

River monitoring

Manual for public environmental monitoring

APPENDIX 2. Organoleptic indicators of water quality

§ 1. Odor

Water odor is dependent on the presence of volatile odorants in it. It may arise in a natural way from water weeds, water molds, actinomyces, and other water organisms. In such cases the odor is classified as earthy, putrefactive, swampy, fetid, etc. If volatile substances penetrate water reservoirs with sewage waters, the odor may be classified as chlorine, phenolic, pharmaceutical, etc. In addition to the type of odor, its intensity is defined as the degree of dilution with odorless water.

Quantitative analysis of odor intensity

Equipment: activated carbon, 1 liter of water, paper or household filter

Testing:

1. Odorless water can be prepared by activated carbon treatment in the amount of 0.6 g carbon per 1 l of water followed by water filtration through a paper filter or by letting the water run through a household filter.

2. Determination of the odor "threshold number" N :

$$N = \frac{V_0}{V_A},$$

where V_0 is the total volume of water (with and without the odor), ml;

V_A is the volume of sampled water (with odor), ml.

If the sampled water contains an odorous substance, its concentration in the sample can be found using the above method.

To do this, first determine the odor threshold number of a standard solution for this odorous substance of known concentration.

Then the concentration of this substance in the sample (C_x) will amount to:

$$C_x = C_0 \times \frac{N_0}{N_x} \text{ (mg/l)}$$

where C_0 is concentration of the sampled substance in the standard solution, mg/l;

N_0 and N_x are correspondingly the odor threshold numbers for the standard solution and the sample.

Determination of the threshold number saves the trouble of finding the quantitative content in the water of the substances for which MPC has been established based on an organoleptic parameter, i.e. the odor (e.g., phenols and chlorophenols).

Qualitative analysis of odor intensity

Equipment: water sample, 250–500 ml retort with a stopper.

Testing:



1. Fill 1/3 of the retort volume with water and plug it with a stopper.
2. Shake up the content of the retort with rotational movement of the hand.
3. Unplug the retort and determine the odor character and intensity immediately inhaling the air as it is shown on the picture. Inhale the air with caution; do not do deep breaths!

The temperature must be indicated when performing odor and off-flavor tests, because the intensity of these indicators increases with the temperature increase.

If the odor cannot be felt right away or is barely detectable (the odor is unclear), the test can be repeated having heated the water in the retort up to 60°C by placing the retort in hot water. Remove the stopper prior to doing this.

4. Determine the odor intensity on a scale from one to five in accordance with Table 1.

Table1.

Table for classification of the character and intensity of odor

Odor intensity	Odor character	Assessment of odor intensity
None	The odor is not perceived	0
Very poor	The odor is not immediately perceived by the consumer but can be detected with thorough testing (water heating)	1
Poor	The odor can be perceived if brought to notice	2
Appreciable	The odor can be easily detected and causes unfavorable attestation of water quality	3
Distinct	The odor strikes the attention and makes the consumer refrain from use	4
Very strong	The odor is so strong that it makes the water unusable	5

Conclusions:

It is assumed that clean natural water has no odor. However, if you have detected it, first of all compare the results of your test with the applicable standards in your country. In particular, according to the Russian Sanitary Rules and Regulations (SanPiNs), the odor of drinking water should not exceed the level of 2. If the standards are exceeded, start looking for the reason. It must be taken into consideration that the water odor is affected by the composition of substances contained in it, the temperature, the pH index, the level of pollution of the water reservoir, the biological situation, the hydrological conditions, etc.

The reasons why the odor standards were exceeded can have a natural origin (living and defunct organisms, impact of soils, water growth, etc.) or a human origin (industrial, agricultural, and household wastewaters). Such odors usually undergo serious change in the process of water treatment.

§ 2. Taste

For safety reasons, water taste analysis is allowed for drinking water only. This parameter should not be examined for natural water reservoirs.

Intensity of taste and flavor is estimated by a five-point grading scale as shown in Table 2.

Table 2.

Table for classification of the character and intensity of taste and flavor

Intensity of taste and	Taste and flavor mode	Estimate of the
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flavor		intensity of taste and flavor
None	Taste and flavor are not consistent	0
Very poor	Taste and flavor are not immediately perceived by consumer but can be detected under thorough testing	1
Poor	Taste and flavor can be perceived if brought to notice	2
Perceptible	Taste and flavor can be easily detected and causes unfavorable attestation of water quality	3
Distinct	Taste and flavor strike the attention and make the consumer to refrain from using	4
Very strong	Taste and flavor are so strong that make the water unusable	5

Important! It is not recommended to let children determine taste and flavor of water in the course of practical work with children for the reasons of children's health safety. .

