

**ANALYSIS OF MODERN SCIENTIFIC AND PRACTICAL RESEARCH IN THE FIELD OF WATER DISTRIBUTION SYSTEM**

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**Abstract.** Solving the problem of ensuring the reliable functioning of drainage systems is important not only for Ukraine, but also for scientists around the world. Since these systems are critically important for life support, their uninterrupted operation is of strategic national importance. The issue of preservation and restoration of existing underground communications is gaining particular relevance due to increased environmental requirements. To protect groundwater from contamination with aggressive reagents, it is important to understand the reasons for the destruction of underground communications structures and effective methods of their repair. The article analyzes scientific works related to the problems of ensuring the trouble-free operation of objects that are part of the complex of constructions of sewer tunnels of the city. Grouped according to the direction of research work: research on the corrosion process in water drainage networks; analysis of modern ones; materials, laboratory tests; technologies for restoring drainage networks. Analysis of studies of the condition of structures of objects; research of materials and methods of repair and restoration of sewage tunnels and inspection shafts, which are currently used with high efficiency in domestic and foreign practice; development of technological and organizational solutions and restoration of destroyed sewage structures of drainage networks. The analysis of the researches of domestic scientists showed that the sewer tunnels of large cities of Ukraine are worn out as a result of long-term operation, ineffective solutions to protect structures from the influence of an aggressive environment, low-quality materials and structures used during construction. Restoring normative operational characteristics, increasing the durability of sewage tunnels is a costly and technically complex task, the solution of which is urgently needed to prevent accidents, including those with serious environmental consequences. Existing modern technologies of work performance, materials and structures used for repair and restoration works with different efficiency solve these problems, at the same time, the need to reduce costs for repair and restoration works requires the search for cost-effective materials, structures and methods of work performance. The analysis of the conducted studies shows that the problem of increasing the durability of sewage network structures should be solved comprehensively, taking into account the current situation.

**Keywords:** sewage disposal, influencing factors, recovery technologies, repair, anti-corrosion coating, research analysis.

**Introduction.** Already at the beginning of the 20th century, and especially after the First World War, the intensive development of technology for the transportation and treatment of wastewater began. The development of industry and the processes of urbanization caused an increase in the volume of wastewater and the load on transport highways.

Since drainage networks belong to life support systems, their normal functioning is a task of state importance. The problem of preservation and restoration of existing underground

communications becomes especially urgent in connection with the increased requirements of ecology. In order to protect groundwater from the ingress of various aggressive reagents, it is necessary to know the reasons for the destruction of underground communications structures and the methods of repairing damage.

Solving the problems of ensuring the reliable operation of the city's drainage systems is relevant not only for Ukraine, but also for scientists around the world.

**Analysis of recent researches and publications.** In the domestic researches of I.O. Abramovich [1], Aleynikova A.I. [2-7], Brigady O.V. [8], Bulgakova Yu.V. [9], Goncharenko D.F. [5-7, 10], Dobryaeva A.A. [11], Zabelina S.A. [4, 5, 11], Kabusya O.V. [12], Kis V.M. [13], Kurovskii I.I. [14], Kovalenko A.V. [15], Korinko I.V. [16], Rosenthal N.K. [17], Starkova O.V. [6, 18, 19], Klein Y.B. [20], Mezhenyskiy A.N. [21], Uvarova E.P. [21], Iurchenko V.O. [22, 23] and others, foreign D. Shtein [27], J. Horstmann [28], W. Fischer [29], U. Schmidt [30], D. Ufermann [31], R. Stein [32], B Müller [33], S. Ellerhorst [34], V. Niederehe [35], R. Kammerer [36], D. Mathews [37], S. Tambe [38], M. Pozoki [39], K. Luo [40], M. Kiliswa [41], T. Gourley [42], E. Hewayde [43], S. Taheri [44] and others pay great attention to the repair and restoration of drainage tunnels with the use of various building and construction materials resistant to aggressive sewage environments, the study of factors affecting the operational durability of sewage tunnels.

