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PROBLEMS OF STANDARDIZATION FOR ENVIRONMENT PROTECTION AND RESOURCES CONSERVATION

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To determine the range of problems raised in this work, the Fig.1 presents schematically the main changes occurring in environment as a result of human activity.

The 'Environment' term is applied here instead of the conventional term "natural environment", for which anthropogeneous factors should be vanishing by definition. In fact, the real environment can no more be considered as exclusively natural. To demonstrate it, one can try to estimate the relation between natural and artificial parts in food, water, air, clothes we consume and in all other surrounding.

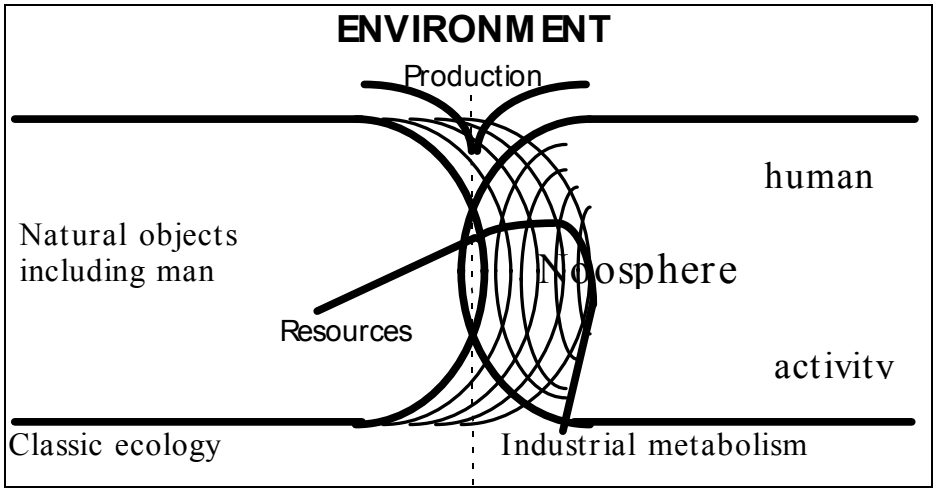

Fig.1. Environment changing as a result of human activity

Expansion of human activity area constantly changes mankind itself and all natural objects affected by its: the surface and bowels of the earth, atmosphere, hydrosphere, outer space... At the same time the other anthropogeneous part of environment, the informational space is expanded. The total result of such changes is formation of the noosphere. In the heaviest degree it is reflected in public awareness and public behaviour, where virtually only subconscious instincts have remained from initial natural environment.

Human activity is aimed to manufacturing products of natural and nonnatural resources to satisfy various demands of people. In the process, natural objects are transformed into fields, reserves, mining deposits, levees, channels, reservoirs, landfills etc. which are necessary for industry and vital activity.

The nowadays level of anthropogeneous changes in environment requires to revise many basic concepts. So, understanding of ecology after E. Heckel means small differences of environment from natural equilibrium, i.e. existence (coexistence) of any biogeocenoses, including mankind, in exclusive dependence on natural factors.

Fig.1 demonstrates us that laws of classic ecology no more extend on the whole environment. For the part of it represented on the right half of Fig.1, it is more appropriate to apply the concept of "industrial metabolism" which appeared in last years.

The concept "Sustainable Development" accepted in the Rio-92 Declaration implies refusal of the conception of "preservation of primeval nature".

Instead, the systems approach to interaction of humanity with environment is formed. On this basis, it is necessary to choose such variants of human progress (including all aspects of vital activity), which ensure subsequent sustainable development for all environmental objects. The alternative is

irreversible degeneration of environment as soon as in 30-50 years if today's tendencies of technological progress are preserved. In this case the statement of some environmentalists about urgent necessity to reduce the total number of mankind by 10 times, would appear not so shocking.

The concept of sustainable development is extended on environmental objects. In the sphere of human activity and resulting production the concept of ecological security is adequate. It is possible to arrange the main kinds of human activity on their degree of integrated ecological danger approximately as follows:.

- power production;
- industrial production (from mining to waste processing);
- agro-industrial complex;
- military activity;
- transportation;
- sphere of municipal and medical service;
- construction.