§ 3. Turbidity and transparency

Turbidity of water (reduction of its transparency) is caused by the presence of fine-grained suspended solids, e.g., sand, clay, inorganic compositions (aluminum hydroxide, carbonates of various metals), and of organic impurities or living organisms, e.g., phytoplankton and zooplankton.

Because of transparency reduction, the light transmission through the water column decreases, and this reduces the efficiency of photosynthesis and natural biological productivity of the water reservoir and changes the habitat conditions for aquatic animals.

Methods for qualitative analysis of turbidity and transparency

1. In the field conditions, turbidity is measured using a Secchi disk which is a plain white circular metal disk, about 20 cm in diameter, which is tied to a long rope marked by length.

Equipment:

Secchi disk tied to a long rope. For school tests, a white enamel cover for a saucepan of appropriate diameter may be used as a Secchi disk.

Testing:

By lowering the disk down in the water until it is no longer visible, we can measure relative water transparency.

Measurements should be repeated several times to avoid possible interfering impact of light reflected from the water surface. For values less than 1 m, the readings should be presented to the accuracy of 1 cm, and for values over 1 m, with 0.1 m accuracy.

This method is convenient for measurements because one can use bridges, tree trunks bent over the water, abrupt coasts, etc.

This method cannot be used for transparent shallow rivers and creeks.

2. Analysis of water turbidity using dark paper

Equipment:

Test tube of 10-12 cm height; sheet of dark paper (for the background)

Testing:

1. Fill the test-tube with water up to a height of 10-12cm.
2. Determine the water turbidity by looking at the test tube on the dark background from above with sufficient side lighting (daylight or artificial lighting). Select an adequate classification from the table.

Water turbidity
Turbidity is unobservable (absent)
Slightly opalescent
Opalescent
Slightly turbid
Turbid
Very turbid

Method of quantitative analysis of turbidity and transparency

The method of quantitative analyses of transparency is based on measurement of the height of a water column under which one can still distinct (read) a 3.5 mm high black font with 0.35 mm line width on white background or see an adjustment mark (e.g., a black cross on white paper).

This method is a uniform test procedure and meets the standard of ISO 7027.

Substances coloring the water and air bubbles may be an obstacle for testing.

Equipment:

A laminated font sample (height: 3.5mm, line width: 0.35 mm) or adjustment marks (2 pieces).

A pipette for water sampling; a tube for transparency measurement (600mm long, 25mm in diameter); a screen for the tube; a syringe with connecting tube

Note. For stability reasons, it is better to fix the tube for transparency testing in a test-tube support.

Sample collection and preparation for testing:

Samples should be collected in glass bottles and plugged with stoppers. Actual testing should preferably follow the sampling immediately. However, if storage is inevitable, the samples should be kept in a cool dark room for no longer than for 24 hours; prevent the water sample from contacting the air and acute temperature change. If samples are stored cooled, keep them at room temperature for a while prior to testing.

Testing:

1. Fix the tube for transparency measurement in the test tube support. Mix the sample thoroughly and put it into the tube. Screen the tube against side light and place it above the laminated font sample or the adjustment mark.
2. Observe transparency of the sample from the open side of the tube at sufficient upper lighting.
3. Gradually lower the level of water by pipetting it until the sample font or the adjustment mark becomes visible.
4. Identify the maximal height of the liquid, h (mm), by the marks on the tube when the adjustment mark becomes visible.
5. Register the measurement data of the water column height with 10 mm accuracy.

Conclusions:

Like odor, water turbidity can be caused by natural or anthropogenic causes. As turbidity of surface waters is often caused by the presence of phytoplankton and zooplankton or clay or silt particles in the water, conclusions should be made bearing in mind that this value depends on the time of flood (low water level) and varies in the course of the year.

If it has been determined that turbidity has anthropogenic origin, then there is a good reason to start looking for the source that impacts the increase of its level. In particular, industrial or household wastewaters can be such a source.

In any case, after analysis of turbidity, the data should be compared with existing standards (if any) for turbidity of natural waters. The World Health Organization does not regulate even drinking water turbidity regarding the impact on public health, but there are standards from the viewpoint of visual appearance and for disinfection purposes.

§ 4. Color

The color of water is a characteristic conditionally adopted for the description of the color of natural and drinking water. It is an indirect indicator of the amounts of organic substances diluted in the water. It depends on the quality and structure of the water bottom, the type of aquatic vegetation, the relief and soils of banks, presence of wetlands and peatlands in the water catch basin, etc.

