

Analysis of research directions in the field of "Water supply and sanitation" in the modern history of the Russian Federation

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Abstract. This article analyzes the results of the work of scientists in the Russian Federation in the field of water supply and sanitation for the historical period of the Russian Federation from 1992 to 2022 inclusive (31 full years). The subject of the research are dissertations for the degree of candidate or doctor of Sciences in the scientific specialty 2.1.4. "Water supply, sewerage, construction systems for the protection of water resources" (05.23.04 to 02/24/2021) in accordance with the nomenclature of scientific specialties. In this paper, we propose a classification of the analyzed works to the main object of research in accordance with the structural part of the water supply and sanitation systems. We explore the intensity of successful defenses of scientific and qualification works by year, the popularity of various areas of scientific research, as well as the rating of Russian cities evaluating relevant scientific works.

Keywords: water supply and sanitation, science in the Russian Federation, phd dissertation, doctoral dissertation, structural part of water supply and sanitation systems

1 Introduction

The importance of water supply and sewerage systems in human life is very great. It is these systems that have allowed humanity to live in large numbers in a relatively small area. Engineering networks of water supply and sewerage are shown in Figure 1.

The history of the development of water supply and sewerage systems goes back many hundreds of years. It is these systems that are the reason for the multiple decrease in infectious diseases of mankind. And of course, engineering and scientific research aimed at the development of these systems has never stopped.

Within the boundaries of this scientific research, we are interested in completed scientific research designed into a completed scientific work – in the territory of the Russian Federation, this is a dissertation for the degree of candidate or doctor of sciences.

The independent state of the Russian Federation, legally formed after the end of the USSR, has existed since December 25, 1991 (almost the end of 1991). It is from this date

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that the newest history of the state of the Russian Federation begins. Therefore, in this study we are interested in the dissertations of research scientists since 1992. The end date of the study time interval is 2022. This is due to the fact that on the territory of the Russian Federation, after successfully defending a dissertation, this dissertation is submitted to the Russian State Library and translated into electronic form. The time required for the translation of dissertations into electronic form required for the library is on average 6 months, so currently (March 2024) the works successfully completed in 2023 are not all in the Russian state library. It is for this reason that 2023 is not considered in this paper.

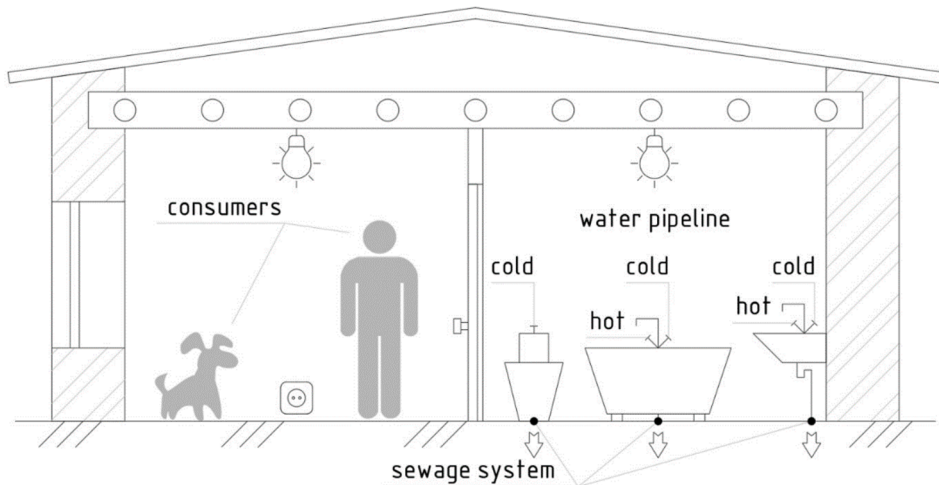


Fig. 1. Water supply and sewerage systems

2 Literature review

When working on an urgent topic, the scientist reviews the knowledge available in the issue of interest to him. This knowledge is available in the literature of various fields.

Educational literature: summarizes human knowledge of the subject in a convenient way for studying. Such literature presents knowledge that has been tested many times and is known to a large number of people. The source of information for such literature is the rules and laws in force in a particular country, well-known engineering solutions and knowledge from related disciplines with the discipline in question.