One can judge about symbiotic nature of development of the concepts "sustainable development" and "ecological safety" through an example of connection between medico-ecological knowledge about man and definition of safety labour conditions. It is easy to see complementary nature of development of these concepts in all aspects from science and laws up to particular technical regulations. The first example of such global approach is introduction in USA since 1997 the standard on processes safety management [1].

It is natural that the necessity for equilibrium of steady development and ecological safety (horizontally on Fig. 1) begins to reveal itself in economic sphere too. And the basic parity between cost of production and value of consumption is touched immediately. Under conditions of competition the so-called "ecologically clean" production today already enjoys advantages, but for the time being it is rather due to fashion. The valuations (in money terms) of all aspects of manufacturing and consumption of such kinds of production as pesticides, asbestos goods, automobiles and others [2] show that real cost of all consequences of production and appearance of this production in environment can surpass their today's market price in 2 orders and more. Therefore the immediate development of appropriate legal and technical norms is rather by urgent task.

The above-mentioned system development needs to find the solution of uniform ecological and resource problem which is displayed in environment with two main aspects:

- the level that human activity affects on environmental objects (along horizontal axis, Fig. 1) exceeding ecologically acceptable limits;
- fast exhausting and price rising of natural resources used to support vital activity and production (along vertical axis, Fig.1).

There has been accumulated significant experience in solving many separate tasks for different sides of this uniform problem, including standardization area, both on international and on national levels. Their detailed analysis cannot be set forth in the present work. Therefore it makes sense to draw up here only the main questions which would provide integrated approach of system of solutions and are in essence new.

The first systems requirement is obviously the necessity for maximum international harmonization of current researches, information systems, existing legislation and technical regulations, including standards [4]. Along with this target, it is necessary to solve two other tasks:

- all the created subsystems for standardization of parameters of environmental objects and requirements for ecological safety must have the possibility of their systematic mutual improvement and development;
- to provide the coordination of mentioned subsystems with development of standardization in resource consuming area (the next part of present work), and to create in this way the "Unified system of standards for environmental protection and conservation of resources".

Construction of such systems for the states of former USSR is considerably different from the existing legislation and standardization in Western countries. In contrast to e.g. USA, the laws on environment protection and resource consumption do not have direct action in these countries. Therefore so-called "ecological standards" are more independent part of the complex: environment justice → standards → direct regulations (codes, penalty regulations etc.). Hence, the system of standards and other technical regulations in this area has crucial significance for economic, information and all other aspects of environment management [5].

On the other hand, in the world practice any standards are a component of technical regulation system applied to products, services, processes and other actions and results of human activity. Therefore during creation of "ecological" standards, the already-formed usual approaches and standardization systems are used to the maximum. As an example, one can see the British standard [6] (which is a prototype of EC standard) in which the principles of construction of quality management systems are present explicitly.

After establishing of environment quality indexing system both at home and in global practice, the next step is to develop the regulation basis for declaring of all negative influences on environment by enterprises. The most clearly such approach is realized in [7]. In aggregate with standards of environment quality, declaration of environment pollution forms the basis for environment monitoring systems [8].

The main complexity in creation of efficient standardization system by the mentioned principles is to find realistic equilibrium between ecologically reasonable requirements and costs necessary for their realization [9,10]. On this reason both monitoring and system of declaring, being not in accordance with existing technology of human-nature interaction will be up in the air.

These complexities, in our opinion, also have another reason, that is, obvious underestimation of true material balance of conversions along the vertical axis of Fig. 1. But, generally these anthropogeneous conversions of matter and energy are decisive for equilibrium between sustainable development of environment and ecological safety of human activity.

At first, in the existing system of production for realization of purposes of human activity, only a rather small part of initial material resources (no more than 2% in nonferrous metallurgy) comes into final production (upwards along Fig.1 axis). As a result, tens of billions tons of industrial wastes are continuously generated in the world.

Secondly, production itself sooner or later is transformed into wastes of consumption, additionally expanding (in particular, by landfills) the anthropogeneous area in the middle part of Fig.1.

At last, thirdly, the ecological danger for environmental objects in most cases is not so much in main material products as in by-products of human activity and, partially, in created products which on any reason (toxicality, low quality, allergeneity) do not correspond to purpose function of this activity (vital, industrial, consuming).

Thus, the key aspect both for equilibrium on axis "sustainable development — ecological safety" and for solving problems on axes "resources — production — secondary resources" is the question of wastes in general.

