Field research of the formation of the ice cover of the Novosibirsk reservoir

Fomicheva Nyailya Nikolaevna

Candidate of Technical Sciences, Associate Professor

Siberian State University of Water Transport

Fomichev Makar Igorevich

Student

Gymnasium №11 "Harmony", Novosibirsk, Russia

Abstract: *The article presents data from field studies of the ice cover at the Novosibirsk reservoir: the results of measurements of the ice thickness, the height of snow on the ice.*

Keywords: *Ice regime, ice thickness, ice structure, meteorological factors.*

The Novosibirsk reservoir was created on the Ob River 21 km above Novosibirsk and has a complex purpose. Water users are: municipal and industrial water supply; hydropower; water transport; fisheries; recreation. Also, the water resources of the Novosibirsk reservoir are used to regulate river flow. The reservoir diagram is shown in fig. 1.

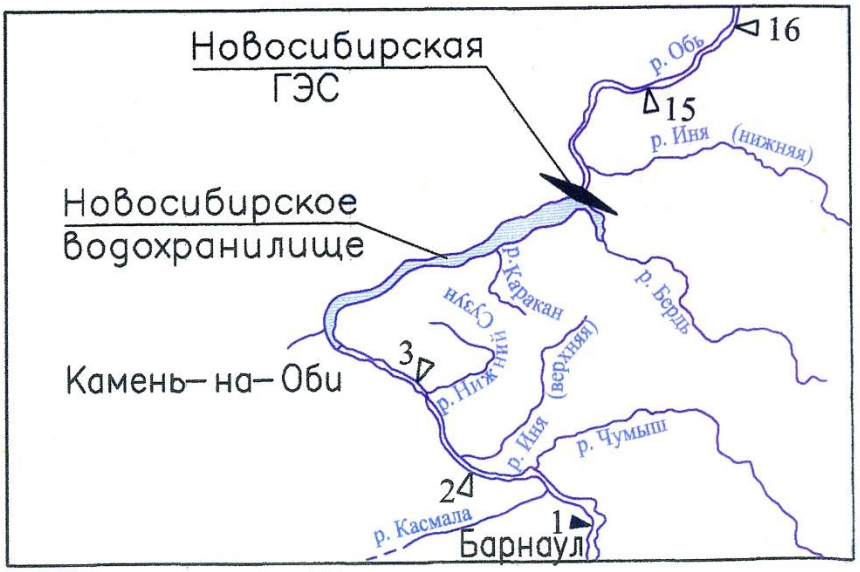


Fig.1. Scheme of the Novosibirsk reservoir hydrological posts: 1 – Barnaul; 2 – Shelabolikha; 3 – Malyshevo; 4 – Dubrovino; 16 – Kruglikovo

The regime of the reservoir and water users is influenced by the state of the ice regime. At hydrological posts, observations are made of the thickness of ice, snow and ice phenomena.

The peculiarities of the ice regime are that its characteristics are constantly changing, not only during one season, but also from year to year, from region to region. Such variability does not allow obtaining unified dependences for predicting the parameters of the ice cover.

Therefore, practically, any new data is unique in its kind, replenishes the database on the characteristics of ice, and field studies allow us to clarify: forecasts of ice phenomena; ice skipping schemes; the dimensions of the projected hydraulic structures and resolve issues related to the prevention of congestion.

Taking into account the above, the purpose of field studies was to obtain data on the increase in the thickness of the ice cover in the Novosibirsk reservoir.

In accordance with the set goal, the tasks of field studies included: study of the structure of the ice cover; measuring the thickness of ice and snow; monitoring the change in meteorological elements.

Research methodology: measurements were carried out on a reservoir near the village of Kirza, Ordynsky district, Novosibirsk Oblast. There is no permanent hydrological post in this place. The expedition works were carried out in 2017, 2019, 2020 and 2021.