A very good and widespread textbook for specialists in the field of water supply and sewerage in the territory of the Russian Federation is the textbook of 1975, the main author of which is Staroverov I.G. «Internal sanitary devices». It consists of 2 parts.

Normative literature (laws): they include the experience of people working on this issue. This literature includes requirements on how to do it, how to do it under no circumstances, and which algorithms of the sequence of actions and which mathematical dependencies to use in working on issues from the field of science under consideration.

The main normative literature regulating the sphere of water supply and sewerage in the territory of the Russian Federation is: 1) A SET OF RULES 30.13330.2020 «Internal water supply and sewerage of buildings»; 2) A SET OF RULES 31.13330.2021 «Water supply. Pipelines and portable water treatment plants»; 3) A SET OF RULES 32.13330.2018

«Sewerage. Pipelines and wastewater treatment plants»; 4) A SET OF RULES 129.13330.2019 « External water supply and sewage networks and structures».

Scientific literature: it is specialized for the purpose. It is intended for specialists in this field of human activity. Examines issues related to the development of the sphere of human knowledge or the elimination of mistakes made by scientists studying this issue earlier. To record the results and make public the results obtained by a scientist or a group of scientists, scientific articles are published or, when widely studied, a scientific work is made that meets the standards of scientific research – a dissertation.

3 Materials and methods

This scientific work will consider the works of scientists who completed their dissertations in the territory of the Russian Federation only in the field of water supply and sanitation for the period of new Russia from 1992 to 2022 inclusive (31 full years). The area of knowledge we are interested in is the scientific specialty 2.1.4. "Water supply, sewerage, construction systems for the protection of water resources" (05.23.04 to 02/24/2021) in accordance with the nomenclature of scientific specialties. The data is received from the fund of the Russian State Library by means of access through the electronic library.

In this paper, we introduce a classification of dissertations on the main object of research in accordance with the structural part of water supply and sanitation systems. The conditional division is shown in Figure 2.