Meanwhile, there exists not even standard definition of wastes. Contradictoriness of definitions in Basel convention, [11], [8] etc. is caused by approaches to determine wastes on different stages of their vital cycle, i.e. with reference to local tasks of ecology, statistics, resource conservation etc. On our opinion, the solution is in the fact that any waste (no matter what happens with it subsequently) has the certain process in which it is generated.

Until now these processes are beyond the field of vision or on second plan of environment management systems. But just in these processes of human activity are present virtually all anthropogeneous causes of environment instability. The same processes are the main sources of ecological danger.

On our opinion, to these processes of human activity and to their performers the main attention should be paid both in environment legislation, and in standardization area. This is the main part of environment management such as ecological monitoring systems, medical researches etc.

Proceeding on stated above, the following definition is given in the standard [12] and in draft of Ukrainian Law about wastes developed by us:

Wastes are material objects or substations being formed in processes of production and life activity, which have no determined compulsory applicability in the site of generation. Waste appear in environment as pollution, occupying in it a certain space and/or affecting negatively on other living and nonliving objects and substances, and, on the other hand, as material resources for possible use immediately after generation, or after proper processing.

The given definition puts genesis at the head of the list, instead of traditional consideration of wastes according to their later possible state and the role they will play subsequently in environment: sewage, discharges, exhausts, toxicants, secondary raw materials etc.

Under such definition of waste, when their processes of genesis became a global aspect of environment's state and further development, it is necessary to define the main principles of activity concerning wastes, including information about them.

According to [7], the main source of information about waste is the data on pollution declaring and monitoring, and only after that the estimation based on material balance is provided. On our opinion, **the principle of material balance** of the waste genesis process should be put in basis for the whole complex of requirements for forecasting of formation, revealing and collection of data on wastes. The necessity for such approach was earlier stated both in [11] and by developers of the USSR Standard ГОСТ 17.0.0.04-90 "Ecological Certificate of Enterprise". However, even the last edition of the European Waste Classifier of 12.10.93 and [14] do not contain any instructions on its realization.

The general outline of wastes circulation in environment is shown on Fig.2, whereas there were simply no wastes in primeval natural environment. Or rather, the thing that we would consider as waste, was an environment object just similar to any other.

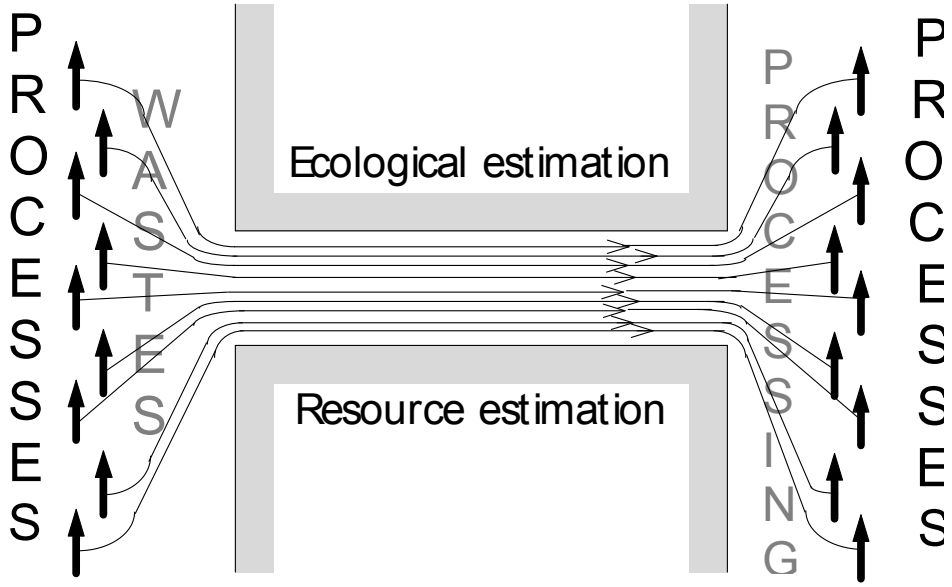

Fig.2. Scheme of total vital cycle of wastes in production and environment.

