Module 16

Practicing Simple Water Quality Tests

Summary

In this module, a whole range of steps concerning water quality testing is introduced: taking and managing a water sample, assessing turbidity of water, odour and colour, doing a pH test and nitrate quick test, recording the measured data and suggestions for related exercises.

Objectives

Pupils can take and label water samples, carry out some related water tests such as some quick tests. They are made aware of the organoleptic character of water (odour, colour, taste, turbidity). The results will be recorded adequately. Pupils learn how to work properly and record the results.

Key words and terms

Odour, taste, turbidity, colour, pH, acidity, alkaline, nitrate quick tests, pH indicator strips, water sample, recording.

Preparation/materials

Materials	Preparation
Several types of water from: tap, well and/or spring, canal, river and rain, vinegar, limestone	Pupils should bring several water samples
Labels and a water proof pen	
Several clean and clear drinking glasses, dish/tea towel	
Nitrate quick tests (range 10-500 mg/l), pH indicator strips or litmus paper, white paper	Nitrate quick tests and pH indicator strips could be obtained via an NGO or a company for laboratory and chemistry equipment
Forms for recording the results, Notebook for reporting the practice	Making copies of the forms for monitoring water quality

Practicing simple water quality tests

1. Taking and managing a water sample

There are certain rules that should be adhered to when sampling drinking water because the quality and reliability of drinking water analyses vary according to the way in which the sample was taken. There are many different types of contaminants and categories of sampling, yet here we concentrate on the ones appropriate for our purposes. Certain categories of analysis require an expert to take the sample. For bacteriological analysis, all tools used for the analysis of the water have to be sterile.

The vessel

One of the most important parts of taking water samples is using clean tools. It is important not to touch the inner side of the vessel or cover it with your fingers. Before the vessel is filled with water to be tested, it is good to rinse out the container once with the water you are testing. This is to reassure you have rinsed out anything in the bottle that might cause cross-contamination. For our purposes, a plastic or glass mineral water bottle of 300 or 500 ml can be used for the sample.

If you want to test the water on metals, pesticides or bacteria you should contact a laboratory and ask how to take the samples (the type of vessel and who should take the sample is essential).

Taking a drinking water sample – an example

Water samples can be taken from freshly extracted water from a well, spring or the tap. If the source is a tap, the best is to take the tap which is used for drinking and cooking, e.g. in the kitchen, and to let the water run for one or two minutes. Be aware that the return of the water should not be wasted, and that it can be used for watering the flowers or it can be given to animals.

A mineral water bottle can be used for sampling. The bottle should be filled completely and covered with a cap, and if possible, no air should be left in the bottle.

Labelling and recording

Write on a water resistant label and fix the label on the bottle:

- Name of the water sampler
- Date and time of sampling
- Name of the water user
- Location: complete address
- Type of source: e.g. tap in kitchen, dug well in yard, rainwater etc.
- Purpose of water: e.g. drinking water, irrigation

Besides labelling the bottle, it is very useful to keep records of the samples that have been taken and analysed in a "laboratory book". Remarks on the well's surrounding, leakages in the pipes or other relevant findings and observations should be noted. Finally, the results of the analyses and tests should be recorded in the book.

Storage of water samples

In general water samples should be stored in a cool and dark place. If several hours pass between sampling and analysing, the sample should be stored in the fridge or in some other cool and dark room (cupboard).

Location and time of carrying out water tests

It is wise to take the samples into the school laboratory, the classroom or the kitchen to do the tests properly. However, if the weather is suitable (no rain, not below approx. 15 ° Celsius), some tests can be performed outside directly at the water source. Nevertheless, indoor pupils can be more attentive, and since chemical analysis means working in a very precise way, it is advisable to be indoors.

Have in mind that some tests need to be done soon after taking the sample. Water is a liquid with several compounds, which can react and change for example the pH. If the sample is not tested soon, eventual present volatile chemicals could evaporate or the odour may change, therefore tests on pH, odour and colour should be done straight away. Nitrate has to be tested within 48 hours. Nitrate is a rather stable compound, however, if the sample is contaminated with bacteria the concentration can change.

Hygienic rules

Working tables should be clean. Tables can be covered with a fresh and clean towel.

