International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-5, March 2020

Laboratory Examination of the Hydrogeological Conditions for the Preparation of Project Documentation for the Construction of an Apartment Building

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Abstract. In this work, laboratory tests were conducted to study hydrogeological conditions, while determining the properties of natural ground water for the preparation of project documentation for the construction of an apartment building at the address: Kirov region, Vyatskopolyansky district, village. Krasnaya Polyana, Druzhby str., 1. In this article, based on the results of chemical analyses, ground water is non-aggressive in relation to W4 concrete in terms of water resistance. According to the content of chlorides, ground water is non-aggressive to the reinforcement of reinforced concrete structures made of concrete of the grade for water impermeability of at least W6. The indicators obtained as a result of laboratory studies will be one of the important indicators during the design work.

Keywords: laboratory engineering and geological surveys, project documentation, hydrogeological conditions, ground water, water resistance, aggressiveness of ground water.

I. INTRODUCTION

The object of the examination is ground water taken for research. The purpose of our work is to conduct laboratory tests of the study of hydrogeological conditions, while determining the properties of natural ground water for the preparation of project documentation for the construction of an apartment building at the address: Kirov region, Vyatskopolyansky district, village. Krasnaya Polyana, Druzhby str., 1. The site is located in the Western part of the urban-type settlement Krasnaya Polyana in the Vyatskopolyansky district of the Kirov region. Residential and public buildings are located in the immediate vicinity of the exanimated site. At the time of the examination, the site of the proposed construction is free of development and is a vacant lot. Underground and above-ground utilities are represented by water, gas, communication and power lines.

Revised Manuscript Received on March 30, 2020.
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II. PROPOSED METHODOLOGY

To perform engineering and geological surveys [1], the following works must be performed:collection and analysis of available stock materials [7] about the survey area;

- field work;
- laboratory work;
- cameral treatment of materials[8].

ANALYSIS

Hydrological conditions of the examinated area are characterized by the presence of the Vyatka river 0.6 km to the South. In geomorphological terms, the section of work is timed to the second over-floodplain terrace of the Vyatka river.

The territory of the examinated site has a General lowering of the terrain in the South direction towards the Vyatka river with a slope of 0°30, the surface of the site is planned (previously, a residential building was located on the site). Absolute marks of completed workings on the site vary from 65.38 to 65.53 m.

There are no external forms of physical and geological processes that can negatively affect the construction and operation of the projected structure, based on the results of a reconnaissance examination on and near the work site.

The composition and scope of work is presented in table 1.

Table 1-Composition and scope of work

№	Works	Unit	Quantity	notice
Field works				
1	Reconnaissance examination	km^2	0,2	Corrected during the working process
2	Drilling with a core auger d 198 mm	well/dive meters	2/16	
3	Water sampling	sample	2	
Laboratory works				
4	Chemical analysis of water	sample	2	Corrected during the working process
Cameral works				
5	Cameral processing of laboratory data	sample	20	Corrected during the working process
6	Cameral treatment of water corrosion aggressiveness	sample	3	

To complete the tasks, a set of field and laboratory tests will be conducted to obtain data and to record hydrogeological conditions, identify dangerous geological and engineering-geological processes.
To examine the hydrogeological conditions of the area, the following types of work are expected to be performed:

1. Well drilling is carried out for the purpose of hydrogeological examinations and water sampling for chemical test. Drilling of wells was carried out with a core auger with a diameter of 198 mm. using the drilling pump of the PBU-2-312 drilling rig based on the KAMAZ vehicle. [9].It is proposed to cut 2 wells with a depth of 8 meters. A journal of geological documentation of wells is kept in the drilling process. The location of the wells is shown in figure 1.

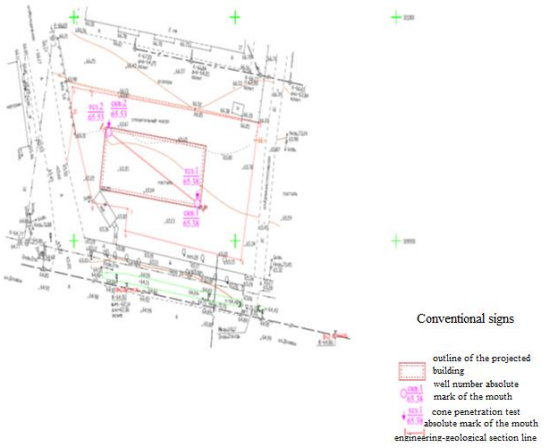


Figure 1 - location of wells for Hydrogeological research

The results of the tests are presented in tables 1-3.

