



USING FIELD CHEMISTRY KITS FOR MONITORING NUTRIENTS IN SURFACE WATER

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Measuring Nutrients in Surface Water

Field chemistry kits can be used to measure concentrations of nutrients like phosphorus and nitrogen in surface waters. This factsheet provides general information on the types of kits that are available.

Nitrogen and phosphorous are nutrients that promote plant and algae growth in aquatic environments. These nutrients are found in organic forms (not immediately available for plant use) and inorganic forms (immediately available for plant use). Organic forms of nutrients are eventually converted to inorganic forms.

Typically, all forms of nutrients are measured in surface water even if they are unavailable for plant use in the short term. The forms of phosphorus that are usually measured include Total Phosphorus (TP), Total Dissolved Phosphorus (TDP) and the inorganic component, Orthophosphate (PO_4). The forms of nitrogen that are usually measured include Total Nitrogen (TN) or Total Kjeldahl Nitrogen (TKN), and the inorganic forms of Nitrate (NO_3), Nitrite (NO_2) and Ammonium (NH_4).

Field chemistry kits are useful for measuring the inorganic nutrient components and will give basic information on the level of nutrients in the water.

Some sophisticated kits can measure Total Phosphorus and Total Nitrogen, but these are not discussed here as they require more complicated sample processing, not suited to field applications.

Types of Kits

There are many types of field kits available. There are also many manufacturers of field kits. In general there are few differences between manufacturers of similar kits, but there are large differences between types of kits. Three common types of field kits include: Test Strip Kits, Visual Comparator Kits, and Photometer Kits. Within the 3 types of kits, visual comparator kits will have the most differences among the various manufacturers of kits because different technologies are used for the colour comparators.

Test strip kits

Test Strip Kits use pre-treated paper strips (Photo 1). When the strip is dipped into a water sample, it turns a colour and the colour is matched to a paper colour comparator to determine the concentration of the parameter. Test Strip Kits are very inexpensive (usually under ~\$30) but usually provide coarse information and are not as useful for low values (concentrations of less than 1 mg/L).

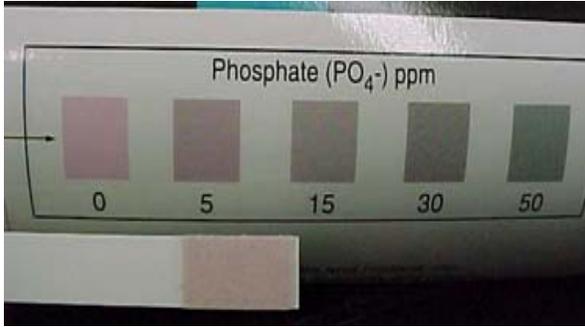


Photo 1: Example of a Phosphate Test Strip
Visual comparator kits

Visual comparator kits require the addition of various chemical reagents to the sample. The sample then turns a colour which is compared visually to a colour comparator to determine the concentration of the parameter.

The colour comparators are usually either a transparent coloured wheel (Photo 2) or a set of liquid colour standards (Photo 3). Some manufacturers incorporate the use of a sample blank, which allows for correction of colour comparisons when the sample is naturally highly coloured. Kits that use colour blanks are advantageous for surface water applications.



Photo 2: Example of a Colour Wheel Comparator manufactured by HACH
 (inset: close-up of colour wheel)

Visual comparator kits are somewhat more expensive (~\$100) but can provide readings for low values between 0 and 1 mg/L, often at steps

of 0.1 mg/L. Most kits will provide enough reagents to complete anywhere from 30-100 tests. The colour comparators and the reagents usually have a shelf-life and may be purchased separately. Typically colour wheels have a longer shelf life than liquid comparators. Comparators should be stored in the dark.



Photo 3: Example of a Set of Liquid Colour Standards manufactured by CHEMetrics

Visual kits are often the first choice of kits by volunteer groups because they are relatively inexpensive, but will still provide valuable information. Some of the key considerations in choosing a visual comparator field kit are described in Table 1 on the following page.

Photometer kits

Photometer kits also require the addition of various chemical reagents to the sample. When the sample turns a colour it is placed in a photometer and the photometer records the percentage of light transmittance through the sample at a specific wavelength, and converts that to a concentration (Photo 4). The use of a photometer removes the human subjectivity that occurs when comparing the colour of the sample to a colour standard.