The processes of production, consumption and vital activity (the left-hand part of Fig.2) have nonnatural purpose functions. As a result, they generate the wastes which do not correspond to this purpose function in certain space-time intervals of such specific processes. As long as the amount and ecological danger of anthropogeneous wastes are low, the nature's "wastelessness" continues to act. However, as of ecological danger and resource deficit (violation of Sustainable Development) increase, it is necessary to create the new mechanism, substituting for natural "digesting" of wastes.

Up to now there exist two main directions in which the wastes are considered as separate objects of standardization as:

1. Secondary material resources regulated with appropriate technical documentation by supply services in industry and other kinds of activity (for example,standards ГОСТ 25916-83; ГОСТ 2787-75; ГОСТ 1639-78; Catalogue of secondary material resources of Main Computing Centre of USSR Supplying Committee, 1988; "Certificate of Waste Generated or Used on Enterprise"; "Technical (physico-chemical) Certificate of Waste" developed in 1990 by the Institute of Resource Conservation with the purpose of creation of Specialized data bank on secondary material resources etc.

2. Hazardous (potentially dangerous) pollution of environment according to ГОСТ 17.0.0.04-90, Basel Convention, [7] etc.

The necessity for systems approach uniting both directions [3] was present implicitly in basic standard [13] and in first edition of ГОСТ 17.0.0.04-90, however in subsequent development such approach was not implemented.

As it was said above, certification of waste should be made at its formation site. From the point of waste generator's view, there may exist only two kinds of activity with wastes:

- using (preventing of generation) directly at site of its formation as a result of technology changing or reusing of waste immediately in the process (for example, in petrochemical production);
- processing, which, as a rule, is connected with waste disposal, for which in [12] and the draft of Ukrainian law on wastes the following definition was given by us:

Waste processing is collection, transportation, separation, storage, neutralization, cleaning, treating, utilization, disposal, marketing and any other actions changing the state of waste, including all operations covered under paragraphs A and B of Annex 4 of the Basel Convention.

Thus, the waste is a raw material or a component of technology (right-hand part, Fig.2) both when it is used at its generation site, and when any other kind of processing (utilization, incineration, composting etc.) is used.

In Nature, "choosing" of kind of processing is determined only by thermodynamic parameters of environment. For conscious choosing of ecologically and economically optimal processing technology, one needs special knowledge about wastes as material (substance). This knowledge can be obtained when considering wastes of today's production and consumption as a new unknown class of materials which is the "dark side" of whole modern material science.

Therefore, according to the standard [12] which was developed by us (with participation of Russian Institute of Resource Conservation), revealing and mainly certification of wastes should be executed by the technologists - experts of production (or other kinds of activity) that is, the "parents" of waste.

The process of certification begins with local qualitative material balance of generation technologies in the point where these wastes (sewage, discharge etc.) are formed. According to [12] such primary analysis is performed by the form in Table 1 or appropriate special program of technologist's computer workstation.

Such beginning of certification immediately guarantees entering the wastes formed in any technological process, into the circle of certified initial components and final products of this process. Thus each substance (material) and technological process (operation, parameter) are taken into account together with current regulations (standards, rules etc.). Simultaneously this solves the task [7] of attaching waste to its primary source.

At the same time, if it is necessary to find out more about the waste's characteristic, then access to all primary information is always possible.

All this predetermines further certification of waste with use of standardized parameters of primary materials, technological processes and production (including units of their measurement and methods of control).

The scope of the next standard developed by us of above-mentioned Unified system of standards "Order of Wastes Revealing and Submission of Information Data about Wastes. General specifications" do not limit waste certification only by sphere of production.

ANNEX D *)
(compulsory)

Form for Representation of Data about the Process of Waste Generation

Starting materials		
Name of mater.	Code	Stand.
18	19	20

Processes by which wastes are generated						
Name Of the proc.	Stand.	Process parameter	Un. meas.	Value		
				min.	nom.	max.
21	22	23	24	25	26	27

Principal products and by-products of the process		
Name	Code	Stand.
28	29	30

Name and signature of the person who filled the form.

*) To be kept in the certificate filling site as primary documentation

It provides forecasting and revealing of wastes by requirements of [12] in all stages of vital cycle of production: from primary researches, through organization of its production, up to final conversion of production into wastes of consumption.

