DOI: https://doi.org/10.31073/mivg202202-334
Available at (PDF): http://mivg.iwpim.com.ua/index.php/mivg/article/view/334
UDC 631.62:631.432:633.2

METHODICAL APPROACHES TO THE DETERMINATION OF EVALUATION CRITERIA AND SELECTION OF THE DESIGN OF ANTI-FILTRATION SCREENS OF RESERVOIRS

I.V. Voytovych[1], Ph.D. in Technical Sciences, O.P. Musyka[2], Ph.D. in Technical Sciences, Y.V. Shevchuk[3], O.S. Ignatova[4], G.Ya Boyko[5]

[1] Institute of Water Problems and Land Reclamation of the NAAS, 03022, Kyiv, Ukraine; https://orcid.org/0000-0002-1543-3955, e-mail: ivan.v.voytovich@gmail.com

[2] Institute of Water Problems and Land Reclamation of the NAAS, 03022, Kyiv, Ukraine; https://orcid.org/0000-0002-3388-3001, e-mail: muzyka_iwpim@ukr.net

[3] Institute of Water Problems and Land Reclamation of the NAAS, 03022, Kyiv, Ukraine; https://orcid.org/0000-0001-6718-3874, e-mail: yaroslav-shevchuk@ukr.net

[4] Institute of Water Problems and Land Reclamation of the NAAS, 03022, Kyiv, Ukraine; https://orcid.org/0000-0002-2074-4555, e-mail: ignatovaoks@ukr.net

[5] Institute of Water Problems and Land Reclamation of the NAAS, 03022, Kyiv, Ukraine; https://orcid.org/0000-0002-2710-8543, e-mail: boykoG7@gmail.com

Abstract. *The relevance of the issue is caused by the presence of significant (more than 20% of the normative indicators) filtration losses from most reservoirs built in Ukraine without anti-filtration protection. Based on the results of analytical and experimental field studies of the constructive elements of anti-filtration protection of reservoirs, calculations of structural parameters, and generalization of scientific research materials, the main areas and trends of improving screen structures of these reservoirs have been determined. It was established that the selection of the designs of anti-filtration screens is based on the optimization of the main indicators of the evaluation criteria of technically and economically expedient designs. The criteria for evaluating the anti-filtration protection design are filtration losses, filtration coefficient, coefficient of performance, coefficient of anti-filtration efficiency, filtering resistance of the structure, optimal parameters of the soil base (density and moisture) of different types of soils, an indicator of environmental safety, and technical and economic efficiency. Creating new types of designs of anti-filtration screens for reservoirs was justified, and the trends of their improvement were specified. Methodical approaches to the selection of optimal screen designs were developed. Prospective designs of anti-filtration screens of reservoirs when using the latest materials and modern technologies are proposed. The design parameters of anti-filtration screens of artificial reservoirs were established depending on the depth of their filling and the physical and mechanical properties of the soil of the reservoir bowl base. The economic efficiency of new types of designs of anti-filtration screens, compared to the traditional ones, is in reducing filtration losses and increasing the efficiency water reservoirs.*

Keywords**:** *reservoir, protective structures, filtration coefficient, methodology, methodical approaches, anti-filtration screen, types of screens*

Introduction. More than 350 large reservoirs were built in Ukraine. About 90% of them are not equipped with anti-filtration protection structures; which leads to significant losses of water as a result of filtration.

According to the "Irrigation and Drainage Strategy in Ukraine for the period up to 2030" [1], the restoration of existing irrigation systems in an area of 1.0–1.2 million hectares is planned. The implementation of this Strategy requires a significant amount of restoration, capital repair, reconstruction, and construction of artificial reservoirs and canals with high and reliable anti-filtration properties.

Analysis of the latest research and publications. The research shows [2; 3; 4] that the performance coefficient of the reservoirs in an earthen bowl is 0.77, and when using traditional anti-filtration protection it is 0.85, which does not correspond to the normative indicators according to SBS B.2.4–1–99 within 20% [5]. In this regard, the development of reliable anti-filtration structures of reservoir screens, which would ensure not only high anti-filtration efficiency but also high operational reliability and durability, is relevant.