Model of qualitative analysis of water color

Equipment: Test tube of 10-12cm height; sheet of dark paper (for the background)

Testing:

1. Fill the test tube with water up to the height of 10-12cm.
2. Determine the water color by looking at the test tube on the white background from above with sufficient side lighting (daylight or artificial lighting). Select the most relevant color from table 3 or fill in the free box in the table.

Table 3.
Water color

Slightly yellowish	Brownish
Light yellowish	Red-brownish
Yellow	Other (indicate)
Intensive yellow	

Method of quantitative analysis of water color

The method of quantitative analysis of water color is based on visual comparison of the color of analyzed water with an artificial standard color chart created by diluted solutions of potassium bichromate and cobaltic sulphate.

The color of water is measured in color degrees by visual comparison of the sample with the color scale of reference solutions:

0°; 10°; 20°; 30°; 40°; 60°; 100°; 300°; 1000° for the case of model reference solutions of the cobaltic sulphate chart;

0°; 30°; 100°; 300°; 1000° for the case of reference film chart.

The volume of the sample that is necessary for determination should be at least 12ml. The duration of testing should not exceed 5 minutes.

Equipment and chemical reagents:

Cobalt-chrome color chart in the form of model reference solutions (9 solutions; see the description of their preparation below);

Note. Service life for cobalt-chrome color chart solutions is six months from the moment of production.

Laboratory funnel, color comparison tube, test tube support, blue band filters;

Reference film chart of sample colors for visual measurement of color value "Tsvetnost".

Sample collection and preparation for testing:

Samples should be collected in glass bottles and plugged with stoppers. Actual testing should take place no later than six hours after sampling. In presence of suspended particles, samples should be filtered through a "blue band" paper filter. Discard first portions of filtered material.

Testing:

1. Fill the color comparison tube with sampled water up to the brim so that a meniscus lens would appear. Holding the tube in vertical position with the hand, plug it with a stopper. Make sure that the o-ring is fit tight.
2. Retrieve samples of reference solutions from the pack and place them with stoppers downward on a smooth horizontal surface on a white background.
3. Turn the tube with tested water stopper downward and compare the color of the tested sample with the standard chrome-cobalt color chart or the film control chart of reference film chart of colors for visual measurement "Tsvetnost", observing the water color from above on the white background with sufficient lightning. Identify the closest color field of the film chart or the color sample of the chrome-cobalt chart and the corresponding value in color degrees.

Note. If the water color and tone do not correspond to model calibration samples of the chrome-cobalt chart, then these indexes should be evaluated qualitatively, e.g., "the color of the sample is red-brown."

Preparation of solutions for the color measurement chart

1. Preparation of the main standard solution (solution № 1). Place quantities of potassium dichromate (0,0875 ±0,0010) g and (2,0000±0,0010) g of cobaltous sulphate, which shall be measured with analytical balances, into a measuring cup of 500 ml capacity; pipette 1.0 ml of concentrated sulphur acid into it, dilute it with distilled water, and make up to volume. The solution corresponds to 1000° color degree.
2. Preparation of the sulphur acid solution (solution № 2). Pipette 1.0 ml of concentrated sulphur acid of 1.84 g/sm³ density into a 1000 ml measuring cup and make up to volume with distilled water.
3. The 50ml Nessler cylinder set is used for preparation of the color measurement chart. The chart of calibration solutions for color measurement is prepared following the algorithm described in the text of the manual and Table 4. Reference solutions for color measurement remain stable for six months.

Table 4.

Algorithm of preparation of the chart of reference solutions for color measurement

Name of the solution and order of its utilization	Amount of solution, ml								
	Number of the calibration solution (sample)								
	1	2	3	4	5	6	7	8	9
Main standard solution with 1000° color degree (solution № 1)	-	0.5	1.0	1.5	2.0	3.0	5.0	15.0	50.0
Solution of	Make up to volume of 50 ml in each cylinder								

sulphur acid (solution № 2)									
Color degrees	0	10	20	30	40	60	100	300	1000

Conclusions:

A high color degree is an alarming sign of water problems. It is very important to find the origin of the color. For example, the yellow or yellowish-brownish water color indicates presence of iron and humic compounds, which are generated with digestion of vegetation. This means that water coloring is not always an indication of anthropogenic pollution.

When finalizing findings on the water color classification, it should be taken into consideration that in accordance with water quality requirements in recreation zones, no color should be visible in water column of 10cm height.

Intensive water color worsens its organoleptic qualities and has a negative impact on the development of water vegetation and aquatic animals as a result of dropdown concentration of diluted oxygen in the water which is consumed for oxidation of iron compounds and humic substances.