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ONTOLOGICAL APPROACH TO THE DESCRIPTION OF THE RESERVOIR'S PASSPORT

Summary: *In this paper, an ontologized description of the ecological passport of reservoirs is proposed that allows grouping and combining all necessary data in one document for solving various ecological problems, in particular for planning environmental measures.*
Key words: *ontologized description; forecasting; ontograph; ecological passport; monitoring of surface reservoirs.*

Introduction

Today, society is increasingly using in its activities information on the state of the environment. This information is needed in everyday life of people, when running an economy, in extraordinary circumstances, etc. An important role in human life plays water. It is necessary to keep hydraulic engineering facilities in proper technical condition and ensure their reliable operation, in particular when passing spring and rain floods.

The objective of monitoring the reservoir (as well as other objects) is to obtain objective information on the state and development of measures to improve the environmental situation. Important is the issue of certification of water objects. With the help of certification you can evaluate the technical condition and to develop plans for the prevention of emergencies, recommendations for necessary precautions, etc. [1].

From the point of view of the world-wide practice, the passport is a comprehensive registration document, which contains information on the main parameters (area, volume, width, length, the presence of a dam, etc.), a unified set of basic data on water regime, physical and geographical features, use natural resources and the ecological state, as well as the development of recommendations for improving the sustainability of the ecological system [2].

The indicated information provides for the presence of a considerable amount of various data, for the systematization and structuring of which should be developed by the corresponding mathematical and methodical apparatus. At the same time, the scientific literature describes models that allow mathematically to describe certain components of the reservoir environment, but there are no complex tools that allow for the formalization of the description [3, 4].

The main part

Passport of Protected Object of Nature is a document in which the basic information about a particular object is recorded. In order to assess the ecological status of the river basin and to develop measures for the rational use and protection of water and the reproduction of water resources, the passport shall be developed in accordance with the procedure established by the Cabinet of Ministers of Ukraine.

Individualization of water objects is carried out the by means of passport. This is a set of state measures aimed at streamlining the use of water objects, protecting them from pollution, clogging and exhaustion, prevention of harmful effects on water and elimination of their consequences, improvement of the state of water objects.

The passport of the water object is developed in accordance with the Order of the Ministry of Ecology and Natural Resources of Ukraine "On Approval of the Procedure for the Development of the Passport of a Water Object" dated March 18, 2013, No. 99, and does not provide for a formalized description for computer.

The purpose of the work is to consider approaches to formalizing the description of the ecological passport of the reservoir on the basis of ontology, which allows to systematize and structure all necessary data for solving various problems, in particular for planning environmental measures.

Ontologized description of the reservoir passport

Passports that are developed by individual organizations are often subjective.

Single space of digital knowledge is not provided. Knowledge base describing environmental passports should include environmental concepts and their links. One of the effective approaches to describing such models is an ontological one, where in the knowledge base in the formalized form the knowledge of the subject field is presented. In ontological Knowledge base, the following requirements are taken into account [5]:

1. Computer ontology provides efficient machine processing of knowledge.
2. In contrast to the usual subjective approach to the design of knowledge base, the ontological approach involves rigid structuring of terms and concepts.
3. It is necessary to use means of support the automated construction of ontology.

The ontological aspects of the description of the reservoir passport include a range of issues: from the structuring of information and characteristics to the to communications of characteristics and measures to improve the ecological status of the reservoir.

The passport of the reservoir should include the following blocks: general information, hydrotechnical characteristics of the reservoir, information on the use of reservoirs for fish farming purposes:

General Information:

1. Name of the reservoir, year of creation.
2. Purpose of the reservoir (fish breeding, fishing, irrigation, water supply, etc.).
3. Filling of the reservoir (filled, deflated on a time, is withered, the dam is broken, etc.). From what time without water.
4. Location of the reservoir (among the village, arable land, in the meadow, in the forest, etc.), the catchment ground (black earth, loam, clay, forest, peat).
5. Pollution of the reservoir (wastewater or uncleanness), what types, what is the source of pollution.
6. Distance from the reservoir to agricultural facilities and to the nearest railway station or pier (name) in km.
7. The state of access roads to the reservoir in the spring and autumn.
8. Is there a fish farm in the area and the distance to it in km?

