Coalition Clean Baltic
For protection of the Baltic Sea environment

River monitoring

Manual for public environmental monitoring

APPENDIX 4. Chemical methods of water quality classification

The majority of field methods for determination of water quality indexes are chemical, because they allow to determine content of chemical components in the composition of water and are based on chemio-analytical reactions. Two simple chemical methods are frequently used for this, namely, the colorimetrical and titrimetric methods for water quality testing.

The visual colorimetrical method is the most acceptable for public environmental testing and the most practical for use are water test strips. However, if the leader of the monitoring group is a chemist, the titrimetric would give a more accurate result.

Chemical methods allow to determine general and consolidated indexes of water quality (diluted oxygen, power of hydrogen, BOD, COD, total phosphorus, etc.), content of biogenic elements, metals, and organic pollutants, e.g., SASs.

The colorimetrical and titrimetric methods are described below[1]. You can read more in the Appendixes describing determination of specific indexes.

The colorimetrical method of water analysis

The colorimetrical (from the English word *color*) method is based on the comparison of the qualitative and quantative variation of visible light flows passing through the solution in question and the reference solution. The analyte component is transferred into a colored compound using a chemio-analytical reaction; after that, the color intensity of the resulting solution is measured. The method of measuring colors of samples with a photocolorimeter is called photocolorimetric analysis. Correspondingly, the method of visual measuring colors of samples (e.g., comparing the intensity of coloring with certain samples) is named visual colorimetric method.

After processing and adding reagents the samples acquire colors. The intensity of coloring is the measure of concentration of the analyte component. In case of visual colorimetric method (pH, total iron, fluoride, nitrate, nitrite, ammonium, total metals), the determination is carried out in colorimetrical test tubes with “5ml” marks or in bottles with “10ml” marks. Colorimetrical test tubes are the broadly used ordinary test tubes of colorless glass with (12.8±0.4) member diameter. Colorimetrical test tubes can have several marks (“5ml”, “10ml”) indicating their capacity (and, correspondingly, their height) to be filled with samples to provide practical and close conditions for visual measurement. Normally, the colorimetrical test tubes should be of identical shape and diameter because the latter affects the height of the colored solution. Bottles for color measurements should be selected in a similar way (routinely these are pharmaceutical vials with the diameter up to 25mm). The most accurate results in visual colorimetrical method are achieved if the sample color is compared with coloring of the model reference solution. Remember that colors emerging in the process of colorimetrical testing are usually quite unstable; for that reason, descriptions of solution preparation might include indications of their shelf life.
To simplify visual measurement, in the field analyses colors of sample solutions may be compared not with reference solution colors but with a printed control strip presenting coloring (color and intensity) of model reference solutions prepared with a standard concentration value of the target component. The control strips used for visual measurements for certain test sets are shown on the color insert. The result of visual measurement is assumed as the concentration of the component in the closest (by color) sample of the control scale or the reference model solution. The result of the analysis should be presented in the following form:
“close to _____ mg/l”.

[1] A.G. Muraviev. *Manual for Determination of Water Quality Indexes in Field Conditions* – 3rd edition, added and reworked – SPb.: “Christmas+”. – 220 p.

Concentration value on the strip

In the cases when coloration of the sample solution in the colorimetrical test tube seems to have intermediate intensity between certain samples on the control strip, the analysis result should be presented in the following form:

“from _____ to _____ mg/l”.

If coloration of the sample solution in the colorimetrical test tube is more intensive than the extreme sample on the control strip with maximal concentration, the sample should be diluted. After repeated measurement, a correction coefficient should be introduced to take into account the degree of sample dilution. The analysis result in such case should be presented in the following form:

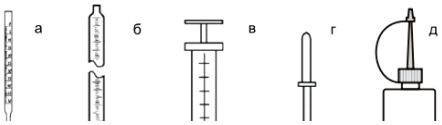
“more than _____ mg/l.”

Maximal concentration value on the strip

Using field methods to perform analyses in expeditions it is rather practical to measure using field colorimeters, e.g., SMART field colorimeter (LaMotte Co., USA). ZAO Christmas+ supplies colorimeters of various types equipped with a set of removable color filters for a broad scale of wavelengths in the visual light band.

The titrimetric method of water analysis

To perform analysis by titrimetric method (carbonate, hydrocarbonate, chloride, calcium, total hardness), measurements should be carried out in bottles or test tubes of 15–20 ml capacity with a 10 ml mark. In the process of titration, stir the solution with a glass stick or by shaking it up. For analysis of low-mineralized waters it is expedient to use volumetric solutions with reduced concentration (0.02–0.03 mol/l) which can be made by dilution of more concentrated volumetric solutions with distilled water. For convenience of working with test tubes, put them into apertures of a turbidimeter or fix them in test tube supports.

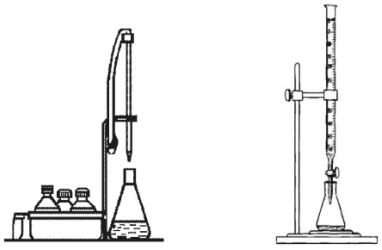


Pic. 1. Solution metering devices:
a) stopcock burette; b) measuring pipette; c) syringe dispenser; d) pipette dropping bottle; e) dropper bottle.

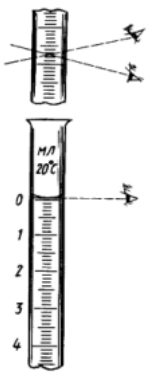
Required volumes of solutions for titration should be measured with a burette, a measuring pipette, or another simple metering device like syringes, calibrated dropping bottles, etc. Stopcock burettes are the most functional for titration.

For convenience of filling measuring pipettes with solutions and titration they should be connected hermetically with a rubber squeeze bulb using a rubber connecting tube. ***It is prohibited to fill the pipettes with solutions by sucking it with the mouth!***

It is even handier to work with measuring pipettes by fixing them in a holder next to a medical syringe connected hermetically with the pipette by a flexible tube (rubber, silicone, etc.).



Pic. 2. Titration unit fixed in a holder
a) measuring pipette; b) stopcock burette.



Remember that for measuring volume of the solution in burettes, measuring pipettes, and measuring bottles, the measurement should be made by the lower meniscus of the liquid (water solutions always have concave menisci). At that, the observer’s eye should be at the level of the mark. Do not blow off the last drop of the solution from the pipette or burette. It is also necessary to know that all measuring glassware is calibrated and graduated at the temperature of 20°C; this is why the temperature of the solutions should be close to room temperature when using pipettes, burettes, and dropper bottles. When using measuring bottles, try to keep the temperature of the solution close to 20°C; the sizable volume of the measuring bottle leads to noticeable errors in volume measurements (at the account of thermal expansion or contraction of the solution) in case of more than 2-3°C temperature deviations from 20°C.