The study of the structure of the ice cover was carried out by examining samples cut from the thickness of the ice with a chainsaw. The thickness of the ice was determined with a measuring tape or rod by immersing it in the holes. The thickness of the snow was also measured with a measuring tape (fig. 2). The air and water temperatures were measured with a mercury thermometer, and the wind speed was measured with an anemometer.

a) preparation of the hole

b) measuring ice thickness

c) measuring the thickness of the snow cover

Fig. 2. Ice cover research during the expedition in winter 2020–2021.

The structure of the ice cover is an important characteristic in the study of ice formations. The availability of data on the structure of the ice cover in the winter and spring periods makes it possible to predict the development of ice drift, changes in the strength and thickness of ice. Studies of the ice structure of the Novosibirsk reservoir, the purpose of which was to identify possible changes in ice parameters over time, carried out in the sixties and eighties of the last century [1, 2], as well as observations showed that no characteristic changes in the structure were observed. In early spring, snow lay on the ice. The vertical section shows that the upper layer is

cloudy, and below it is transparent ice. The warming effect of solar radiation contributes to the appearance of a layer of water on the ice [1, 4].

The results of measurements of the thickness of the ice cover in the investigated section of the reservoir are shown in table 1.

Table 1 – Results of field measurements of ice thickness and snow depth at the Novosibirsk reservoir in 2020–2021 (near the village of Kirza)

Date / Indicators	29.11.2020	06.12.2020	10.12.2020	01.01.2021	28.01.2021	06.03.2021
h_{ice}, cm	15.0	25.0	35.0	47.0	70.0	100.0
h_{snow}, cm	2.0	2.0	15.0	100÷20.0	0÷30.0	0÷50.0

Note: Snow depth is unstable. This factor is explained by the presence of strong winds in a large open area.

The data obtained are shown graphically in fig. 3. It also shows the results of measurements performed in 2017 at the same point.

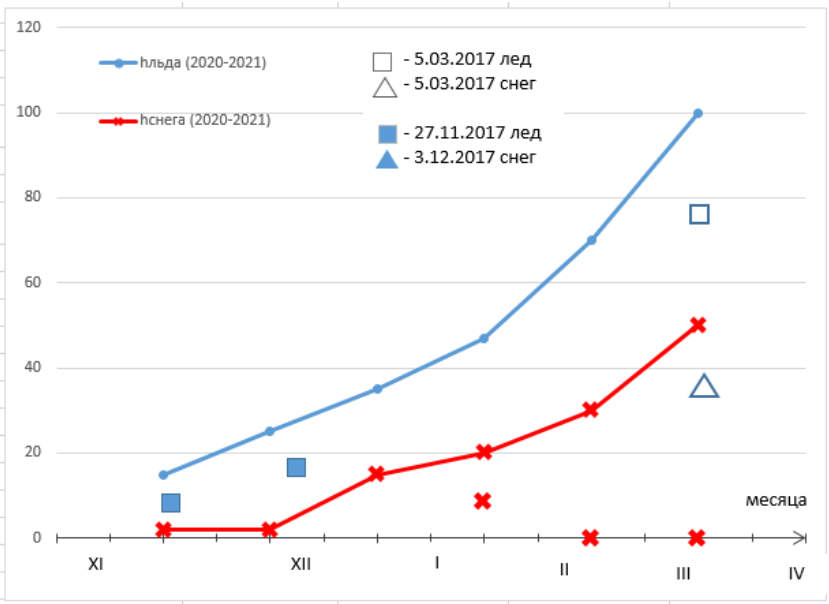


Fig.3. Graphs of changes in the thickness of ice and snow on the Novosibirsk reservoir