**The purpose and objectives of the research.** The purpose of the article is the analysis of modern scientific and practical research in the field of water distribution systems. Analysis of scientific works:

- regarding the condition of structures of objects that are included in the complex of structures of sewage networks, research of factors leading to their failure of functioning and research devoted to the issue of reducing the influence of an aggressive environment on drainage structures;
- aimed at solving the problems of increasing the operational reliability of sewage tunnels;
- research of materials for repair and restoration of sewage tunnels and inspection shafts, methods of their implementation;
- regarding the methods of technological, organizational and constructive solutions for the repair and restoration of destroyed sewage tunnels and inspection shafts.

**The main part.** Researchers from all over the world are dealing with issues of increasing the operational resource of sewage collectors. Based on a comparison of the scientific works of researchers from near and far abroad, they can be grouped according to the direction of research works:

- research of the corrosion process in water drainage networks (Table 1, Item 1);
- analysis of modern materials, laboratory tests (Table 1, Item 2);
- technologies for restoring drainage networks. (Table 1, Item 3).

Table 1 – Analysis of modern scientific and practical research in the field of water distribution system

| №  | Scientific works, scientists | The main provisions of the study, advantages   | Comment  |
|--|------------------------------|--|--|
| 1  | 2                            | 3  | 4  |
| 1. Corrosion processes in the sewage network |                              |  |  |
| 1.1  | I.O. Abramovich [1]          | In the works of Professor I.O. Abramovich [1], who was most directly related to the design and construction of sewage tunnels in the city of Kharkiv, great attention was paid to the study of factors affecting their durability. As the author emphasizes in his scientific works, it is the corrosion processes occurring in the above-water part of the tunnels that have the greatest impact on their durability. | At the same time, in his work, the author paid insufficient attention to the selection of construction materials that can resist corrosion of reinforced concrete pipes, tubing and monolithic reinforced tunnel treatment. His assumptions about the destructive effect |

| 1   | 2                       | 3   | 4   |
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|     |                         |   | of gas corrosion were confirmed after several years of operation of both reinforced concrete pipes and tunnels.   |
| 1.2 | V.O. Iurchenko [22, 23] | In the studies, much attention is paid to the process of gas corrosion and reducing the influence of an aggressive environment on the construction of drainage networks. In the works, the author noted that the genesis of acid formation on the vault is caused by microbiological processes, which are caused by immobilized microbiocenoses in the tray part of sewer pipelines: mainly microbiological sulfate reduction of sulfate reduction to hydrogen sulfide by protons of organic compounds. The formed hydrogen sulfide is released into the atmosphere of the basement space and dissolves in film moisture on the tunnel vault. The work noted that an important condition for the development of biogenic sulfuric acid corrosion in sewage systems is the presence of moisture on the surface of the building structure, which is exposed to hydrogen sulfide. Building structures that are constantly in a dry state are not susceptible to biogenic sulfuric acid corrosion, even if hydrogen sulfide is constantly present. Decreasing the humidity of the gas environment of the tunnel by supplying fresh air to the sub-basement space significantly slows down the rate of concrete corrosion. | A comprehensive study highlighting the quantitative and qualitative assessment of the dispersion of harmful substances in the atmosphere directly for the city of Kharkiv.  |
| 1.3 | Brigada O.V. [8]        | The work provides an analysis of emergency situations during the operation of drainage networks, methods of diagnosing their condition and controlling the composition of the atmosphere in the underground space of sewage pipelines. The features of non-destructive monitoring of the state of concrete collectors are characterized, the main coefficients for calculating the depth and speed of concrete corrosion are determined experimentally.   | A meaningful study in which reviews of sections of sewerage networks in the city of Kharkiv are given, the concentration of hydrogen sulfide in the atmosphere of the underground space is determined by two methods. The determination of the effectiveness of protective coatings of various compositions to protect concrete from the biogenic aggression of sulfuric acid is given. |