2. Hydrogeological tests are provided for the examinations of all selected aquifers and consist in monitoring the level of ground water, visual and laboratory determination of the degree of water saturation of the soil, the presence of a temporary aquifer. Each aquifer within the interaction area must be characterized by at least three standard analyses of water samples. Each type of water aggressiveness in the area of impact on building structures must be confirmed by at least three samples.
3. Chemical tests of water will be conducted in the testing center of LLC "Voda Vyatskaya".
4. Cameral processing of materials will be performed in accordance with Design and construction specifications 47.13330.2012[3]. , Design and construction specifications 11-105-97[2]., Design and construction specifications 22.13330.2016[4].
During the period of examination (beginning of August 2019), hydrogeological conditions are characterized by the presence of a permanent, non-pressure aquifer. The established groundwater level is recorded at a depth of 3.1-3.2 m (abs. OTM. 62.28 – 62.33 m) from the earth's surface. The aquifer is fed mainly by infiltration of surface water and atmospheric precipitation. The maximum water level is predicted during snowmelt and during prolonged rains on the OTM. 63.5 – 63.6 m, and is shown on the engineering-geological section (Annex 1). During unfavorable periods in technogenic soils (IGE-1), it is possible to form a temporary aquifer (perched ground water).
According to the results of chemical tests, ground water is bicarbonate-calcium, non-aggressive in relation to W4 concrete in terms of water resistance (SP 28.13330.2012[6]., table. V. 3, V. 4). According to the content of chlorides, ground water is not aggressive to the reinforcement of reinforced concrete structures made of concrete with a water resistance of at least W6 (table. G. 2 SP 28.13330.2012).

Table 1 – results of the tests of well 1 (selection depth 3.1 m.; date of receipt 14.08.2019; date of testing from 14.08.2019 to 17.09.2019)

Elements of the testing	mg/dm^3	mole/dm^3	% equ	Specification documents for the methods of the testing
Fe^{2+}	0,07			
Fe^{3+}	0,10			Federative sd 14.1:2:4,50-96
$Na^+ + K^+$	80,73	3,51	23,72	SD 153-34.2-21.544-2002
Ca^{2+}	174,59	8,71	58,85	Federative sd 14.1:2:3.95-97
Mg^{2+}	31,37	2,58	17,43	Federative sd 14.1:2:3.95-97
Sum of cations		14,80	100	
NO_2^-	0,43			Federative sd 14.1:2:4,3-95
NO_3^-	11,46	0,18	1,22	Federative sd 14.1:2:4,4-95
Cl^-	53,75	1,51	10,20	Federative sd 14.1:2:3,96-97
SO_4^-	63,45	1,32	8,92	Federative sd 14.1:2.159-2000
HCO_3^-	79,16	11,79	79,66	State All-Union standard 31957-2012
Sum of anions		14,80	100	

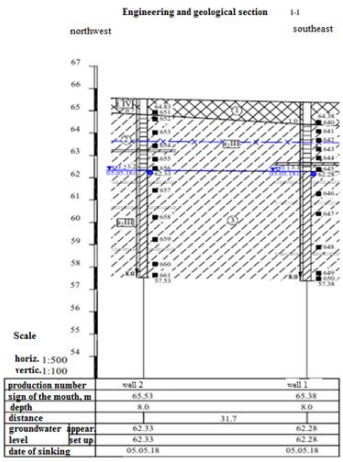
NH_4^+	1,75			Federative sd 14.1:2:4.262-10
Solids	795			Federative sd 14.1:2:4.114-97
CO_2 aggressive	Sorted out			SD 153-34.2-21.544-2002
pH		7,56		Federative sd 14.1:2:3:4.121-97
General hardness		11,29		Federative sd 14.1:2:398-97
Carbonate hardness		11,29		State All-Union standard 31957-2012