In international practice, one of the modern ways of increasing anti-filtration efficiency is the use of geomembranes in combination with protective geosynthetic materials, which are used in Europe, the USA, and also in Ukraine [6; 7].

However, in Ukraine, their use is limited due to insufficient regulatory, methodological, and technical support for the use of these materials and technologies.

The purpose of the research is to analyze methodical approaches to the assessment of the technical condition of the designs of anti-filtration screens of reservoirs and to justify their promising types.

This goal can be realized following the working hypothesis of creating new types of anti-filtration screens in the form of a multilayer structure, which takes into account both the anti-filtration and protective functions of the screen and the base, which would allow combining the anti-filtration properties of new polymeric materials and the protective properties of geosynthetics and traditional local materials to ensure optimal waterproofing, strength, and reliability.

This especially applies to the latest materials and technologies, the use of which requires an update of methodological approaches regarding the determination of physical and mechanical properties, calculation and application of these materials in prospective designs of anti-filtration screens, evaluation of their criteria, selection, and justification.

Research materials and methods. Analytical and experimental field research methods were applied. The research methodology includes examination and assessment of the technical condition of anti-filtration screen structures of reservoirs under current requirements [8; 9]. To calculate the parameters of anti-filtration screen structures all types of loads during their construction and operation were taken into account. The values of filtration losses of different types of linings were obtained when monitoring the technical condition of the HTS on the main irrigation systems of Ukraine (Kakhovska, North-Rohachytska, Krasnoznamyanska, Inguletska, Danube-Dnistrovska, Nyzhnyodnistrovska), as well as hydrotechnical structures of the cascade of protective facilities of the Dnieper reservoirs (Orilska protective dam, Western-Kryukivska, and Verkhnyodniprovska dams) [9; 10].

Research results. In the course of the research, an assessment of the technical condition of anti-filtration screen structures of the reservoirs was carried out, the main types of damage were identified, and methodical approaches to the creation of new screen designs were developed.

It was established that the selection of anti-filtration screen designs is based on the optimization of the main indicators of the design evaluation criteria.

The following criteria for evaluating screen designs were considered: filtration losses, $Q_{обл.}$; filtration coefficient, $K_{обл.}$; performance coefficient, η; coefficient of anti-filtration efficiency, E; filtration resistance of the structure, $\Phi_{обл.}$; optimal parameters of the soil base: density (ρ_d) and moisture *(W)* for different types of soils; environmental safety factor; technical and economic efficiency [10].

Filtration losses. According to the data of long-term field studies carried out at the Institute of Water Problems and Land Reclamation, the filtration losses of various types of screens, which were widely implemented in the 50–80s of the last century on irrigation systems, were developed and evaluated, and by normative and methodical recommendations [10; 11], the filtration coefficients of linings were determined (Table 1).

It should be noted that the filtration losses of these structures vary from 0.0015 to 0.250 m^3/day from the reservoir bowl of 1 m^2. Monolithic concrete coatings with or without a film have the smallest filtration losses (filtration losses q = 0.0015 or 0.003 m^3/day from the reservoir bowl of 1 m^2). Coverings made of reinforced concrete NPK slabs have the largest losses, from q = 0.010 to 0.020 m^3/day from the reservoir bowl of 1 m^2. This also applies to the designs of anti-filtration screens of irrigation canals, which are practically identical in their technical and economic characteristics [7].

Filtration losses from reservoirs in an earthen bowl are 0.25–0.30 m^3/day from 1 m^2 of surface [13; 14].

However, the screen filtration coefficient is not a sufficient characteristic of efficiency, as it does not take into account the properties of the "screen-soil base" system, which makes it necessary to determine the anti-filtration efficiency coefficient, especially for the designs of anti-filtration screens of reservoirs.