| 1   | 2                                       | 3   | 4   |
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| 1.4   | S.A. Zabelin,<br>A.I. Aleynikova<br>[4] | In the scientific work, an analysis of experimental studies of materials that resist corrosion was carried out.   | A meaningful study. On the basis of the analysis of the latest works, approaches, and practices devoted to the study of corrosion processes of sewage collectors, and according to the results of their grouping in accordance with the direction of research, the authors proposed a methodology for the study of microbiological corrosion of drainage collectors and the main methods of combating it. |
| 2. Analysis of modern materials, laboratory tests |   |   |   |
| 2.1   | N.K. Rosenthal<br>[17]                  | The studies emphasize that the catastrophic consequences of corrosion destruction of water supply, drainage and water treatment facilities require large-scale solutions to the problem of ensuring their durability at the stages of design, construction and operation. The safe operation of these facilities requires taking into account world experience and conducting own research with the involvement of specialists from various fields: chemists, technologists, microbiologists, designers. In his work, promising materials for corrosion protection were considered. | Modern sewage pipelines are a complex complex of interconnected structures in which various physical, chemical and biological processes take place. The action of such processes is not controlled and is accompanied by significant costs associated, in particular, with a decrease in the operational reliability of the functioning of sewage collectors. Almost all modern studies of methods        |
| 2.2   | V.M. Kis [13]                           | The question of increasing the durability of reinforced concrete pipelines was reflected in the works where the author developed liner pipelines lined with thin-walled profiled polyethylene.  | of increasing the operational resource of water drainage networks, destroyed under the influence of microbiological corrosion,  |
| 2.3   | O. Kabus,<br>V. Lykhogray<br>[12]       | The work considers the assessment of the increase in durability of protective coatings applied to the middle layer of polymer concrete. This is a layer that is formed as a result of applying a polymer coating with a filler on the surface of ordinary concrete with a large exposed aggregate. Exposing the large aggregate using the "washed concrete" technology allows you to significantly reduce the contact area of the coating with cement hydrates that react with an acidic environment and reduce the likelihood of subsurface corrosion and peeling of the           | are related to the application of technologies for the use of polymeric materials. Modern multi-component materials have quality characteristics that prevent corrosion damage to structures.   |

| 1   | 2   | 3  | 4 |
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|     |   | coating. The results showed that the formation of a surface polymer concrete layer allows to increase the durability of concrete structures in an acidic environment.  |   |
| 2.4 | V. Fischer (Germany) [29]                 | In the scientific work of the German scientist, considerable attention is paid to the selection of pipes for open methods of repair and restoration work on sewage networks. Special attention in his research was paid to pipes of large diameters made on the basis of polypropylene. The strength characteristics of the pipes and the expediency of their use under various operating conditions are given in the work.  |   |
| 2.5 | Bodo Müller (Germany) [33]                | In his work, the author presented the results of research on plastic materials for their use in repair and restoration works.  |   |
| 2.6 | Wilhelm Niederehe (Germany) [35]          | The work considers static loads on sewage pipelines during open repair works, in particular for pipes made of concrete, reinforced concrete, polymer concrete, fiberglass and other materials.   |   |
| 2.7 | D. Mathews, A. Cox (USA) [96]             | The research conducted by the authors suggests the use of polymer nanocoatings as a method of controlling the corrosion of iron pipelines.   |   |
| 2.8 | S. Tambe and his colleagues (India) [38]  | Laboratory modeling of microbiological corrosion processes of sewage systems was analyzed in the research. The article evaluates the effectiveness of epoxy coatings with and without biocides through their interaction with cultures of sulfate-reducing bacteria in an anaerobic environment. Methods such as the formation of inhibition zones, visual observations, scanning electron microscopy (SEM), electrochemical impedance spectroscopy (EIS) and analysis of coating adhesion to the inner walls of the collector were used to evaluate the microbiological efficiency. |   |
| 2.9 | N. Rohem and his colleagues (Brazil) [46] | The study analyzes the use of polymer-based composite materials for repairing and strengthening damaged pipelines. Experimental tests have shown the high efficiency of the new composite material in the process of restoring the inner surface of pipelines.   |   |