Morphometric and hydraulic engineering characteristics:

9. Form of the reservoir (round, oval, branched, rectangular, etc.).

10. The area of the reservoir, formed by filling water, ha, change in spring, low water.

11. Dimensions of the reservoir (length, width).

12. Depth of reservoirs (largest and medium).

13. The nature of the shores (high, low, steep, flattened, overgrown, swampy, shattered shores, landslides, etc.).

14. Nature of the coastline (equable, winding).

15. Is there an inflow and a runoff or not, permanent, temporary (keys, stream, river, atmospheric waters, etc.).

16. Is reservoir flooded with flood waters and on what time? Is reservoir connected with other reservoirs after the fall of the flood?

17. Is reservoir overgrown with the vegetation, what is exactly, what percentage of the area of overgrown, are there any islands?

18. Soils of the bottom of the reservoir and the degree of silting, the thickness of the layer of mud, the relief of the bottom (even, hollow, etc.).

19. What kind of fish is the usual in the pond (list) that prevails. Fish fattening, fish growth.

20. Is there a predator and garbage fish (pike, perch, etc.) in reservoir and during the flood?

21. Are there crayfish, mollusks in the reservoir?

22. Water quality (fresh, salty, is drinking by people, cattle, no one drinks). Water color. Whether it is noted whether the smell of hydrogen sulfide and to what extent (sharply, weakly).

23. Is there waterfowl in the reservoir and in what quantity?

24. What are the structures in the reservoir: the dam (its length, height, width), water runoff, drainage, pipe, etc. Their design and condition (wooden, stone, brick, working, old, damaged, filtering, etc.).

Information on the use of reservoirs for fish farming purposes:

25. Is it possible catches a fish in reservoir with a seine or other fishing gear, on which part is not catches a fish and for what reasons (pits, driftwood, thickets, etc.).

26. Is there fishing in the reservoir, catching fish, fishing gear and fishing season.

27. Number of fish per year. Specify which breeds are predominant in catches.

28. Is there fish mortality, when and what it is caused. Was it possible to spend the winter in the reservoir: carp, crucian carp.

29. Is it possible to lower a reservoir for fishing, without breaking other economic needs? What needs to be done for descent and how quickly the reservoir is filled after descent and from where.

30. Was the filling with fish with a carp or other fish, when and in what quantity? From which reservoir the fish was taken and what were the results?

Other information.

Accordingly, the part of the ontograph of the passport will look like (Fig. 1).

In addition, ontologized description of the passport of the reservoir contains measures to improve the ecological status of the reservoir.

Methods of wastewater treatment can be divided into mechanical, chemical, physico-chemical and biological, when they are used together, the method of purification and disposal of sewage is called combined [6–15].

The essence of the mechanical method is that mechanical impurities are removed from the sewage by means of settling and filtration. Particles, depending on the size,

are captured by lattices, sieves, sand trap, septic tanks, trap for pus, and surface contamination – oil trap, gasoline trap, sump, etc. Mechanical purification allows to separate from domestic wastewater to 60–75% of insoluble impurities, and from industrial – to 95%, many of which as valuable impurities are used in production.