- Wash your hands before doing the tests.
- Never touch the "chemicals on the strip" with your fingers.
- Never lay down test strips on the table or on the towel. The chemicals on the strip will react also with chemical traces on the table or towel.

http://en.wikipedia.org/wiki/Hand_washing#Soap_and_water

2. How to assess turbidity of water

Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye, similar to smoke in the air. The measurement of turbidity is a key test of water quality. Fluids can contain suspended solid matter consisting of many different sized particles. While some suspended materials are large and heavy enough to settle rapidly to the bottom of the container, if a liquid sample is left to stand (the settable solids), very small particles settle only very slowly or not at all. Small solid particles cause the liquid to appear turbid.

The turbidity of drinking water can be assessed visually in the field. A glass with 0,3 l volume is filled with water. It is held against the light. Turbidity is assigned to the categories: clear, weak turbid, medium turbid or strong turbid. Note if the suspended solids settle to the bottom of the glass after some time.

Samples of turbidity standards with 5, 50, and 500 NTU. Source: http://en.wikipedia.org/wiki/Turbidity

A more accurate measure of turbidity is based on the property that particles scatter light when a light beam is focussed on them. Turbidity measured this way uses an instrument called a nephelometer with a detector set up to the side of the light beam. More light reaches the detector if there are lots of small particles scattering the source beam than if there were few. The units of turbidity from a calibrated nephelometer are called Nephelometric Turbidity Units (NTU).

The Drinking Water Directive of the European Union (98/83/EC) stipulates that the turbidity of water should be acceptable to consumers and should not show any abnormal change. In the case of surface water treatment, EU Member States should strive for a parametric value not exceeding 1,0 NTU in the water ex treatment works.

3. How to assess taste, odour and colour

All water sources contain a number of naturally occurring minerals such as calcium, magnesium and iron. The varying concentrations of these minerals in water give rise to slightly different colours and tastes that can be detected easily. People, travelling to different parts of the country will be able to notice differences. Water also contains dissolved gases, such as oxygen and carbon dioxide that can give tap water a distinctive taste. Without these elements, water would taste flat and unappetising.

While relatively small quantities of water are colourless when observed by humans, pure water has a slight blue colour that becomes a deeper blue as the thickness of the observed sample increases. The blue tint of water is an intrinsic property and is caused by selective absorption and scattering of white light. Impurities dissolved or suspended in water may give water different coloured appearances. The presence of colour in water does not necessarily indicate that the water is not potable. Colour-causing substances, such as tannins, may be harmless.
Qualitative visual assessment of the watercolour can be carried out in the field by filling a 0.3 l volume drinking glass and holding it in front of white paper.

Different tastes and odours

The odour of drinking water samples can be determined by the olfactory sense of the sampler in the field, or the well-covered sample can also be taken indoors for testing. For the field test, a 0.3l glass is filled with water and the odour is determined by smelling. The intensity of the smell can be categorised as weak, medium or strong. The type of odour can be attributed to no odour, faecal, soil, chlorine and others.

In many centralised water supply systems, chlorine gas is added to drinking water during the final stages of treatment to kill any harmful germs that may be present. A small amount of chlorine remains in the water as it makes its way to customers' taps and gives the water a *chlorine* taste.
Water that passes through peaty land can have an *earthy or musty taste* and/or *odour.* Rubber and plastic hoses used to fill drinking water tanks or vending machines and hoses of washing machines and dishwashers can give rise to *a rubbery* or *plastic* taste. Copper, iron or galvanised pipes can cause a metallic or bitter taste.

Spilled heating or motor oil or petrol on driveways and gardens can adversely affect the ground water. A plastic service pipe located in this area can also adversely affect water. If *petrol or a chemical* taste or odour is detected in the drinking water, the customers should contact the water supplier.

4. How to do a pH test

pH is the unit of the acidity or alkalinity of a solution. Pure distilled water at 25°C has a pH level of 7 and is called neutral (the measurement scale ranges from 0-14). Acids are defined as solutions that have a pH less than 7, while bases (alkaline) are defined as solutions that have a pH greater than 7. The normal range for pH in surface water systems is 6.5 to 8.5, and the pH range for groundwater systems is between 6 and 8.5.

