Coalition Clean Baltic
For protection of the Baltic Sea environment

River monitoring

Manual for public environmental monitoring

APPENDIX 7. Determination of biogenic elements

Biogenic elements (biogens) are traditionally understood as elements present in considerable amounts in living organisms (nitrogen, phosphorus, sulphur, iron, calcium, magnesium, potassium, etc.). The issues of water quality control and environmental assessment of water reservoirs have introduced a more specific meaning into the concept of biogenic elements; they are referred to as compounds which are, first, products of metabolic activities of living organisms and, second, the "construction material" for living organisms. These are, firstly, nitrogen compounds (nitrates, nitrites, organic and non-organic ammonia compounds) and, secondly, phosphorous compounds (orthophosphates, polyphosphates, organic esters of phosphoric acid, etc.).

§ 1. Nitrates

In water reservoirs, nitrogen compounds from external sources transform from one form into another. For example, during the first several hours after manure discharge into water, an increased content of ammonium cations can be detected; then ammonium cations transform into nitrites and then almost immediately after into nitrates. This shows that nitrates are an accumulating characteristic and its measurement is the easiest for volunteer researchers. Nitrates are salts of nitric acid.

The method for nitrate anions measurement in water is a unified method based on visual comparison of the color of a sample with the control color scale of reference solutions with different content of nitrate anions.

Measurement of nitrate anions is based on preceding reduction of nitrate anions to nitrite anions with subsequent formation of azoic color in the presence of sulphanilic acid and α-naphthylamine by the reaction described for nitrite determination.

The range of nitrate anions in water varies from 0 to 50 mg/l.

The volume of the sample needed for testing is 6 ml.

The time of testing should no exceed 25 minutes.

Equipment and chemical reagents:

Zincous reducing powder agent; α-naphthylamine solution, sulphanilic acid solution;

Dropper pipette for 3 ml; two 5 ml graduated test tubes with caps; two flasks for measurement with 10 ml marks, flask for preparation of nitrate anion reagent; spatula;

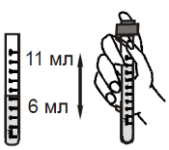
The "Nitrate anions" control color scale for visual measurement (0–10–30–50 mg/l) from the test kit.

See the description of preparation of solutions and reagents below.

Test preparations:

Preparation of the nitrate anion reagent. Measure equal volumes of α-naphthylamine solution and sulphanilic acid solution using graduated test tubes and mix them in the flask to make the nitrate anion reagent. Prepare the reagent in the amount necessary for testing and use it the same day.

Testing:



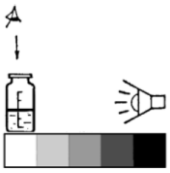
1. Rinse the graduated test tube with analyte water. Collect 6 ml of analyte water (sample) into it, complete with distillate up to 11 ml mark, and mix.

2. Add 2.0 ml of fresh nitrate anion reagent to the content of the test tube, cap it and shake up to mix the solution.

3. Add 0.2 g of zincous reducing powder agent to the content of the test tube using the spatulas (0.2 g of the powder fill ½ of the spatula's depth with no heap). Cap the test tube and mix thoroughly.

4. Leave the test tube for 15 minutes for full completion of the reaction and shake it up periodically.

5. Pour the solution from the test tube into the measurement flask up to the 10 ml mark trying not to let any residuum into the flask.



6. Make visual measurement of the sample. To do this, place the flask onto the white field of the control scale and, illuminating it with dissipated white light of sufficient intensity, identify the field of the control scale that is the closest by coloring and the corresponding value of nitrate anions in mg/l.

Test accuracy control

Accuracy control for nitrate measurement is performed using reference solutions or using verified (reference) nitrate meter.

Preparation of solutions and reagents:

Preparation of the basic nitrate anion solution

Place a quantity (1.6300±0.0010) g of potassium nitrate, which should be weighted on an analytical balance and preliminarily dried up to permanent mass at 100–105°C, into the measurement flask of 1000 ml capacity, dissolve it in 200–300 ml of distilled water, and complete the volume of the solution to the mark. The solution received contains 1.00 mg/ ml of nitrate anion.

The solution is stable within 6 months if kept in a refrigerator.

Preparation of standard solution with 0.05mg/ ml concentration

Using a pipette, place 5.0 ml of the basic solution with 1.00mg/ ml concentration into the measuring flask of 100 ml capacity and complete the solution up to the mark with distilled water.

Table 1

Algorithm for preparation of the scale of reference solutions for measurement of nitrate anion solutions

Name of the solution and the order of its use	**Amount of solution, ml**					
	Number of the standard solution (sample)					
	1	2	3	4	5	6
Standard solution with nitrate anion concentration 0.05mg/ ml	-	1.2	2.4	2.6	4.8	6.0
Distilled water	6.0	4.8	3.6	2.4	1.2	-
Distilled water	5.0 ml to each sample					
Nitrate anion reagent	2.0 ml to each sample					
Zincous reducing powder	0.2 ml to each sample					
-	The sample is poured into the measurement flask up to the 10 ml mark not allowing any floc into it					
Content of nitrate anions in the sample	0	00.6	0.12	0.18	0.24	0.30
Concentration of nitrate anions in the 6.0 ml sample; mg/l	0	10	20	30	40	50

Reference solutions for nitrate anion measurements are stable for three months if kept in hermetically capped test tubes in a dark cool place.

Conclusions:

Increased content of nitrates in water can be an indicator of water reservoir pollution in the result of dissemination of faeces or chemical pollutions (residential, agricultural, and industrial). Many mineral fertilizers contain nitrates which can pollute water reservoirs in case of excessive or non-rational application. Other possible sources of water pollution are surface effluents from pastures, cattle farms, milk farms, etc. Nitrates stimulate mass development of aquatic growth (primarily blue-green algae) and accelerate eutrophication of water reservoirs.