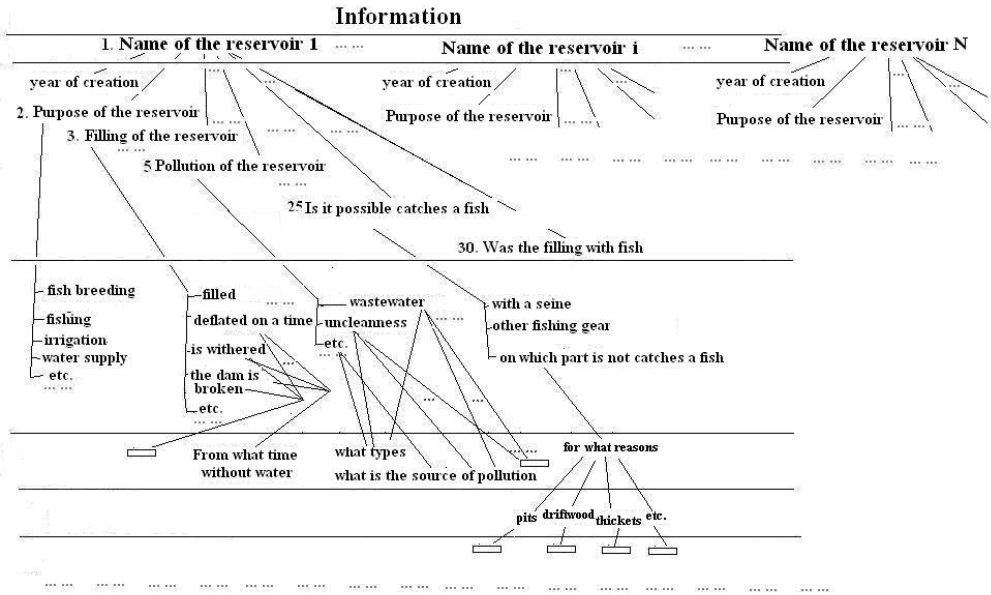

Fig. 1 – Fragment of ontograph "Information"

The chemical method consists in the fact that various chemical reagents are added to the waste water, which react with pollutants and enclose them in the form of insoluble precipitates. Chemical purification reduces insoluble impurities to 95% and soluble – up to 25%.

In the physico-chemical method of treatment from sewage, finely dispersed and dissolved inorganic impurities are removed and organic and badly oxidized substances are destroyed. Often, from physico-chemical methods, coagulation, oxidation, sorption, extraction, and the like are used. Electrolysis is also widely used. It consists in the destruction of organic substances in waste water and the extraction of metals, acids and other inorganic substances. Electrolytic cleaning is carried out in special structures – electrolyzers. The purification of sewage with electrolysis is effective at the lead and copper enterprises, in paintwork and in some other areas of industry.

Contaminated wastewater is also cleaned by ultrasound, ozone, ion-exchange resins and high pressure, good purification by chlorination.

Among the methods of wastewater treatment, an important role is played by the biological method, based on the use of regularities of biochemical and physiological self-purification of rivers and other reservoirs. There are several types of biological devices for sewage treatment: biofilters, biological pond and aero tanks. In aero tanks there is a purification of water by bioorganisms, whose vital activity is supported by the supply of oxygen.

Environmental rehabilitation of reservoirs includes:

– cleaning of the bed of reservoir from contaminated deposits;
– strengthening the bottom;
– accumulation and purification of drainage and storm water, which feed the reservoirs;
– reclamation of catchment areas;
– strengthening the shore;
– rehabilitation and improvement of floodplain territories;
– landscaping of coastal zones.

Environmental rehab consists of several stages:

1. Stages of preparatory work.

The study of hydrogeological characteristics of the reservoir, its morphological parameters (depth, relief of the bottom), sampling of water and sludge deposits for laboratory analysis on the subject of chemical contamination doing.

2. Stages of technical rehabilitation of the reservoir.

Depending on the size of the reservoir, the availability of hydrotechnical structures, hydrogeological characteristics of the area and a number of other circumstances, the need for mechanical cleaning of the reservoir from the sludge is determined.

3. Stage of biological rehabilitation.
4. Creation (restoration) of the coastal ecosystem.

Correctly located and formed coastal areas in many respects determine the qualitative composition of water in the future. Helps to form the natural landscape to provide a forage base of the biota of the reservoir. Restoration in the coastal zone of a certain type of green plantings and various living organisms favorably affects the ecosystem of reservoirs.

5. Complex improvement of the adjoining territory.

Recovery measures include artificial breeding and subsequent release into the habitat of fry, in the first place those species of fish that have suffered the greatest damage and whose populations either have already reached, or are at the border of the amount at which its self-recovery becomes impossible.