Coefficient of anti-filtration efficiency. The anti-filtration efficiency of screens of various designs, regardless of soil conditions, is characterized by the coefficient of anti-filtration efficiency of the screen E [11]:

$$E = \frac{Q_{гр} - Q_{обл}}{Q_{гр}},$$

where $Q_{гр}$ – filtration losses from the reservoir in the earth bed, m^3/day; $Q_{обл}$ – filtration losses in reservoirs with a screen, m^3/day.

The coefficient of anti-filtration screen efficiency *(E)* takes into account the combined efficiency of the screen and the soil base and varies within $0 < E < 1$: $E = 1$ – there are no filtration losses (if there is a screen); $E = 0$ – filtration losses did not decrease after installing the screen.

The conducted research on determining the coefficient of anti-filtration efficiency led to the need to fundamentally change methodological

1. Filtering properties of screen linings of various designs

Lining type	Filtration losses *q*, m³/day from 1 m² of reservoir bowl	Filtration coefficient of lining, $K_{обл}$, m/s
Monolithic reinforced concrete of 0.12–0.15 m, loam preparation of 0.20 m, ρ_d = 1.67 g/cm³	0.009	2.35×10^{-8}
Monolithic reinforced concrete of 0.12–0.15 m, polyethylene film of 0.2 mm, loam preparation of 0.20 m, ρ_d = 1.67 g/cm³	0.002	5.23×10^{-9}
NPK slabs, polyethylene wide film of 8 m wide, loam preparation of 0.20 m, ρ_d = 1.67 g/cm³. Highly careful execution of work	0.004	8.24×10^{-9}
NPK slabs, polyethylene film of 3 m wide, loam preparation of 0.20 m, ρ_d = 1.67 g/cm³. Usual execution of works	0.020	4.36×10^{-8}
Monolithic reinforced concrete of 0.12–0.15 m, polyethylene film of 0.2 mm, loam preparation of 0.20 m, ρ_d = 1.67 g/cm³	0.0028	5.06 10-7
NPK slabs, polyethylene film of 3 m wide, loam preparation of 0.20 m, ρ_d = 1.67 g/cm³. Usual execution of work, pouring of cement mortar into the sub-slab space	0.010	1.8×10^{-8}
Monolithic concrete of 0.08 m, polyvinyl chloride film of 0.27 mm	0.0017	0.9×10^{-9}
Monolithic concrete of 0.08 m, polyethylene film of 0.25 mm	0.0024	1.62×10^{-9}
Monolithic concrete of 0.08 m, polyolefin film of 0.52 mm	0.0015	0.88×10^{-9}
Precast and monolithic (along the bottom with an outlet at 0.7 m of canal slope – monolithic reinforced concrete 0.14 m; on the slopes – NPK slabs), along the entire perimeter of the canal there is polyolefin film of 0.52 mm	0.003	2.08×10^{-9}
Precast and monolithic (similar design), polyvinyl chloride film of 0.27 mm	0.008	6.48×10^{-9}
Precast and monolithic (similar design), polyvinyl chloride film of 0.25 mm	0.015	1.38×10^{-8}
Reservoir without lining in loamy soils	0.250	–

approaches to the use of the latest materials, which would ensure the improvement of the quality of various types of screen structures (Table 2). This especially applies to the increase in filtration resistance when using the latest materials for lining structures, the dynamics of changes in the anti-filtration effect, and the assessment of the state of the structures during their operation.

It was established that, by the coefficient of anti-filtration efficiency, monolithic concrete