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| 2.10 | M. Pazoki and his co-authors (Iran) [39]      | The study conducted a comparative analysis of polyurethane and polyvinyl chloride for lining concrete sewer pipes for protection against biological corrosion. Experimental data showed that after three months, polyurethane demonstrates better strength and stability in an acidic, aggressive environment compared to PVC. Thanks to its strong adhesion to the concrete surface, the polyurethane coating effectively reduces the penetration of the acidic solution formed as a result of the fermentation of sewage into the concrete structure. |   |
| 2.11 | K. Luo and his co-authors (China) [40]        | The study considered tubular composite raw materials, as well as a comparison of methods of their formation and evaluation of efficiency, in particular from the point of view of service life. and corrosion resistance.   |   |
| 2.12 | M. Kiliswa (South Africa) [41]                | In scientific works, the rate of biogenic corrosion of concrete is analyzed, which depends on the chemical composition of binding components (cement, additives), as well as on the microstructural characteristics of concrete. mixtures used in the manufacture of sewer pipes.   |   |
| 2.13 | T. Gourley, G. Johnson (Australia) [42]       | Research by scientists has suggested sewer pipes made using geopolymer concrete show excellent corrosion resistance in these highly aggressive environments. Laboratory and practical comparative tests of sewage networks show the advantage of a sewer pipe made of geopolymer concrete.  |   |
| 2.14 | E. Hewayde and co-authors [43] (Iraq),        | The paper investigates the issue of anti-corrosion coating based on copper oxide and silver oxide. Each of the oxides was mixed with an epoxy resin used to repair concrete sewer pipes before being sprayed onto the inner surface of the concrete pipes to form a coating film. These tests showed that sulfide formation by sulfate-reducing bacteria in oxide-coated pipes was reduced by 92% and 100%.   |   |
| 2.15 | S. Taheri and his colleagues (Australia) [44] | In a scientific study, the influence of mullite, an aluminosilicate mineral, on the strength and resistance of concrete to acid corrosion was analyzed under the conditions of accelerated tests in sulfuric  |   |

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|                                 |                                   | <p>acid solutions at pH 0.25 and 1. Scanning electron microscopy, micro-X-ray fluorescence spectrometry and Vickers hardness were used to evaluate physicochemical methods such as compressive strength. The results showed that the addition of mullite slightly changes the overall strength of solutions and concrete samples, but significantly increases their resistance to sulfate corrosion, in particular by 90%. This indicates a potential extension of service life and reduced maintenance costs for concrete pipes subject to acid corrosion in sewage systems. It was also noted that the inhibition efficiency depends on the acid concentration and improves with increasing mullite content in the samples.</p> |  |
| <p>3. Recovery technologies</p> |                                   |   |  |
| <p>3.1</p>                      | <p>A.O. Dobryaev [11]</p>         | <p>The scientific research is devoted to an open way of carrying out repair and restoration works. With the participation of the author, constructive solutions for the restoration of the Ordzhonikidzev collector in the city of Kharkiv were developed: the pipeline to be restored is built from monolithic reinforced concrete, the preserved tray part serves as the basis for the new pipeline, and a pipe made of profiled polyethylene is installed as a lining. The method of calculating the strength characteristics of the structure being developed, based on the finite element method, is proposed.</p>   | <p>The technical, technological and organizational solutions proposed by the author significantly shorten the duration and reduce the cost of repair work, extending the life of the collector by using profiled polyethylene.</p> |
| <p>3.2</p>                      | <p>Yu.B. Klein [20]</p>           | <p>In the studies, the performance of works in an open way in water-saturated soils is considered. The work proposes a device that allows combining the processes of soil development and temporary fastening with simultaneous drying of the soil in the drilling zone with water-receiving devices mounted in the blade part of the shield of the temporary mobile fastening.</p>   | <p>The use of this method using the developed device makes it possible to reduce the duration of work by 2 times compared to the duration of these works by existing methods.</p>  |
| <p>3.3</p>                      | <p>D.F. Goncharenko [5-7, 10]</p> | <p>In scientific works, the problems of the destruction of shallow sewage collectors, methods of their preparation for restoration and repair, technological solutions for repair and restoration of collectors by open and closed methods</p>  | <p>The author devoted numerous studies and scientific works, proposed numerous technical, technological and organizational solutions that</p>  |