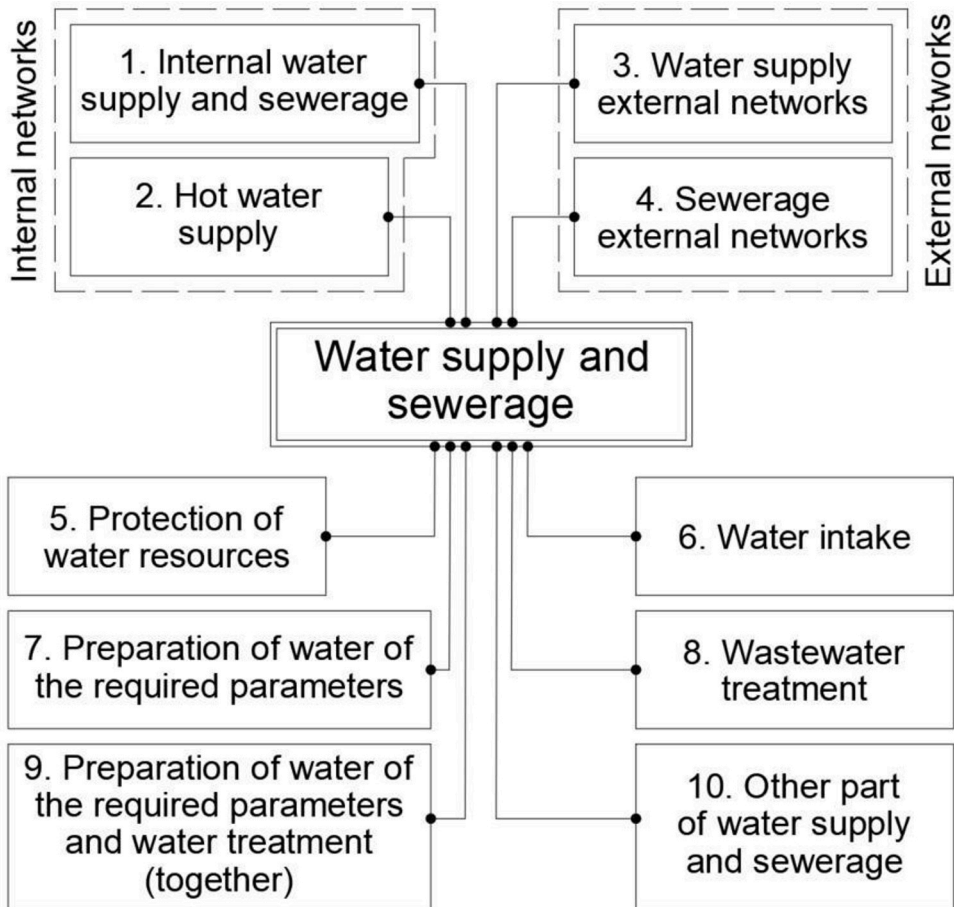


Fig. 2. Sections of scientific research in the sphere of water supply and sewerage

4 Results of research

The total number of dissertations for the degree of candidate or doctor of Sciences in the scientific specialty 2.1.4. "Water supply, sewerage, construction systems for the protection of water resources" (05.23.04 to 02/24/2021) in accordance with the nomenclature of scientific specialties for the period from 1992 to 2022 inclusive (31 full years) was: **623** pieces. Of these, dissertations for the degree of candidate of sciences - **545** pieces, and doctors of sciences – **78** pieces.

In accordance with the order of the Ministry of Science and Higher Education of the Russian Federation dated February 24, 2021 No. 118 "On approval of the nomenclature of scientific specialties for which academic degrees are awarded, and Amendments to the Regulations on the Council for the Defense of Dissertations for the degree of Candidate of Sciences, for the degree of Doctor of Sciences, approved by the order of the Ministry of Education and Science sciences of the Russian Federation dated November 10, 2017 N 1093" cipher of the scientific specialty "Water supply, sewerage, construction systems for the protection of water resources" from 05.23.04 changed to 2.1.4. accordingly, with small time delays, further protected works have a new cipher. Here is a list of the number of dissertations on scientific ciphers and academic degrees in Table 1.

Table 1. A list of the number of dissertations on scientific ciphers and academic degrees.

| The code of the scientific specialty | Candidate of Science level | Doctor of Science level | Total |
|---|-----------------------------------|--------------------------------|--------------|
| 2.1.4. | 7 | - | 7 |
| 05.23.04 | 538 | 78 | 616 |
| TOTAL | 545 | 78 | 623 |

The number of successfully completed dissertations by year for the scientific specialty "Water supply, sewerage, construction systems of water resources protection" is shown in Table 2.

Table 2. The number of successfully completed dissertations by year.

| The year in review | Candidate of Science level | Doctor of Science level | Total |
|---------------------------|-----------------------------------|--------------------------------|--------------|
| 1992 | 29 | 3 | 32 |
| 1993 | 28 | 2 | 30 |
| 1994 | 24 | 5 | 29 |
| 1995 | 12 | 1 | 13 |
| 1996 | 24 | 8 | 32 |
| 1997 | 27 | 6 | 33 |
| 1998 | 16 | 5 | 21 |
| 1999 | 19 | 5 | 24 |
| 2000 | 39 | 5 | 44 |
| 2001 | 20 | 4 | 24 |
| 2002 | 16 | 2 | 18 |
| 2003 | 24 | 3 | 27 |
| 2004 | 18 | 6 | 24 |
| 2005 | 24 | 3 | 27 |
| 2006 | 17 | 8 | 25 |
| 2007 | 23 | 2 | 25 |
| 2008 | 14 | - | 14 |
| 2009 | 23 | 1 | 24 |
| 2010 | 32 | 2 | 34 |

| The year in review | Candidate of Science level | Doctor of Science level | Total |
|--------------------|----------------------------|-------------------------|------------|
| 2011 | 20 | 2 | 22 |
| 2012 | 16 | 1 | 17 |
| 2013 | 17 | - | 17 |
| 2014 | 12 | 1 | 13 |
| 2015 | 12 | 1 | 13 |
| 2016 | 10 | - | 10 |
| 2017 | 9 | - | 9 |
| 2018 | 2 | - | 2 |
| 2019 | 6 | - | 6 |
| 2020 | - | 1 | 1 |
| 2021 | 7 | - | 7 |
| 2022 | 5 | 1 | 6 |
| TOTAL | 545 | 78 | 623 |