2. The coefficient of anti-filtration efficiency of various types of lining structures

Lining type	Coefficient of anti-filtration efficiency, *E*
Monolithic concrete lining, *t* = 0.12 m	0.94
Monolithic concrete, *t* = 0.15 m	0.90
Monolithic reinforced concrete *t* = 0.12–0.15 m, polyethylene film of 0.2 mm	0.90
Monolithic concrete *t* = 0.07 m, polyvinyl chloride film of 0.27 mm	0.87
Soil film lining (Geosynthetic materials)	0.85
Monolithic concrete lining, *t* = 0.07 m	0.84
Reinforced concrete slabs, 0.2 mm polyethylene film of 8 m wide	0.80
Polyolefin film of 0.52 mm, sand layer *t* = 0.38 m	0.70
Polyvinyl chloride film of 0.27 mm under a sand-gravel layer *t* = 0.38 m	0.60
Reinforced concrete slabs, cement-sand joints, polyethylene film of 0.4 mm	0.54
Polyethylene film of 0.52 mm under the sand-gravel layer *t* = 0.38 m	0.50
Reinforced concrete slabs with reinforcement outlets with a thickness of *t* = 0.08 m	0.40
Monolithic concrete *t* = 0.05 m	0.38
Precast fastening with plates, polyethylene film of 0.2 mm	0.35

anti-filtration coatings with or without a polymer film (E = 0.87–0.94) are the most effective ones among traditional screen designs. The precast reinforced concrete coatings (E = 0.35–0.40), which are used in hydrotechnical structures of the reclamation facilities of Ukraine, have the lowest anti-filtration efficiency [11; 12; 13; 14].

The main shortcomings of the structures were identified, the elimination of which requires improvement of the quality characteristics of the structural components of the screen structure and compatible work in general. To compare the filtration resistance parameters of different designs of screens, both traditional and modern designs were considered.

Filtration resistance of the structure. The anti-filtration effect of various screen designs is characterized by the value of the filtration resistance of the screen design $\Phi_{обл}$.

The filtration resistance of various designs of anti-filtration screens of reservoirs based on the research and analytical calculation data and analysis of the materials of design solutions is given in Table 3 [5; 10; 11].

Current building regulations in Ukraine CH 551–82 (Instructions for the design and construction of anti-filtration screens made of polyethylene film for artificial water bodies) is the only normative document that regulates the entire process of design and construction of film screens of traditional structures. The use of polymer films with a thickness of 0.2–0.4 mm provided by this document currently does not meet modern requirements for reliability, safety, and anti-filtration efficiency, and screen lining structures based on them are out-of-date. This is confirmed by the research materials of traditional structures of anti-filtration screens, which are currently subject to reconstruction and overhaul.

Recently, polymer geomembranes began to be used, which, compared to films, were developed and are widely used as anti-filtration screens on reservoirs. Based on field, laboratory, and theoretical (including analytical) studies, technical conditions, requirements, and recommendations for the use of polymer geomembranes along with geosynthetic materials have been developed.

When choosing optimal screen designs when using the latest geosynthetic materials, there is a need for normative provision and refinement of methodological approaches to the calculation and generalization of evaluation criteria, which will make it possible to perform the selection and justification of certain materials and types of structures.

It is proposed to use the coefficient of filtration losses and performance indicators as generalized criteria. They were used when calculating technical and economic indicators both for traditional and modern structures on reservoirs of reclamation and water management area. Table 4 shows the results of calculations of the assessment of the anti-filtration efficiency of screen designs (traditional and modern structures) by the above criteria.

Based on the results of the analysis of technical and economic indicators given in Table 4, it can be stated that the latest designs of anti-filtration screens when using geomembranes and protective geosynthetic materials increase the maximum service life by 1.5–2.0 times (up to

3. Filtration resistance of various designs of anti-filtration screens of reservoirs

Lining type	Filtration resistance $\Phi_{обл}$
Traditional designs	
Monolithic concrete, t = 0.15 m	95
Polyolefin film of 0.52 mm under precast monolithic concrete (along the bottom with an outlet at 0.7 m of canal slope – monolithic reinforced concrete of 0.14 m	80
Polyvinyl chloride film of 0.20 mm under precast monolithic concrete (the design of the concrete lining is similar to the previous one)	72
Polyethylene film of 0.25 mm under precast monolithic concrete (the design of the concrete lining is similar to the previous one)	36
Reinforced concrete slabs, polyethylene film of 0.2 mm, 8 m wide, loam preparation t = 0.2 m, ρ_d = 1.67 g/cm^3	65
The latest designs (structures of anti-filtration linings with the use of geosynthetic materials)	
Geomembrane with a protective coating made of concrete	96
Geomembrane with a protective coating made of soil	95
Geomembrane with a protective coating made of a stone coat	96
Geomembrane with a protective coating made of gabions and geogrids	96
Anti-filtration coating when using bentomats	97