As a starting pulse of certification process, the local material balance at waste's generation site creates the conditions for solving more global tasks with the help of computer workstations. The computer joining of waste generation sites allows to trace material flows of production, from initial raw materials to output of final products, discharges, sewage and solid wastes of enterprise. This enables to return to ecological certification of enterprises as a whole on new qualitative level which was not completely possible by ГОСТ 17.0.0.04-90.

The further process of certification of revealed wastes regulated by [12] solves some of particular tasks mentioned in the text of standard. The major of them is definition for each waste its processing technology optimal in ecological and resource aspects. Such position is reflected in legislation of some countries [15], where the priority of any waste utilization prevails over its chemo-physical or mechanical destruction, mineralization, passivation or burying.

In fact, here is discussed the information-expert corresponding between set of wastes formed in particular processes, and the set of processes in which these wastes can be processed (see Fig.2). Obviously, such corresponding can be established only by one of the two ways: either on parameters of processes, or on parameters of wastes.

From Fig.2 one can see that the parameters of waste's genesis and processing (use) are far more distant from each other than the parameters of formed and processed waste. Besides that, the

technologies cannot be described only by the set of their parameters, because it is characterized also by the way of its realization. And, at last, by commercial reasons, any holder of technology will not enter in data base the comprehensive description of his technology with all its know-how.

The nowadays material science makes it possible to describe any waste at the necessary level of precision by a set of unified parameters of composition, aggregate state, structure, properties, classes of danger, economic, organoleptic and any other required characteristics. The criterion of completeness of such set of parameters is its sufficiency for founding at least one acceptable processing technology for certificated waste.

At the same time, this criterion shows, that each technology is also possible to be described by a set of requirements to the material to be processed by it (as a raw material or component). Actually, the whole existing system of logistics of production and consumption is based just on such kind of information.

Hence, the system of waste certification, as well as regional and industrial data banks about wastes and their processing technologies, should be constructed on the basis of waste parameter sets.

The forms of representation of data about waste (Table 2) and its processing technology (Table 3) in certificate [12], corresponding to main parts of standard files in data bases (DB), are presented below. It enables their further mutual search and raising precision. But if the waste description in DB is compulsory, new or already-existing DB on technologies can be constructed in any convenient way with additional information block by the mentioned principle.

Table 2

ДСТУ 2195-93 (ГОСТ17.0.0.05-93)

ANNEX E

(compulsory)

Form for representation of the waste characteristics

CHARACTERISTIC	Un. meas.	Available methods of measurement
31	32	33

Assumed parameter value	Method of measurement used
34	35

Param.affecting measuarment			Measured waste parameter values		
Name of par	Unit	Value	min.	nom.	max.
36	37	38	39	40	41

N o t e s
42

Name and signature of the person who filled the form.

Such description of wastes and their processing technologies requires specification of unified units of measurement and methods of control of parameters to reflect in the certificate real fields of values of each one of them unequivocally. The increase of reliability and completeness of the certificate should be helped by providing columns 33 and 34 (Table 2), which allows to separate reference information from actually received data.

The unified structure of data on wastes and technologies incorporated in the system of standards allows to create, possibly using object-oriented programming, computer workstations in enterprises and informational-expert systems (IES) on the regional and industrial level which are organized by the uniform principle. Exchange with standard DB files and their comparison allow to perform mutual search and estimation (ecological, resource, statistical one) of wastes, technologies, parameter sets, their control methods, enterprises, products of waste processing etc.

Table 3

ANNEX F

(compulsory)

Form for Representation of Data about Existing and Potential Waste Processing Technologies

General data		
Name of techn	Standard	Patents, other sources
43	44	45

Holder of technology		
Name, code	Mailing addr. phone, telex	Shipping terminal
46	47	48

Technology requirements on waste					
CHARACTE-RISTIC	Un. meas	Method of measurem.	Value		
			min.	nom.	max.
49	50	51	52	53	54

Final product data							
Name, code	Stanard (patent)	CHARACTE-RISTIC	Un. meas	Method Measurem	Value		
					min.	nom.	max.
55	56	57	58	59	60	61	62

Amount of processed waste	
Un.meas.	Qantity
63	64

Name and signature of the person who filled the form

However, realization of such approach for ecological-resource problem of wastes comes across two main complexities:

– large amounts of involved information, most part of which thereto is verbal, thus ambiguous and/or synonymous;

– lack of established cognitive connections between standardized objects (wastes), in contrast to all other kinds of human activity, in which the logic of concepts and terminology was established in a natural way as they were developed.

