

Phosphorus

Purpose

Along with nitrogen (N), phosphorous (P) is one of the most common growth-limiting nutrients for plants in terrestrial and aquatic ecosystems. The role of phosphorus is critical in aquatic ecosystems. Systems with too much phosphorous accumulate algae and other plants that consume oxygen as they die and decompose. This can kill large numbers of fish. This process, called eutrophication, is the leading problem in Kansas lakes and ponds. Most lakes and almost all ponds in Kansas are moderately to severely eutrophic.

Phosphorus can enter surface water from many sources, including industrial waste, wastewater treatment plant effluent, septic system leakage, storm water runoff, runoff from agricultural land and livestock wastes. A permitting process allows municipal sewage treatment plants a certain level of phosphorous in the discharge to rivers and streams. Soil runoff from the erosion of land recently treated with fertilizer or manure can be a major source of phosphorus in rural watersheds. This includes runoff from livestock

lots, manure storage, or composting areas. Field runoff sources can be minimized by incorporating nutrients at recommended rates based on soil tests, implementing soil conservation practices within fields, and establishing perennial grass or forested field buffers and stream riparian areas.

In water, phosphorus may be present in a plant-available, soluble form (orthophosphate) and in a variety of forms that are not immediately available to plants, such as dissolved and suspended organic matter, decaying residues, living cells and various phosphate minerals. Unlike nitrogen, most of the phosphorus in soil or sediment is tightly bound to mineral particles as mineral precipitates or as adsorbed organic material. When this material reaches a stream or lake, some of this phosphorus is released, leading to a temporary increase in orthophosphate and a long-term increase in eutrophication. High levels of total phosphorus are routinely found in silt-laden runoff from agricultural fields.



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Phosphorus

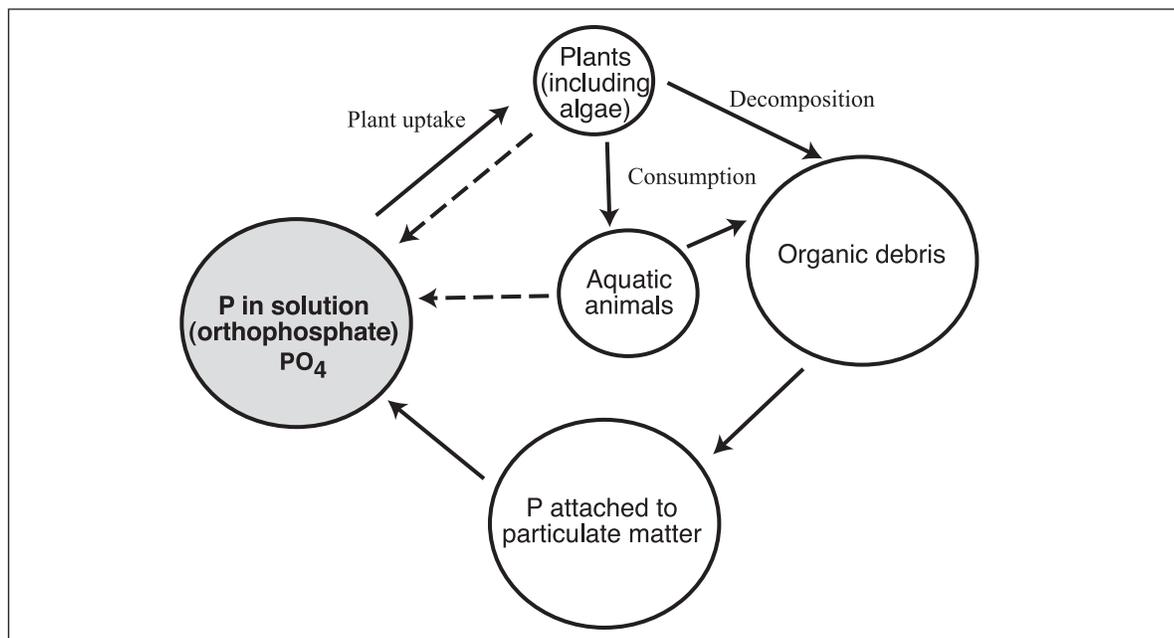


Figure 5-1. Phosphorus cycle in water. Phosphorus entering the water cycle may come from plants, animals, organic debris, phosphorus attached to eroded soil, or soluble P coming in from fields, livestock lots, or household waste systems.