4. Technical and economic indicators of various types of anti-filtration screen designs of reservoirs

№	Anti-filtration screens	Service life *t*, years	Reduction of filtration losses compared to an earthen bed *σ*, %
Traditional designs			
1	Monolithic concrete with polyethylene film of 0.2 mm thick	20–40	up to 95
2	Reinforced concrete monolithic with polyethylene film of 0.2 mm thick	30–40	up to 93
3	Precast monolithic reinforced concrete with polyethylene film of 0.2 mm thick	30–40	88
4	Precast reinforced concrete with polyethylene film of 0.2 mm thick	30–40	85
5	Asphalt concrete with a polyethylene film of 0.2 mm thick	5–10	90
6	Clay	10	70
7	Soil compaction	3–5	50
8	Soil colmatation	12–15	60
Latest designs			
9	Monolithic concrete with geomembrane of 0.4 mm thick at least	70–85	98
10	Reinforced concrete monolithic with geomembrane of 0.4 mm thick at least	70–85	92
11	Precast monolithic reinforced concrete with geomembrane of 0.4 mm thick at least, protected by geosynthetic material	70–80	98
12	Geomembrane with a protective soil layer, protected by geosynthetic material	80–90	97

90 years) compared to the traditional ones and reduce filtration losses by 1.5 times (96–98 %).

Conclusions

1. Based on the results of analytical and experimental studies on the assessment of the technical condition of hydrotechnical structures during their operation within the main irrigation systems of Ukraine, when using traditional designs of anti-filtration screens, it was established their being unable to provide effective anti-filtration protection, and the filtration losses at that exceed the standard indicators by an average of 20 %.

2. Based on the results of the research, the coefficient of filtration losses and performance indicators as generalized criteria for selection and justification of prospective designs of anti-filtration screens when using geomembranes and protective geosynthetic materials has been justified.

3. The use of the proposed methodical approaches to the selection and justification of promising designs of anti-filtration linings enables to increase in the anti-filtration capacity of the screens by 1,5 times as well as their service life up to 90 years.

References

1. Stratehia sroshennia ta drenazhu v Ukraini na perid do 2030 roku – [Irrigation and drainage strategy in Ukraine for the period until 2030]. (2019). Cabinet of Ministers of Ukraine. Skhvaleno Kabinetom Ministriv Ukrainy, 14.08.2019, №688-r. https://zakon.rada.gov.ua/laws/show/688-2019-%D1%80#Text [in Ukrainian]

2. Alimov, A.G., & Ivanov, V.M. (1977). Rezul'taty opredelenija poter vody na fil'traciju cherez monolitnuju betonnuju oblicovku pri razlichnom podpore gruntovyh vod – [Results of determination of water losses due to filtration through a monolithic concrete lining with different ground water support]. Volgograd : Volgogiprovodhoz. [in Ukrainian]

3. Vasil'ev, S.V. (1970). Metody fil'tracionnyh raschetov gidromeliorativnyh system – [Methods of filtration calculations of hydromelioration systems]. Moskva : Kolos. [in Russian]

4. Kosichenko, Ju.M., & Baev, O.A. (2014). Protivofil'tracionnoe pokrytie iz geosinteticheskih materialov – [Anti-filtration coating made of geosynthetic materials]. Novocherkassk : RosNIIPM. [in Russian]

5. Metodyka otsinky tekhnichnoho stanu kanaliv melioratyvnykh system – [Techniques for assessing the technical condition of canals of reclamation systems]. (2009). Posibnyk do DBN V.2.4-1-99 Melioratyvni systemy ta sporudy – [Guide to DBN V.2.4-1-99 Reclamation systems and structures.]. Kyiv : DP Informatsiino-analitychne ahentstvo. [in Ukrainian]