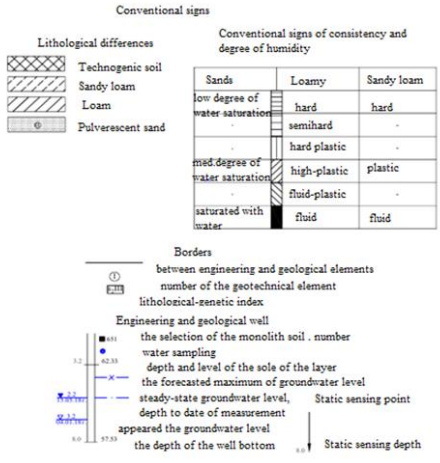
Table 2-test Results of well 2 (sampling depth 3.2 m; date of receipt 14.08.2019; date of testing from 14.08.2019 to 17.09.2019)

Elements of the testing	mg/dm^3	$mole/dm^3$	% equ	Specification documents for the methods of the testing
Fe^{2+}	0,09			
Fe^{3+}	0,10			Federative sd 14.1:2:4,50-96
$Na^+ + K^+$	86,71	3,77	25,54	SD 153-34.2-21.544-2002
Ca^{2+}	178,56	8,91	60,37	Federative sd 14.1:2:3.95-97
Mg^{2+}	25,29	2,08	14,09	Federative sd 14.1:2:3.95-97
Sum of cations		14,76	100	
NO_2^-	0,44			Federative sd 14.1:2:4,3-95
NO_3^-	11,09	0,18	1,22	Federative sd 14.1:2:4,4-95
Cl^-	49,49	1,39	9,42	Federative sd 14.1:2:3,96-97
SO_4^-	65,45	1,36	9,21	Federative sd 14.1:2.159-2000
HCO_3^-	721,16	11,83	80,15	State All-Union standard 31957-2012
Sum of anions		14,76	100	
NH_4^+	1,87			Federative sd 14.1:2:4.262-10
Solids	765			Federative sd 14.1:2:4.114-97
CO_2 agressive	Sorted out			Federative sd 153-34.2-21.544-2002
pH		7,60		Federative sd 14.1:2:3:4.121-97
General hardness		10,99		Federative sd 14.1:2:398-97
Carbonate hardness		10,99		State All-Union standard 31957-2012

Table 3- test results of well 2 (depth of selection 3.3 m; date of receipt 14.08.2019; date of testing from 14.08.2019 to 17.09.2019)

Elements of the testing	mg/dm^3	mole/dm^3	% equ	Specification documents for the methods of the testing
Fe^{2+}	0,05			
Fe^{3+}	0,09			Federative sd 14.1:2:4,50-96
$Na^+ + K^+$	97,06	4,22	27,56	SD 153-34.2-21.544-2002
Ca^{2+}	178,56	8,91	58,20	Federative sd 14.1:2:3.95-97
Mg^{2+}	132,98	2,18	14,24	Federative sd 14.1:2:3.95-97
Sum of cations		15,31	100	
NO_2^-	0,47			Federative sd 14.1:2:4,3-95
NO_3^-	11,05	0,18	1,18	Federative sd 14.1:2:4,4-95
Cl^-	55,58	1,57	10,25	Federative sd 14.1:2:3,96-97
SO_4^-	71,12	1,48	9,67	Federative sd 14.1:2.159-2000
HCO_3^-	736,88	12,08	78,90	State All-Union standard 31957-2012
Sum of anions		15,31	100	
NH_4^+	1,56			Federative sd 14.1:2:4.262-10
Solids	868			Federative sd 14.1:2:4.114-97
CO_2 aggressiv	Sorted out			SD 153-34.2-21.544-2002
pH		7,43		Federative sd 14.1:2:3:4.121-97
General hardness		11,09		Federative sd 14.1:2:398-97
Carbon. hardness		11,09		State All-Union standard 31957-2012





III. CONCLUSION

We draw a conclusion based on the results of laboratory tests: for the period of the examination (beginning from August 2019), hydrogeological conditions are characterized by the presence of a permanent, non-pressure aquifer. The established groundwater level is recorded at a depth of 3.1-3.2 m (abs. OTM. 62.28 – 62.33 m) from the earth's surface. The maximum water level is predicted during snowmelt and during prolonged rains on the OTM. 63.5 – 63.6 m. during unfavorable periods in technogenic soils (IGE-1), it is possible to form a temporary aquifer (upper water). [5].

According to the results of chemical tests, ground water is non-aggressive in relation to W4 concrete in terms of water resistance (SP 28.13330.2012, table. V. 3, V. 4). According to the content of chlorides, ground water is not aggressive to the reinforcement of reinforced concrete structures made of concrete of a grade of water impermeability of at least W6 (table. G. 2 SP 28.13330.2012).

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