The next type of events considered is economic measures, one of which is the rational nature management. The use of nature in any field is based on the following principles:

– principle of system approach;
– principle of optimization of nature use;
– the principle of advancing;
– principle of harmonization of relations of nature and production;
– the principle of integrated use.

Let's briefly consider these principles.

The principle of a systematic approach involves a comprehensive assessment of the impact of production on the environment and its corresponding reactions. For example, rational use of irrigation increases the soil fertility, while at the same time it leads to the depletion of water resources. The discharge of pollutants in the reservoirs is assessed not only by the influence on the biota, but also determine the life cycle of water objects.

The principle of optimization of nature management is to make appropriate decisions on the use of natural resources and natural systems on the basis of simultaneous application of ecological and economic approaches, forecasting the development of various industries and geographical regions.

The principle of outspeeding up the production of raw materials by processing rates is based on reducing the amount of waste in the production process. It envisages the growth of products through more complete use of raw materials, resource conservation and technology improvement.

The principle of harmonization of relations of nature and production is based on the creation and exploitation of natural and man-made ecological and economic systems, representing a set of industries that provide high production rates. At the same time, maintaining an environmentally safe environment is ensured. The production has a management service for timely detection of harmful effects and adjustment of system components. For example, if a deterioration of the environment due to the production activity of the enterprise is detected, the management decides to suspend the process or reduce emissions and discharges. In such systems, prediction of unwanted situations is foreseen by monitoring.

The principle of integrated use of natural resources involves the creation of territorial production complexes based on existing raw materials and energy resources, which allow for a more complete use of these resources, while reducing the technogenic load on the environment. They have a specialization, concentrated in a certain territory, have a single industrial and social structure and jointly promote the protection of the natural environment. However, these complexes can also have a negative impact on the natural environment, but due to the complex use of resources, this effect is significantly reduced.

The measures necessary for improve the ecological status of the reservoir are also described by the relevant part of the ontograph of the passport (Fig. 2).

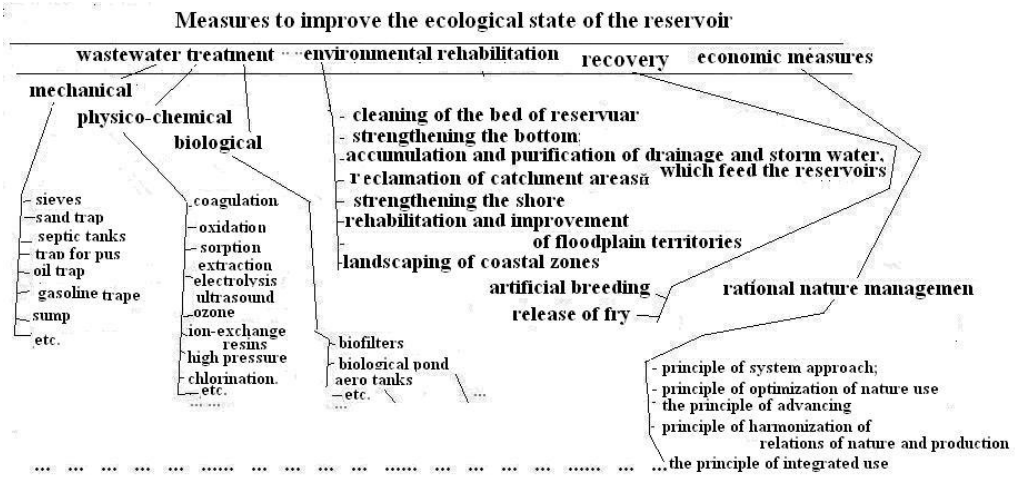

Fig. 2 – Fragment of the ontograph "Measures to improve the ecological state of the reservoir"

Applications of ontologized description of the passport.

Computer ontologies (KO) make it possible to solve a certain range of tasks:

– Analysis of the status of objects in order to develop recommendations for improvement environmental indicators and prevention of emergencies.