6. Glebov, V.D., & Lysenko, V.P. (1977). Osnovnye rezul'taty issledovanij plenochnyh jekranov vo VNIIGe im. B.E. Vedeneeva. Trudy koordinacionnyh soveshhanij po gidrotehnike VNIIG im. B.E. Vedeneeva – [The main results of research on film screens at VNIIG named after B.E. Vedeneeva // Proceedings of coordination meetings on hydraulic engineering VNIIG named after B.E. Vedeneeva]. Vyp. 114. 157–162. [in Russian]

7. Rekomendacii po proektirovaniju protivofil'tracionnyh ustrojstv iz polimernyh materialov – [Recommendations for the design of anti-filtration devices from polymer materials. OJSC VNIIG named after B.G. Vedeneeva] (1999). OAO «VNIIG im. B.G. Vedeneeva», SPb NII AKH im. K.D. Panfilova, OOO «Gidrokor»-SPb. [in Ukrainian]

8. Metodyka provedennia naturnykh obstezhen zemlianykh hrebel i zakhysnykh damb vodohospodarskoho pryznachennia – [Methodology for field surveys of earthen dams and protective dams for water management purposes]. (2003). Posibnyk do VBN V.2.4-33-2.3-03-2000 Rehuliuvannia rusel richok. Normy proektuvannia – [Guide to VBN V.2.4-33-2.3-03-2000 Regulation of riverbeds. Design standards]. Kyiv. [in Russian]

9. Dekhtiar, O.O., Kovalenko, O.V., & Briuzghina, N.D. (2018). Otsiniuvannia tekhnichnoho stanu obiektiv inzhenernoi infrastruktury melioratyvnykh system – [Assessment of the technical condition of engineering infrastructure objects of reclamation systems]. *Melioratsiia i vodne hospodarstvo*. Vyp. 107. 102–107. DOI: 10.31073/mivg201801-106 [in Ukrainian]

10. Proektuvannia protyfiltratsiinykh oblytsiuvan i kriplen kanaliv zroshuvalnykh system – [Design of anti-filtration linings and fastenings of channels of irrigation systems]. (2006). Posibnyk do DBN V.2.4-1-99 Melioratyvni systemy ta sporudy – [Guide to DBN V.2.4-1-99 Reclamation systems and structures]. Kyiv : Informatsiino-vydavnychyi tsentr Derzhkomstatu Ukrainy. [in Ukrainian]

11. Metodyka vyznachennia filtratsiinykh vtrat vody iz kanaliv i vodoskhovyshch – [Methodology for determining filtration losses of water from canals and reservoirs] (2013). Kyiv : IVPiM NAAN. [in Ukrainian]

12. Romashchenko, M.I., Yatsiuk, M.V., Voitovych, I.V. (2019). Otsinka tekhnichnoho stanu zakhysnykh gruntovykh damb vodoskhovyshch i richok Ukrainy. Proekt "Stvorennia systemy poperedzhennia pro nadzvychaini sytuatsii ta rozroblennia planu dii dlia upravlinnia ryzykamy zemlianykh hrebel u baseini richky Kura" – [Assessment of the technical condition of protective soil dams of reservoirs and rivers of Ukraine. Project "Creation of an emergency warning system and development of an action plan for risk management of earthen dams in the Kura River Basin"] Mizhnarodna naukovo-praktychna konferentsiia, Tbilisi. [in Ukrainian]

13. Voitovych, I.V., Dekhtiar, O.O., Boiko, H.Ya., Shevchuk, Ya.V. (2020). Otsinka stanu vodoim ta rozrobka tekhnichnykh rishen yikh vidnovlennia – [Assessment of the state of reservoirs and development of technical solutions for their restoration]. Suchasni tekhnolohii ta dosiahnennia inzhenernykh nauk v haluzi hidrotekhnichnoho budivnytstva ta vodnoi inzhenerii – [Modern technologies and achievements of engineering sciences in the field of hydraulic construction and water engineering] : II Mizhnarodna naukovo-praktychna konferentsiia. Kherson. 11–16. [in Ukrainian]