The drinking water directive of the European Union indicates the pH units in drinking water should not be aggressive which means not less than 6,5 and not exceed 9,5 pH units.

pH		
1	Gastric acid	Acid
2	Lemon juice	
3	Apple, orange	
4	Tomato juice	
5	Black coffee	
6	Milk, Urine	
7	Destilled water	Neutral
8	Sea water	Alkaline
9	Baking soda	
10	Soap	
11	Ammonia solution	
12	Soapy water	
13	Bleach	
14		

Examples of some liquids and their pH (acidity/alkalinity)
Source: http://en.wikipedia.org/wiki/PH

How to use the pH indicator test strips:

- Water temperature should be about 20°C when it is measured because the pH level depends on the temperature as well.
- Dip the strip for 1- 3 seconds for reaction to take place and compare strip to colour chart.

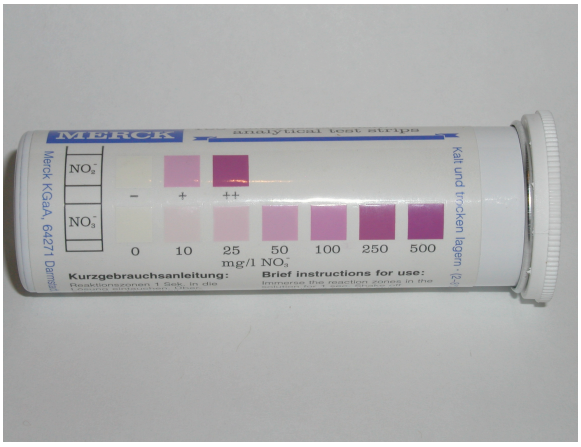
Litmus tests can be applied to indicate if a liquid is acid or alkaline. Litmus strips are cheaper than pH indicator test strips, however they are not as precise.

5. How to do quick nitrate tests

Nitrate in water is undetectable without testing because it is colourless, odourless, and tasteless. Nitrate in drinking water can be a problem, especially for infants. A water test is the only way to determine the nitrate-nitrogen concentration and ascertain whether it is under the acceptable EU standard of 50 mg/l.

A quantitative nitrate test is usually done in a laboratory, but with nitrate quick tests strips, a very good and reliable impression on the rate of the nitrate concentration in water can be gained. Nitrate test strips give a semi quantitative result, and fulfil the purpose of detecting a nitrate contamination or not. Although the tests are easy to carry out, some regulations have to be followed:

1. Read the instructions of the package carefully. Assure a clean and proper working place.
2. For testing the nitrate concentration in water, keep the strip just one second in the water sample and shake excess water from the strip very gently.
3. Wait one minute and compare the developed colour with the colour scale on the tube.
4. Do not test nitrate in an area with a temperature below 15° Celsius. During times with cold temperatures the chemical reaction of test strips is decreased. Therefore please take the sample to a warm location for testing.
5. In case of unexpected results, it is necessary to repeat the analysis. For this reason, pour a new sample into a clean glass and repeat the procedure as described above.
6. Please be aware that the test strips are not suitable for chlorinated drinking water.
7. If no tests are carried out between testing phases, please cover the test strip tube with the lid.
8. Store the well-closed tube in a cool place. The fridge is the best place.



Nitrate testing tube containing test strips, measuring the nitrate concentration of water with a range from 0 – 10 – 25- 50 -100- 250 – 500 mg/litre are very suitable.

It is possible to cut the test strip lengthways and make two strips from one strip. Please work very clean and hygienically and use very clean scissors. Never touch the nitrate indicator with your fingers and do not lay the strips down anywhere, like on the table.

6. Recording the results

Recording and reporting the sample type, tests carried out, results and observations are the basis for communication and keeping track of developments. Recorded results should be readable, understandable and transparent to all concerned stakeholders. Please record at least the following information of sampling: date and location (street, house number, village), source of water, some information about the environment of the water source, and the results. See also module 17.

7. Exercises and questions

- Pupils test different liquids such as vinegar, soap, fruit juice, loamy water, rainwater and tap water on pH.
- Which different nitrate results are observed after testing various types of water/liquid?
- Which observations of turbidity, colour and odour of the tested liquids can be made? Discuss the differences.
- Pupils record all the results and observations, presented and discussed.

WSP related activities

- Each participant could take samples from water sources in their environment, carry out an adequate labelling of the samples, test the samples and record the results. Individual wells and several taps in households that are served by the public water supply could be tested this way.
- Compare the collected results and get an overview on how clean the groundwater is.
- The water supplier should be asked about available results of water tests, and about the frequency of the analyses and the location of sampling. Discuss these results and experience.

8. Text sources and further reading

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