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|     |  | are widely considered. These works are based on theoretical calculations and have practical implementation.   | significantly shorten the duration and reduce the cost of repair and restoration works.  |
| 3.4 | D.F. Goncharenko, O.V. Starkova, A.I. Aleynikova [6] | The scientific publication examines the theoretical justification of the choice of open and closed methods of repair and restoration of water pipes. In these works, the authors study the methods of choosing priority factors that affect the determination of the method of carrying out repair and restoration works. In the scientific works, the authors developed automated systems for choosing the method of restoring water pipes using the apparatus of fuzzy logic.   | The automated systems for choosing the way to restore water pipes using the fuzzy logic apparatus proposed by the authors will allow to significantly reduce the cost of repair and restoration works. |
| 3.5 | D.F. Goncharenko Yu.V. Bulgakov [9]                  | The research has developed several options for carrying out repair work in sewage tunnels damaged by gas corrosion. The main one is the insertion method, which involves the use of polyethylene and fiberglass pipes of large diameter. In case of incomplete corrosion destruction of the finish, it is proposed to restore the crypt part of the tunnel by reinforcing it with composite reinforcement, followed by the application of a protective layer by fiber shotcrete. For this purpose, the authors selected fibers and complex additives that allow to increase the strength and waterproofing of the concrete layer that is applied again. | Technical, technological and organizational solutions proposed by the author significantly shorten the duration and reduce the cost of repair and restoration works.                                   |
| 3.6 | O.B. Starkova [6, 18, 19]                            | In the works, a model of a justified choice of methods of repair and restoration of the sewage network section was developed. The author considered single-criteria optimization under the condition of choosing one method of repairing the section of the sewage collector; single-criterion optimization under the condition of choosing several methods of repairing the section of the sewage collector; multi-criteria optimization when choosing methods for repairing the sewage collector area.  | The author developed a method for the reasonable selection of methods of repair and restoration of the sewage network and is recommended for further implementation in practice.                       |
| 3.7 | A.N. Mezhenskiy, E.P. Uvarova [21]                   | Scientific works are devoted to methodical development of selection and standardization of indicators of reliability of water supply and drainage pipelines.  | The presented approach is meaningful, and for further implementation in production and use in  |



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|      |   | <p>In these works, the composition and structure of the parameters of the sequence of the formation of design materials of all sections of the complex project were determined, the potential possibilities of their multivariation were revealed for all stages in the genesis of the complete life cycle of the construction, operation, reconstruction project, using the calculation method of carrying out planned and preventive repairs taking into account the level of normative environmental requirements.</p> | <p>practice, it requires certain qualifications.</p>   |
| 3.8  | S.A. Zabelin [4]                                      | <p>In scientific studies, special attention is paid to the repair and restoration of sewage pipelines at a depth of 4 m or more, located in heterogeneous bulk soils, where the groundwater level can reach 0.5 m. Often, water supply, gas supply and other communication networks are located nearby. For repairs in such conditions, the author developed a design solution for vertical fastening for trenches and pits.</p>  | <p>The universal installation, developed by the author, ensures the stability of the soil on the walls of trenches and pits and allows the removal of soil, atmospheric and waste water during work.</p>   |
| 3.9  | A.I. Aleynikova, B.S. Sorokina, V.Yu. Sorokina [2]    | <p>In the scientific work, with the help of economic forecasting methods, accident rates were calculated and a comparative analysis with previous years was carried out. We note the constant rapid growth of costs for the repair of sewage manholes from year to year, which once again confirms the relevance and timeliness of conducting this study, because all these costs can be reduced due to the implementation of a monitoring system.</p>  | <p>The authors suggested conducting two types of monitoring - periodic, which is carried out 4 times a year, and large-scale, which is carried out once, which will allow for more detailed forecasting and reduce the costs of restoring drainage networks.</p> |
| 3.10 | A.I. Aleynikova, P.Yu. Hulievskiy, I.V. Voronenko [3] | <p>The scientific publication noted that basalt-based products meet the requirements for materials used to protect sewage networks. The authors proposed developed organizational and technological solutions for the repair and restoration of tunnels in the bordering places with inspection shafts by restoring the arch with basalt tile lining.</p>   | <p>The authors offer a complex of technical, technological and organizational solutions that significantly shorten the execution time and reduce the costs of repair and restoration works.</p>  |
| 3.11 | A.V. Kovalenko [15]                                   | <p>The work is devoted to the development of effective technological solutions for the elimination of accidents in sewage tunnels. The author analyzed emergency situations that occurred in various cities, including Kharkiv. For this purpose, the</p>   | <p>A distinctive feature of the technologies developed by the author during the elimination of accidents in deep tunnels is the double protection of the massif and</p>  |