These kits are the most expensive (\$1000-\$2000), but can provide readings at very low concentrations and at steps ranging from 0.001 to 0.01 mg/L. Once the photometer kit is purchased, only reagents need to be re-purchased (~\$50-\$100 for 50-200 tests).

Table 1: Key Considerations in Choosing a Visual Comparator Field Kit

Consideration	Excellent	Average	Poor
Ability to Accurately Interpret Value	Colour comparator uses a sample blank to account for colour in the sample and Colour comparator has small graduations (.01-.02 mg/L) in colour change thus allowing for accurate assessment of value	Colour comparator uses a sample blank to account for colour in the sample but Colour comparator has large graduations in colour change thus requiring interpolation between values	Colour comparator does not incorporate the use of a sample blank
Ease of Use in Field	Reagents contained in self-filling vacuum- sealed ampoules	Reagents for each test contained in individual packets	Reagents contained in bulk containers thus requiring measuring of the reagent for each test
Longevity of Kit	Reagents and colour comparators have a shelf-life of 2-3 years	Reagents or colour comparator have a shelf life of 1-2 years	Reagents or colour comparator have a shelf life of less than 1 year
Minimum Detection Limit	0.05 mg/L	0.1 mg/L	0.2 mg/L
Approximate Time to Complete Test	< 5 min	10 minutes	> 15 minutes
Hazardous Materials	None produced	Small amount produced	---



Photo 4: Example of a Photometer manufactured by Palintest.

General Considerations for All Kits

Concentrations of phosphate, nitrate, nitrite, and ammonium are often less than 1 mg/L in many lakes and streams throughout the year. It is usually advisable to first test a sample using low range procedures (0-1 mg/L) because more often than not, the sample concentrations will fall below 1 mg/L.

There are several guidelines that should be followed in order to use the kits safely and effectively:

- It is important to rinse instruments in the kit with distilled de-ionized water before and after completing a test. Residue from past experiments will give false conclusions.
- Read the instruction book carefully before and during the test. It is very important to have the right amount of sample water. The temperature of the water and turbidity may also need to be at a certain level to ensure errors do not occur. All of these things are made clear in the instruction manual and should be followed to achieve accuracy in results.
- All tests should be done in sunlight or good indoor light in order to compare colours accurately.
- Some tests (typically nitrate) produce hazardous waste which must be disposed of properly and according to local guidelines.

- If you do not believe the test kit is giving you accurate results there may be something in your water which is causing errors. For example, metals, oil, grease, and chlorine may alter your test results.

Hazardous Waste Disposal

Some of the tests in these kits (typically nitrate tests) produce hazardous waste which needs to be disposed of properly. In most cases, the amount of waste generated from these kits is very small.

The best way of disposing of the waste is to place the waste in a secure container filled with kitty litter and disposed of at a Toxic Waste Round Up, or taken to an Eco-Station where it can be disposed of appropriately.

Some urban centres allow disposal of small volumes of waste by flushing the sample down the drain with lots of running water because it will be

treated at the wastewater treatment plant. **It is important to check with the appropriate facility before disposing of the waste down the drain as not all wastewater treatment plants can handle the waste.**

The Big Picture

Preference of the type of field chemistry kits will be very specific to the user. A decision on which type of kit to use, and which manufacturer of kit to purchase should be made based on the objective of the sampling, the physical characteristics of the water that is being sampled, and the environment under which the sampling will be done. See Table 2 for the comparative summary.

For more information on protecting and improving rural water supplies, contact your nearest Agriculture and Agri-Food Canada - PFRA office, or visit the Prairie Farm Rehabilitation Administration web site at www.agr.gc.ca/pfra.

Table 2: Comparative Summary of Chemistry Kits for Nutrients in Surface Water

	Test Strip Kits	Visual Comparator Kits	Photometer Kits
Applicability to Low Values	Poor	Average	Excellent
Degree of Subjectivity in Interpolating Results	High	Average	Low
Cost	Low	Average	High
Ease of Use	Very Easy	Easy	Easy
Best Application	Awareness	Awareness and General Monitoring	General or Dedicated Monitoring

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