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Procedure

1. The water sample should be as fresh as possible (less than 24 hours since sampling) and if the test is not run immediately, the sample should be stored in the refrigerator. Fill the sample cup (in the black CHEMets case) to the 25 ml mark with the sample.
2. Add two drops of A-8500 activator solution. Cap the sample cup and shake it briefly to mix the contents well. (Figure 5-2)
3. Place the CHEMets glass tube (ampoule) in the sample cup with the pointed end down. Hold the ampoule at a diagonal in the cup, bracing the tip against the raised part of the bottom. Snap the tip by pressing the ampoule against the side of the cup. Push hard, especially if it is the first time this is done. (Figure 5-3)
4. The ampoule will fill, leaving a small bubble to facilitate mixing. Mix the contents of the ampoule by inverting it several times, allowing the bubble to travel from end to end each time. Wipe all liquid from the exterior of the ampoule. Wait at least two minutes for color to develop after filling the ampoule and mixing the contents. (Figure 5-4)
5. Hold the CHEMets ampoule next to the 1 to 10 ppm comparison tubes in the lid of the CHEMets box. Read the color closest to the color in the tube, or estimate the value if it is between two color intensities. If the blue color in the sample tube is lighter than 1 ppm, place the sample tube (flat end down, sharp end up) into the center section of the comparator tube located in the right-hand section of the box. Hold this tube up to a light or to sunlight, and look at the intensity of the color as compared to the 0 to 1.0 scale. Read the number closest to the value in the sample.

Note: The test kit samples only the orthophosphate form.



Figure 5-2. Add 25 ml of water to sample vial, then add two drops of activator solution.

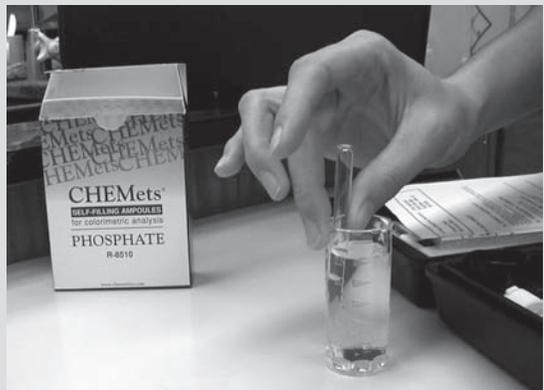


Figure 5-3. Break off the tip of the glass ampoule under water.

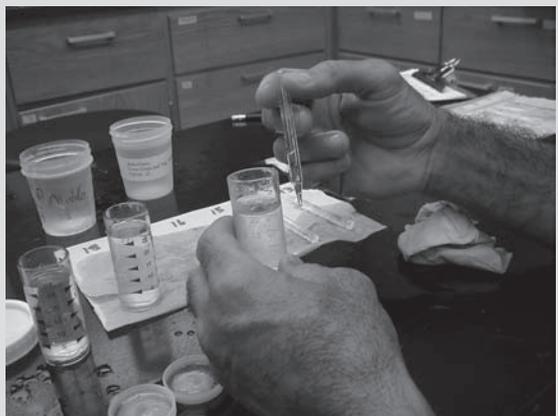


Figure 5-4. Use the bubble to mix the sample. Then read the blue color indicator.

Tools

CHEMets orthophosphate test

We compared several phosphorus test kits to commercial lab results. Some test kits are not accurate, and others are too complex for field

use. We recommend the CHEMets kit because it is accurate, easy to use, and reasonably priced. Directions in this fact sheet are specific for this kit. Results are presented as PO_4 , similar to an agricultural soil test, rather than $\text{PO}_4\text{-P}$, more common for water samples. Store the kit at room

temperature between uses. You will also need a water scoop, sample containers, and distilled water to rinse the test-kit mixing container. This kit comes with glass vials instead of plastic test strips, so handle them carefully and dispose of them properly after running the test. Because of the sharp glass, this test kit is not appropriate for young children. An adult should run the test, but someone younger can complete the color comparison.

