources - taking into account solid household wastes (SHW) as secondary energy resources.

Investigation of the process of auto-oxidation of polyolefins during the exploitation [1, 3-6] is characterized by three stages:

- the induction period, which accompanies the stage of nucleation of the chains;
- the acceleration period, which corresponds to the growth stages of the chains;
- the deceleration period corresponding to the stage of the chain breaks.

The processes of the chains origin are associated with the emergence of radicals, here are the following opportunities in the stages:

1. Connection of oxygen molecules at the place of double bond and the following disintegration with the formation of hydroperoxide:

$$-CH_2-CH=CH-CH_2- \xrightarrow{O_2} -CH_2-\underset{\displaystyle O-O^{\cdot}}{CH}-CH-CH_2- \rightarrow$$
$$\rightarrow -CH_2-\underset{\displaystyle OOH}{CH}-CH=CH- \qquad (1)$$

hydroperoxide splits and forms:

$$ROOH \rightarrow RO^{\cdot} + {}^{\cdot}OH$$

2. Photoinitiation or absorption of a light quantum by a hydrogen atom in a tertiary carbon atom, followed by a cleavage of a hydrogen atom:

$$RH \xrightarrow{h\nu} RH^* \longrightarrow R^* + H^* \quad (1a)$$

3. Thermal initiation connected with the thermal break of the bond C-C or C-N. The presence of unsaturated groups in polyethylene molecules greatly accelerates the formation of primary radicals. Thermal initiation requires significant warming up.

The formation of the radicals R or RO_2 occurs with a constant K_1, and then the chain is growing in accordance with the rate constant of the oxidation reaction K_2 and K_3:

$$RH^* + O_2 \xrightarrow{K_2} RO_2^* \quad (2)$$

$$RO_2^* + RH \xrightarrow{K_3} ROOH + R^* \quad (3)$$

The chain break occurs in one of the following reactions in accordance with the constant of the rate of chemical reactions K_4, K_5 and K_6.

The oxygen addition to the radical R occurs extremely fast, with almost zero activation energy.

$$2R^* \xrightarrow{K_4} R\text{-}R \quad (4)$$

$$R^* + RO_2^* \xrightarrow{K_5} ROOR \quad (5)$$

$$2RO_2^* \xrightarrow{K_6} ROOR + O_2 \quad (6)$$

The radical RO_2 is much less active, it can be decided so by the time of the half-conversion of these radicals for $R^\bullet$ – 10^{-8}s and for $RO_2^\bullet$ – 10^{-2}s [84]. Therefore, with an excess of oxygen, the breakdown of the chain occurs almost exclusively in reaction $[RO_2^\bullet]$ $[R^\bullet]$ (6).

As a result of a monomolecular or bimolecular decomposition of hydroperoxide there is a secondary formation of radicals:

$$ROOH \xrightarrow{K_7} RO^* + OH^* \quad (7)$$

$$2ROOH \xrightarrow{K_8} RO^* + RO_2^* + H_2O \quad (8)$$

The peculiarity of this stage in terms of classification-identification of a polymeric solids particle has a great variety (Table 1 and 2) and emphasizes further conclusions in the intellectual property development. We have also developed a scientific strategy basis for the creation of intellectual property, taking into account the evolution and development of the interrelations between the synergistic processes of utilization and modification, the polymeric share of solid waste taking into account the stage of identification-classification.

To accomplish such tasks, we have analyzed the results of experimental [1, 4, 5] studies at different stages of the experiment on the study of the operation characteristics of polymeric container and packaging, and the characteristics of all components of the identification-classification of these processes are determined: the change of the structure of polymers in the exploitation

Table 1: Classification-identification of the polymeric fraction of solid waste

	Specific parameters within the specific class of the polymeric fraction of solid waste
1	Definition of highly specialized criteria for the collection organization and marking identification
2	Determination of the highly specialized features of polymer varieties after the completion of the exploitation process
3	Determination of new features of secondary polymers after the completion of operation processes
4	Determination of new methods for controlling the polymers features after the completion of operation processes
5	Determination of synergetic processes for secondary polymers of multiple recycling
6	Determination of synergetic processes for secondary recycling polymers
7	Definition of synergetic processes for secondary polymers with introduced additives-enhancers
8	Determination of synergetic processes for secondary polymers of foaming varieties
9	Definition of synergetic processes for secondary polymers from a polymers mixture
10	Determination of synergetic processes for secondary polymers from reactive layers
11	Determination of synergetic processes for secondary polymers from polymeric container and packaging
12	Determination of synergetic processes for secondary polymers as energy resources
13	Choice of scientifically-based synergetic directions and methods for the regions of Ukraine
14	Determination of boundary conditions for modeling and optimization of the above-mentioned synergetic processes
15	Definition of varieties of project effectiveness
16	Identification of intellectual property objects at the stage of large-scale collection of solid waste
17	Definition of intellectual property objects at the stage of identification-classification of solid waste
18	Definition of intellectual property objects at the stage of selection of synergetic processing processes
19	Definition of intellectual property objects at the stage of selection of synergy processes of utilization-modification