While these complexities remain unsolved, we will only fight against consequences of pollution instead of eliminating the cause of the ecologo-resource imbalance.

In our opinion, the solution consists in construction of such waste classification on genetic basis, which would ensure relationality of data about their origin, parameters, methods of control and waste processing technologies. At the same time it is necessary to create a thesaurus-like system enabling to use achievements of modern mathematical linguistics and terminology [16,17] for maximal unification of verbal part of the existing global and national levels of standardized terms.

The final realization of such solution should be regulated by special standard "Unified system of standards… Classification of wastes. General requirements". In 1993 the Subcommittee on Waste and their Processing of National Technical Committee for Standardization TC-82 "Environment Protection and Rational Using of Resources of Ukraine" headed by author of the present work has commenced development of such standard as a uniform base for system of national and a set of special waste classifiers for every branch of economical activity of Ukraine (and probably for all CIS countries).

Since consideration of all aspects of this task is impossible within the present article, for its logical completion let us concentrate on focal points of the proposed solution [18,19].

In the survey work [20] two main approaches to waste classification implemented today in [7,8,11,14 etc.] are resumed: on the base of special parameter sets or on the basis of dividing by economical activities. Their main defect (with a lot of advantages also used by us) is applying of the valid term "waste" as a basic element of the classification scheme. Actually the word "waste" is merely a fetish, using of which shows only that:

– given object (substation) does not correspond to the purpose function of the particular process of its formation (or it is known nothing at all about this process);

– structural state of this object is unknown;

– it is unknown what to do with this object further.

The waste classification proposed by us is based on the complete name of the waste, determined during its certification by [12], which corresponds to its condition and origin. In such a way we build three-dimensional information space for all data on wastes based on the following components: the standard name of the branch of activity; the standard name of technological process the waste was generated; the name of waste itself. Any kind of waste will take a certain cell or some topological set of cells in this space. The first and the second components of such space, as it seems, do not require principal clarifications, though a number of technical complexities needs special consideration.

The main principle of construction of the proper name of the waste is to allow using the word "waste" only when it is impossible to apply neither of meaning terms from the following classes:

1. Main terms determining the most general kinds of waste state: mixture, solution, aerosol etc. (total of 10 - 20 concepts in main world's languages).

2. Main special terms denoting particular structural condition of waste or its component like: slag, sediment, dust, sewage, dung… (total about 200 words, including some synonyms).

3. Standard names of materials (substances), in particular from the State System of Standard Data, from which the waste or its component which completely enough represent the waste and its component (for example, steel 40X, oil È20, polyethylene...) with possibility to add to such name

words like: substandard, polluted… The main mechanism of such kind of waste name definition is local qualitative material balance of the waste generation process pursuant to Table 1 from [12].

4. Special terms determining the name of waste as a derivative from the standard name of its formation process: derivative, by-product, fraction and so on.

All verbal information relating to waste's name, parameters, methods of control and technologies of processing, should pass examination and correction to eliminate or minimize ambiguity (synonymy) and to unify the used terms as much as possible. Such correcting is performed by sequential thesaurus improvements of concepts and terms usage with as possible higher rank of unification. It is realized as follows:

1. For each word entered into the corresponding column of the certificate, either directly or with help of preliminary morphological analysis, the definition of concept is proposed, which can be improved by the workstation operator or by the IES expert with the help of synonyms.

2. After clarification of the concept (possibly with several iterations) the system offeres to choose a unified term with the highest possible rank. In contrast to the usual two-level descriptor-ascriptor system, it is based on the following system of ranking:

– terms standardized on ISO level which have unambiguous concepts in all main world languages;

– terms standardized on levels of interstate agreements (of EC, CIS and so on);

– terms standardized on the national level;

– terms standardized on industrial branch level;

– terms on levels of local standard and other kinds of enterprise's documentation;

– terms from known sources of information;

– terms defined nowhere.

Comparison of results of realization of all stated above, already obtained by us and expected in near future, with the world's experience (e.g. [21]), shows that the offered uniform systems approach to standardization in areas of environment protection and rational use of resources can create necessary conditions for achievement of global equilibrium between Sustainable Development, ecological safety and rational using of resources in all main kinds of human activity.

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