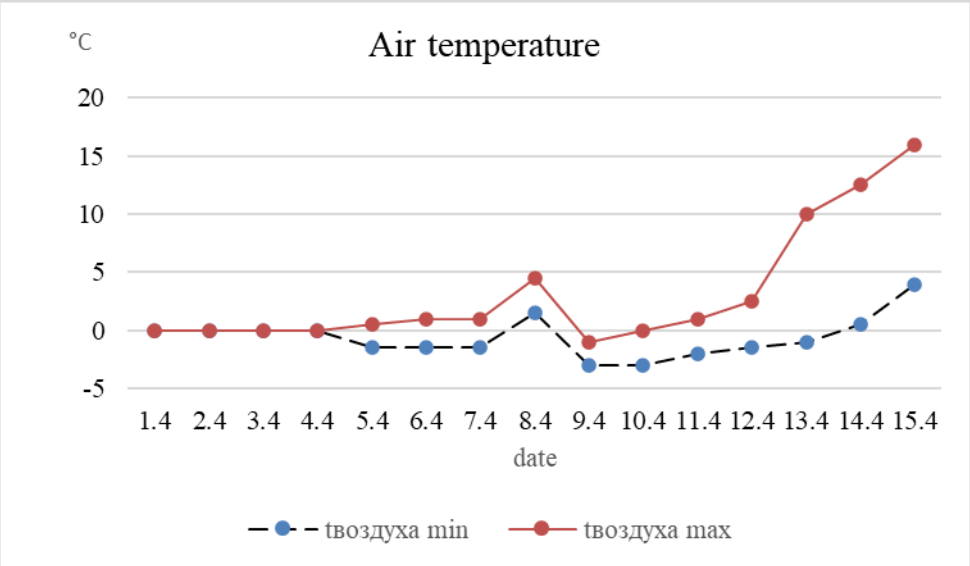
Some results of observations of the nature of changes in meteorological conditions, carried out in the study area, can be presented in the following form.

Object	t_{air}, °C	t_{water}, °C	Wind speed, m/s
Observations at sea (as of 05.03.2017)	–5.8°	–0.1°	5.0
An island covered with a birch forest (as	–6.6°	–	2.7

of 03.05.2017)			

Below are the data on measurements of the thickness of the ice cover in the spring, carried out earlier at the Novosibirsk reservoir [3, 5] (fig. 4).

a)



b)

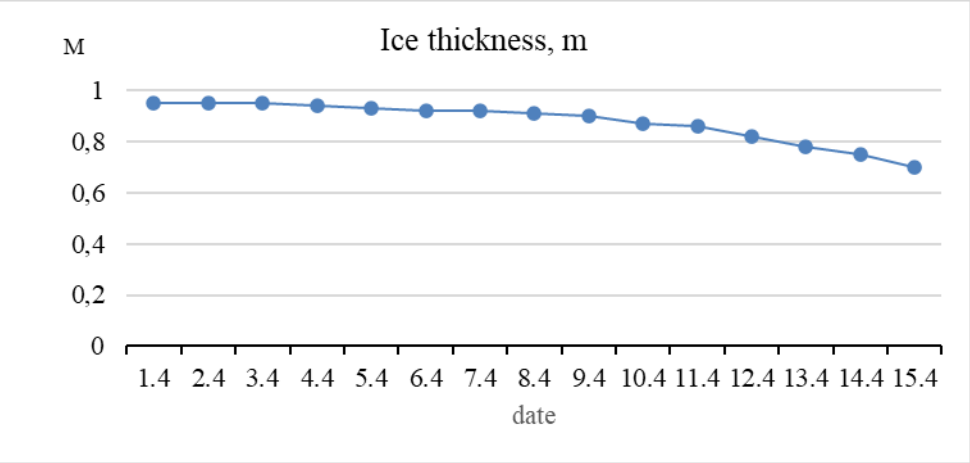


Fig. 4. Reducing the thickness of the ice cover of the Novosibirsk reservoir
a) air temperature; b) ice thickness

Conclusions

1. Measurements of the increase in ice thickness in the Novosibirsk reservoir were carried out.

2. Measurements of the height of the snow cover on the ice were carried out.

3. The intensity of the increase in ice thickness on average for the winter period 2020–2021 was 0.87 cm per day.

4. The maximum height of snow on ice by the end of winter 2020–2021 was 50 cm, but it should be noted that there is a significant unevenness in the distribution of snow cover.

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