– Analysis of static and dynamic information about objects with the purpose of making recommendations for scheduled maintenance and (or) emergency repairs.

– Development of recommendations for optimization of maintenance processes.

The use of an ontological description of environmental problems and measures that are necessary to improve the ecological status allows us to take into account the linkages of problems and corresponding measures, which should increase the effectiveness of the recommendations and plan the measures for improving the ecological state.

An example is the planning of some measures in reservoirs to improve the ecological state. Notions of fragment ontograph "Information" (Fig. 1), which determine the ecological problem associated with those notions of the fragment of the ontograph "Measures to improve the ecological status of the reservoir" (Fig. 2), which can solve this problem (Fig. 3).

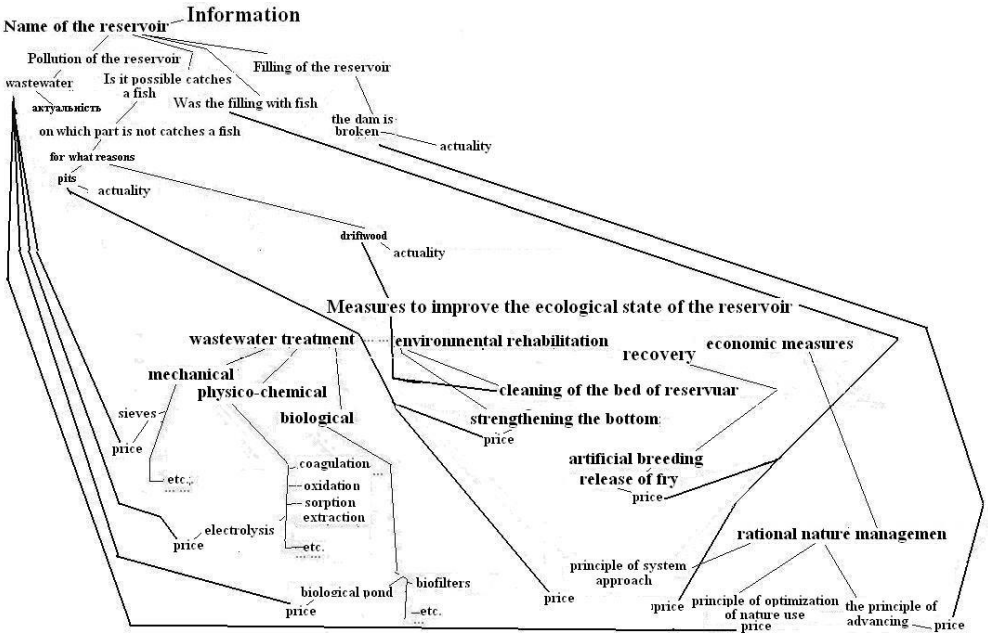

Fig. 3 – Communication concepts and measures

In Figure 3, such connections combine the notions of "waste waters", "pits", "driftwood", "ruptured dam" with the notions of "sieves", "electrolysis", "biological pond", "banding", "fry production", "the principle of integrated use", "the principle of optimizing the use of nature".

The interest of society in solving a specific ecological problem is reflected in the description of the concept of "relevance" which is associated with the concept defining the problem. This indicator corresponds to the degree of "maturity" of the problem (how clearly it is determined, how much it is necessary for society, how much society is ready to pay for it). financing in a certain period or priority can be of the decision of practical implementation of this characteristic. Specific data is contained in the description of ontology (in the description of the concept of "relevance").

For example, the notions of "ruptured dam" ontology with the threat of flooding of housing will be the first priority, as society is very interested in solving this problem. At the same time, the "Nature of the coastline" (the coefficient of winding) is what is unlikely to be a problem for society.

Each notion of the ontograph of measures that respond to environmental problems is a technical, scientific or economic opportunity to address these problems. The price of solving a specific environmental problem is reflected in the description of the concept of "price" which is associated with the notion of measure that solving problem. Consider more detailed planning of measures to reduce the pollution of reservoirs by sewage. Measures to improve the ecological state for this are expensive and time-consuming. Meaningless carry out all measures at the same time. Necessary is plan of development and implementation (ranking by the order of conducting, in particular – which to implement first).