14. Voitovych, I.V., Shevchuk, Ya.V., & Ihnatova, O.S. (2020). Otsinka tekhnichnoho stanu oblytsiuvan zroshuvalnykh kanaliv – [Assessment of the technical condition of linings of irrigation canals]. Suchasni tekhnolohii ta dosiahnennia inzhenernykh nauk v haluzi hidrotekhnichnoho budivnytstva ta vodnoi inzhenerii – [Modern technologies and achievements of engineering sciences in the field of hydraulic construction and water engineering] : II Mizhnarodna naukovo-praktychna konferentsiia. Kherson. 29–35. [in Ukrainian]

УДК 631.62:631.432:633.2

МЕТОДИЧНІ ПІДХОДИ ДО ВИЗНАЧЕННЯ КРИТЕРІЇВ ОЦІНЮВАННЯ ТА ВИБОРУ КОНСТРУКЦІЙ ПРОТИФІЛЬТРАЦІЙНИХ ЕКРАНІВ ВОДОЙМ

І.В. Войтович[1], канд. техн. наук, О.П. Музика[2], канд. техн. наук, Я.В. Шевчук[3], О.С. Ігнатова[4], Г.Я. Бойко[5]

[1] Інститут водних проблем і меліорації НААН, 03022, м. Київ, Україна
https://orcid.org/0000-0002-1543-3955, e-mail: ivan.v.voytovich@gmail.com
[2] Інститут водних проблем і меліорації НААН, 03022, м. Київ, Україна
https://orcid.org/0000-0002-3388-3001, e-mail: muzyka_iwpim@ukr.net
[3] Інститут водних проблем і меліорації НААН, 03022, м. Київ, Україна
https://orcid.org/0000-0001-6718-3874, e-mail: yaroslav-shevchuk@ukr.net
[4] Інститут водних проблем і меліорації НААН, 03022, м. Київ, Україна
https://orcid.org/0000-0002-2074-4555, e-mail: ignatovaoks@ukr.net
[5] Інститут водних проблем і меліорації НААН, 03022, м. Київ, Україна
https://orcid.org/0000-0002-2710-8543, e-m ail: boykoG7@gmail.com

Анотація. *Актуальність питання викликана наявністю значних, понад 20 % від нормативних, фільтраційних втрат з більшості водойм, побудованих в Україні без протифільтраційного захисту. За результатами аналітичних та експериментально-польових досліджень конструктивних елементів протифільтраційного захисту водойм, розрахунків параметрів конструкцій та узагальнення матеріалів наукових досліджень визначено основні напрями і тенденції удосконалення конструкцій екранів цих водойм. Встановлено, що вибір конструкцій протифільтраційних екранів базується на оптимізації основних показників критеріїв оцінювання технічно й економічно доцільних конструкцій. За критерії оцінювання конструкції протифільтраційного захисту прийнято: фільтраційні втрати; коефіцієнт фільтрації; коефіцієнт корисної дії; коефіцієнт протифільтраційної ефективності; фільтраційний опір конструкції; оптимальні параметри ґрунтової основи (щільність і вологість) різних типів ґрунтів; показник екологічної безпеки; техніко-економічна ефективність. Обґрунтовано можливість створення нових типів конструкцій протифільтраційних екранів водойм та встановлено тенденції їх удосконалення. Сформовано методичні підходи щодо вибору оптимальних конструкцій екранів. Запропоновано перспективні конструкції протифільтраційних екранів водойм із використанням новітніх матеріалів та сучасних технологій. Встановлено конструктивні параметри протифільтраційних екранів штучних водойм залежно від глибини їх наповнення та фізико-механічних властивостей грунтів основи чаші водойми. Економічна ефективність нових типів конструкцій протифільтраційних екранів, порівняно з традиційними, полягає у зменшенні фільтраційних втрат та підвищенні коефіцієнта корисної дії водойм.*

Ключові слова: *водойма, захисні конструкції, коефіцієнт фільтрації, методика, методичні підходи, протифільтраційний екран, типи екранів*