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|      |  | <p>author proposed technical and technological solutions aimed at creating protection of the massif and the surface of the soil by artificially freezing them with liquid nitrogen, followed by penetration of the blockage and construction of secondary processing by counter-pressing with reinforced concrete rings.</p>                      | <p>the soil surface from displacements and deformations. At the same time, the tray part of the tunnel treatment that is not destroyed by gas corrosion is used as a fence from below.</p>  |
| 3.12 | I.I. Kurovskii [14]  | <p>In his works, the author developed a methodology for calculating the strength of precast monolithic steel-concrete liner pipelines lined with material from slag casting of the Nikopol Ferroalloy Plant. In his work, the designs of the joints of steel nicrolite pipe liners are proposed.</p>  | <p>It would be advisable to make the economic efficiency of using this technique and compare it with other techniques.</p>  |
| 3.13 | G.O. Damekin [24]  | <p>The work is devoted to increasing the efficiency of works on the restoration of tunnel collector structures. The author proposed to repair the crypt part of the tunnels damaged by corrosion by lining them with large-format sheets of ceramic tiles. A methodology for calculating the strength of the facing layer has been developed.</p> | <p>Technical, technological and organizational solutions proposed by the author significantly shorten the duration and reduce the cost of repair and restoration works.</p>   |
| 3.14 | I.V. Korinko [16],<br>V.O. Voronenko [25],<br>V.V. Zaporozcia [26] | <p>The issue of increasing the operational durability of inspection mine structures was reflected in the works. Repair and restoration of mine wall structures was carried out using reinforced concrete panels lined with profiled polyethylene, slag-cast panels manufactured at the ferroalloy plant, clinker brick, and polymer concrete.</p> | <p>Technical, technological and organizational solutions proposed by the authors for the restoration of inspection shafts of sewage collectors, which significantly shorten the duration and reduce the cost of repair and restoration works.</p> |
| 3.15 | D. Stein (Germany) [27]  | <p>In scientific works, considerable attention is paid to open methods of repair and restoration of sewage pipelines. The author believes that an important part of pipeline repair is the arrangement of pipe joints and the replacement of damaged elements.</p>  | <p>The scientist investigates numerous examples of the repair of sewage systems using ceramic, polyethylene and fiberglass pipes, and also presents the results of the restoration of brick pipelines in the cities of Western Europe.</p>        |
| 3.16 | J. Horstmann, P. Pfannenschmidt (Germany) [28]                     | <p>In the scientific works of scientists, the use of geotextile materials in open methods of repair and restoration works on sewage pipelines is considered.</p>  | <p>The author presents a number of technical, technological and organizational solutions that significantly shorten the execution time and reduce the costs of repair and restoration works.</p>  |

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| 3.17 | U. Schmidt,<br>A. Bohasch<br>(Germany) [30]                   | The research examines technical and technological solutions that were developed in the German city of Minden to reduce the level of corrosion of reinforced concrete channels, as well as odors entering the environment from the channels.  | Special attention is paid to the system of damping the outgoing gases from the channels with the help of special equipment installed in inspection shafts. Quantitative indicators characterizing the effectiveness of the adopted decisions are presented. |
| 3.18 | R. Stein<br>(Germany)<br>[32]                                 | In the studies, the question of the effectiveness of the application of injection methods during the rehabilitation of channels made of reinforced concrete is considered. The qualitative characteristics of construction materials used for injecting pipelines located in different soils are presented.  | Attention is paid to the efficiency of using various materials and methods of their application in damaged channels and pipelines.  |
| 3.19 | S. Ellerhorst,<br>M. Schröder,<br>B. Woffen<br>(Germany) [34] | Scientific research was focused on the analysis of the economic efficiency of methods of carrying out repair and restoration works in an open manner.  | The presented approach is meaningful, and for further implementation in production and use in practice, it requires certain qualifications.   |
| 3.20 | R. Kammerer<br>(Germany) [36]                                 | In his research, the author considered in detail the repair and restoration of pipelines made of ceramic bricks. The author of the article, using the example of channels laid out of bricks in the century before last in Frankfurt am Main, provides the method of research of these channels, the list of equipment and tools that are recommended for its implementation. Factors leading to their destruction, plans for their rehabilitation are considered. | Technical, technological and organizational solutions proposed by the author significantly shorten the duration and reduce the cost of repair and restoration works.  |
| 3.21 | Z. Suligowski,<br>M. Orłowska-<br>Sczostak<br>(Poland) [45]   | The work in which the technical and organizational-technological solutions of the reconstruction of the drainage system in the city of Warsaw are considered is significant. During the construction of the new tunnels, the microtunneling method was used with the use of shields, which allow laying fiberglass pipes with a diameter of 3000 mm, which were supplied by the Hobas company.   | The author offers a number of technical, technological and organizational measures that significantly reduce the duration and costs of repair and restoration works.  |

**Conclusions and directions for future research.** In the article, the following were grouped according to the direction of research work and summarized in a table: the study of the corrosion process in water drainage networks; analysis of modern ones; materials, laboratory tests; technologies for restoring drainage networks.