Next, let's move on to the resulting part of our scientific research - the distribution of scientific research in accordance with the classification in Figure 2

5 Conclusions

The selected areas of research within the scientific specialty "Water supply, sewerage, building systems for the protection of water resources" in accordance with the classification in Figure 2:

1. Internal water supply and sewerage: it includes supply and discharge networks inside the building, as well as water collection and control valves. For example, a dissertation [5].
2. Hot water supply: dissertations on energy efficiency and compensation of heat demand of the hot water supply system.
3. Water supply external networks: modeling, calculation, design and reconstruction of trunk and distribution supply networks outside buildings. For example, a dissertation [6].
4. Sewerage external networks: modeling, calculation, design and reconstruction trunk and distribution outlet networks outside buildings. For example, a dissertation [7].
5. Protection of water resources: dissertations on the protection and forecasts of pollution of water basins. For example, a dissertation [8].
6. Water intake: dissertations on water intake from underground and surface water sources For example, a dissertation [9].
7. Preparation of water of the required parameters: dissertations on the processes of water treatment of the required quality, on the design solutions of water treatment plants. For example, a dissertation [10].

8. Wastewater treatment: dissertations on wastewater treatment processes, on design solutions for treatment plants. For example, a dissertation [11].
9. Preparation of water of the required parameters and water treatment (together). For example, a dissertation [12].
10. Other part of water supply and sewerage: dissertations on related topics. For example, a dissertation [13, 14]

The results of the distribution for the corresponding positions are presented in Table 3 below.

Table 3. Distribution by research positions.

| № | Name | Candidate of Science level | Doctor of Science level | Total |
|----|--|----------------------------|-------------------------|------------|
| 1 | Internal water supply and sewerage | 1 | 1 | 2 |
| 2 | Hot water supply | - | - | - |
| 3 | Water supply external networks | 32 | 6 | 38 |
| 4 | Sewerage external networks | 29 | 9 | 38 |
| 5 | Protection of water resources | 9 | 4 | 13 |
| 6 | Water intake | 13 | 3 | 16 |
| 7 | Preparation of water of the required parameters | 120 | 19 | 139 |
| 8 | Wastewater treatment | 292 | 28 | 320 |
| 9 | Preparation of water of the required parameters and water treatment (together) | 24 | 3 | 27 |
| 10 | Other part of water supply and sewerage | 25 | 5 | 30 |
| - | TOTAL | 545 | 78 | 623 |

The results of the distribution by cities are presented in Table 4 below.

Table 4. Distribution by cities.

| № | City | Qty | % |
|---|------------------|-----|------|
| 1 | Moscow | 177 | 28,4 |
| 2 | Saint Petersburg | 97 | 15,6 |
| 3 | Penza | 46 | 7,4 |
| 4 | Volgograd | 45 | 7,2 |
| 5 | Irkutsk | 41 | 6,5 |

| | | | |
|---|------------------|------------|------------|
| 6 | Others cities | 186 | 29,9 |
| 7 | Others countries | 31 | 5,0 |
| - | TOTAL | 623 | 100 |

During the period under review, 623 dissertations were defended in the relevant field of science, which is an average of 20 dissertations per year. Of these, 545 dissertations for the degree of Candidate of Sciences (17.5 papers per year), Doctor of Sciences -78 (2.5 papers per year).

The distribution of successful defenses per year is extremely uneven and there are no mathematical dependencies describing this process.

The main topic for dissertation research is wastewater treatment of 320 pieces (more than 50% of all successfully defended works during the period under review).

At the same time, Moscow is the most active city for conducting research in the field of water supply and sanitation. It accounts for about 1/3 of all dissertation research

References

Normative literature

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2. A SET OF RULES 31.13330.2021 «Water supply. Pipelines and portable water treatment plants» (2021)
3. A SET OF RULES 32.13330.2018 «Sewerage. Pipelines and wastewater treatment plants» (2018)
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