From the computer ontology (ontologized description of the passport) in the automated mode selected notions that denote appropriate measures. The description of the concept of "price", which is connected with the concept "wastewaters" are doing analyzed. The ranking is performed in accordance with the fragment of the algorithm in Fig. 4. Using the graphical interface, an expert adjusts the ranking of events and determines waste waters one to enter first.

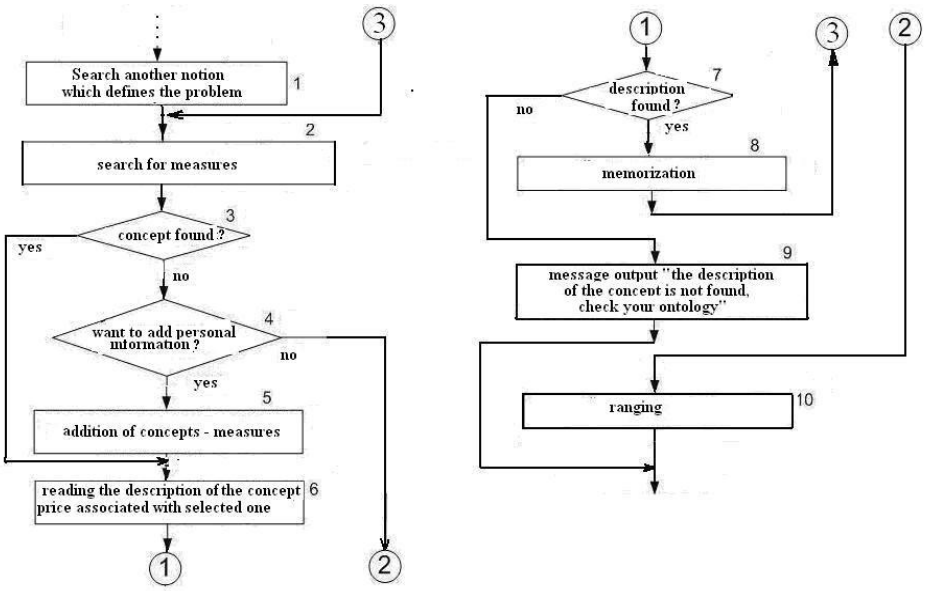

Fig. 4 – Fragment of the algorithm relating to the ranking of measures for a notion that defines an environmental problem

In block 1 in this example, the notion "waste waters" choosed.

In block 2 the following notion is sought – a measure associated with the chosen one.

In block 3 the situation when the notion is not found means that the list of measures for this problem is exhausted.

In blocks 4, 5 a dialogue and a window for introducing additional notion – measures are displayed.

In block 7, the situation when the description is not found requires updating the ontology, is displayed message in block 9.

Block 8 stores the notion – measure and the value of its price for further ranking.

In block 10, the ranking of concepts – measures on the difference "funding from the selected problem" – "price of the event".

Conclusions

An ontological approach to the description of the ecological passport of a reservoir, which uses computer ontologies, provides systematization of concepts, taking into account their interconnection and provides the opportunity to group and combine all necessary data in one document for solving various ecological tasks, in particular for planning of ecological measures. A similar approach can be used for planning in industry and other industries, including in education to plan e-course preparation.

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ОНТОЛОГІЧНИЙ ПІДХІД ДО ОПИСУ ПАСПОРТА ВОДОЙМИЩА

Анотація. У даній роботі пропонується онтологізований опис екологічного паспорта водоймищ, що дозволяє згрупувати і об'єднати всі необхідні дані в одному документі для вирішення різних екологічних завдань, зокрема для планування екологічних заходів.

Ключові слова: онтологізований опис; прогнозування; онтограф; екологічний паспорт; моніторинг поверхневих водойм; БЗ.

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