On the basis of the performed analysis of the latest works, approaches, and practices devoted to the study of problems in the operation of drainage networks, the problem of increasing the durability of sewage tunnels, which include main and duplicate tunnels, inspection shafts and ring sections, should be solved comprehensively, taking into account the current situation .

The analysis of research by domestic and foreign scientists showed that sewer tunnels of large cities are worn out due to long-term operation, ineffective solutions to protect structures from the influence of an aggressive environment, low-quality materials and structures used during construction. Restoring normative operational characteristics, increasing the durability of sewage tunnels is a costly and technically complex task, the solution of which is urgently needed to prevent accidents, including those with serious environmental consequences. Existing modern technologies of work performance, materials and structures used for repair and restoration works with different efficiency solve these problems, at the same time, the need to reduce costs for repair and restoration works requires the search for cost-effective materials, structures and methods of work in the future.

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**АНАЛІЗ СУЧАСНИХ НАУКОВИХ ТА ПРАКТИЧНИХ ДОСЛІДЖЕНЬ В ГАЛУЗІ РОЗПОДІЛЬЧОЇ СИСТЕМИ ВОДОВІДВЕДЕННЯ**

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**Анотація.** Розв'язання проблеми забезпечення надійного функціонування систем водовідведення є важливим не лише для вчених нашої країни, але й для науковців усього світу. Оскільки ці системи є критично важливими для життєзабезпечення, їх безперерйна робота має стратегічне державне значення. Особливої актуальності набуває питання збереження та відновлення існуючих підземних комунікацій через посилені екологічні вимоги. Для захисту ґрунтових вод від забруднення агресивними реагентами важливо розуміти причини руйнування конструкцій підземних комунікацій та ефективні методи їх ремонту. У статті проведено аналіз наукових праць що стосуються проблем забезпечення безаварійної експлуатації об'єктів, що входять до комплексу споруд каналізаційних тунелів міста. Згруповано відповідно до напрямку робіт досліджень: дослідження корозійного процесу в мережах водовідведення; аналіз сучасних; матеріалів, лабораторні випробування; технології відновлення мереж водовідведення. Аналіз досліджень стану конструкцій об'єктів; дослідження матеріалів і методів ремонту та відновлення каналізаційних тунелів і оглядових шахт, які на сьогодні з високою ефективністю застосовуються у вітчизняній та зарубіжній практиці; розробку технологічних та організаційних рішень та відновлення зруйнованих каналізаційних конструкцій мереж водовідведення. Аналіз досліджень вітчизняних вчених показав, що каналізаційні тунелі великих міст України зношені внаслідок тривалої експлуатації, не ефективних рішень щодо захисту конструкцій від впливу агресивного середовища, низької якості матеріалів і конструкцій, які застосовувались під час будівництва. Відновлення нормативних експлуатаційних характеристик, підвищення довговічності каналізаційних тунелів витратна і технічно складна задача, вирішення якої гостро необхідне для запобігання аваріям, у тому числі таким, що мають серйозні екологічні наслідки. Існуючі сучасні технології виконання робіт, матеріали та конструкції, що застосовуються для ремонтно-відновлювальних робіт із різною ефективністю, вирішують ці задачі, разом з тим потреба зниження витрат на ремонтно-відновлювальні роботи вимагає пошуку економічно ефективних матеріалів, конструкцій та методів виконання робіт. Аналіз здійснених досліджень показує, що проблема підвищення довговічності конструкцій каналізаційних мереж повинна розв'язуватися комплексно з урахуванням поточної ситуації.

**Ключові слова:** водовідведення, фактори впливу, технології відновлення, ремонт, актикорозійні покриття, аналіз досліджень.

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