Table 2: Classification-identification of the polymeric fraction of solid waste

	Universal additional indicators for polymeric particles types of solid waste
1	Highly specialized inter-branch ties for target functions
2	Determination of structural changes in polymers after the processes of operation
3	Determination of new rheological features of polymers after the processes of operation
4	Determination of new physico-chemical properties of polymers after the exploitation
5	Determination of new physical and mechanical polymers features after the processes of exploitation
6	Determination of new thermophysical properties of polymers after the exploitation
7	Determination of the criteria for evaluation of new properties of polymers after operation processes
8	Determination of the secondary polymers range as the raw materials for the processing industry
9	Ecological safety for the new raw materials and energy resources
10	Management of the branches interconnection in synergetic directions and methods for Ukraine
11	Marketing of interconnections of branches of synergetic directions and methods for Ukraine
12	Social relations of synergetic directions and methods for Ukraine
13	Communicative relations depending on the factors of regional development
14	Public and life functions of secondary raw materials of regions, etc

The determination of the properties of polymers (special and universal) in the exploitation process and for secondary polymers, the hierarchy of synergistic recycling possibilities for products of the innovative range for different types of industries; possible effects on the human body during the exploitation; scientific substantiation choice of further processes of synergistic utilization-modification, etc. (Table 1 and 2).

Thus, it can be concluded that the specialists in the development of complex innovative projects should use different methods while making management decisions on the definition of intellectual property objects, which will achieve the stated goal: Establishing the need to study the main structural- chemical changes of polyolefins during oxidation. The methods of studying physical and chemical features in the process of exploitation of products from polyethylene have been developed and the lawfulness of changes in its operational characteristics has been revealed.

Such actions are also related to the conditions for increasing the economic efficiency of using solid household waste and waste from various industries on the complex enterprise that can provide all of its energy needs on its own.

The analysis of literary sources, which present the results of studying the effects of synergism in the technology of polymer processing, was made.

The scientific substantiation of modern approaches to the synergistic effects evaluation is considered: identification of changes in features in the process of exploitation of products from polymeric materials, analysis of the indicators of their features developed by us, and mechanisms for the formation of synergetic systems that solved complex innovative problems for the polymeric share of solid waste are analyzed.

Practical tasks of recipes compilation for utilization-modification stages, taking into account the innovative synergetic features of the new secondary polymer materials and selection of the technological processes parameters of their processing are optimized.

In practice, the principle of systematic and consistency of student learning is implemented by compliance with many rules of instruction, the most important of which are described below[23]. The use of logically structured schemes, plans and algorithms for the definition of intellectual property objects. It is necessary to divide the content of the material into logically completed parts. A fundamental disclosure and consideration of each issue and the plan point.

We must remember: what is elementary and simple in terms of definition and logic, it often turns out to be the most difficult for conscious assimilation.

The notes, structural and logical schemes of educational material that facilitate the process of learning knowledge learning should be done. It is needed to frequently repeat earlier assimilation to ensure systematic and consistent learning. Understanding the system requires logic, but its formation – feelings and emotions.

Concepts explain and incentives stimulate to action. At the end of the section or the course generalizations and systematization are compulsory. It is important to study and to become accustomed to a systematic analysis of own errors.

4. Conclusions and perspectives of further this direction development

Traditional technology of handling the polymer waste as a solid waste part already at the stage of collection does not give any possibility for the environmentally safe recycling into secondary material.

It does not meet even the sanitary and hygienic norms, and the processing into high-quality products does not work at all. Such problem defines intellectual property objects, methods of their research and final analysis for the purpose of utilization-modification or development of other processing methods for new fields of received products application.

The basis of environmental safety in the technology of handling such polymer waste is the creation of a new efficient, scientifically-based, low-waste or non-waste recycling technology that allows the production of target products for the chemical industry and energy, and only the products that make up the biosphere can be derived from the system.

Creating such technologies of intellectual property allows to solve two interrelated tasks:

1) ecological safety of solid waste part utilization, taking into account the resource and energy saving, and

2) economic expediency, taking into account social efficiency, which allows the intensive development of industry.

The results of the achievements are implemented in the hierarchy of identification-classification – the definition of the features change, chemical structure and construction of polyolefins in the processes of their operation under conditions for varieties of polyolefins – basic and applied research with scientifically grounded original innovative results has been performed.

Thus, it is possible to switch to the less primary energy resources use for the same buildings energy supply level or technological processes in the production. This field of knowledge is at the junction of technology and engineering.

Unlike energy saving, mainly aimed at reducing energy consumption, energy efficiency (energy utility) – is useful (efficient) energy consumption.

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