Tips

Sometimes samples appear cloudy or gray rather than a shade of blue, especially if the water has a heavy silt load. This can be a problem in runoff after it rains. Although some phosphorus may be attached to these fine particles, this test detects only soluble phosphorus, so it is okay to run these water samples through filter paper or let them settle for a few hours while refrigerated, and then repeat the test using clear water.

Many detergents contain phosphates, so do not wash sampling containers or the sample cup in this kit with soap or detergent. To clean, rinse at least twice with distilled water and air dry. Phosphorus can adhere to plastic, so if a high-phosphorus sample stands in a plastic container for a long time, discard or rinse with dilute acid, such as clear vinegar, before using it for other samples. If you suspect contamination, run a distilled water control sample using the plastic container. Distilled water should have no detectable orthophosphate.

Interpretation

Phosphate is not toxic to animals, but the Kansas Department of Health and Environment has established a level of 0.1 ppm phosphorus as a numeric criteria for chronic effects on aquatic life based on eutrophication. Detectable levels of orthophosphorus are rarely found in surface

water unless there have been recent additions from some source. Thus, any phosphorus detected with the CHEMets test kit should indicate a recent addition of phosphorus that has the potential to cause eutrophication. The CHEMets kit gives a reading as PO_4 , which is three times greater than the equivalent phosphorus value, so the chronic criteria level will be 0.3 using the test kit. These scores are based on data collected during the pilot test of these test kits and comparisons to other Kansas stream and pond data.

What to do if your water test shows high PO_4 ?

If the water you have tested is higher than 0.3 ppm PO_4 , the first thing to do is to consider where the P may be coming from. If you are testing a stream or river at high water or flood stage, the P could be coming from many different places that have washed into tributaries and combined to create the high level. If you are testing in an agricultural area, look for areas where fertilizers, manures, or soil are contributing phosphorus. In rural environments, P can also come from field runoff, damaged septic systems, tile subsurface drainage in fields with pipes that empty into streams, and pipes from permitted rural or suburban sanitary waste treatment plants.

Look at maps, the landscape, and talk to people who may be aware of possible phosphorus sources. Additional samples can be collected to confirm this, or to rule out possible sources. For example, one could sample at high and at low water flow in a stream, sample upstream and downstream from a pipe or other suspected contributor, or sample the pipe or tributary directly. We rarely find orthophosphate in pond or lake water because most of it is immediately absorbed by aquatic plants and microbes.



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Phosphorus Rating			
4 – Best	3 – Good	2 – Fair	1 – Poor
Zero. No detectable phosphorus.	PO_4 reading higher than 0 but less than 0.3 ppm (Phosphorus levels detectable at the 0.1 ppm level or lower.)	PO_4 reading between 0.3 and 3.0 ppm. (Phosphorus levels between 0.1 and 1.0 ppm.)	PO_4 reading higher than 3.0 ppm. (Phosphorus levels higher than 1.0 ppm.)



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Once a source of contamination has been identified, the next step is to determine how to reduce the phosphorus going into the water, if possible. There may be cases where the phosphorus is coming from a permitted facility or from land not under your control or ownership.

Establish grass buffer strips to filter sediment that might be carrying phosphorus, or build berms along waterways to keep surface runoff from eroding a direct channel into a stream. Incorporating fertilizers and manures by tilling or knifing them in as they are applied also will help. Manure sources of phosphorus can be managed in a variety of ways to reduce runoff.

Best management guidelines are available for many farming practices. The *River Friendly Farm* assessment tool can be used by anyone who would like to improve overall farm management skills. The *Clean Streams for Kansas* slide show illustrates best common management practices. Both of these can be found on the Web at www.oznet.ksu.edu/rff.

Where to order supplies

CHEMetrics, Inc.

Route 28
Calverton, VA 20138-9850
1-800-356-3072

www.chemetrics.com

proinfo@chemetrics.com

Order # K-8510 “Ortho P kit.” Each will do 30 tests.

Order #R-8510 for refill tubes and A-8500 for refill solution.

The blue color in the reference tubes will fade slightly over a period of months, so note the expiration date on your kit and reorder new comparison tubes (a new kit) every few years.

Cost is about \$1.07 per test with one kit and one refill.

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

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