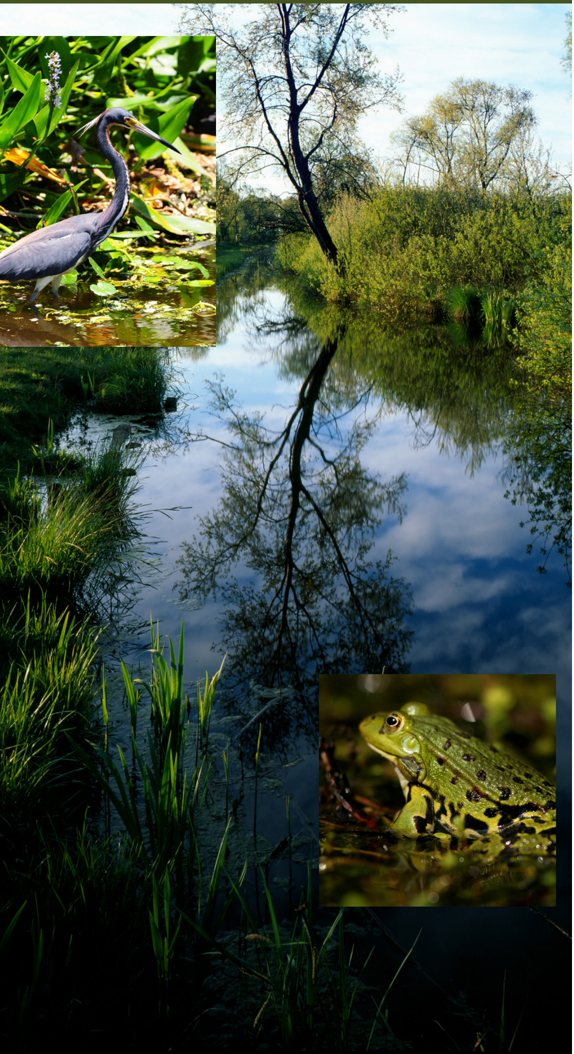
Water Pollution **Detection**



Test Kit Instruction Manual

Code 5905-02

LaMotte®

WARNING! This set contains chemicals that may be harmful if misued. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

*WARNING: Reagents marked with an * are considered to be potential health hazards. To view or print a Safety Data Sheet (SDS) for these reagents go to www.lamotte.com. Search for the four digit reagent code number listed on the reagent label, in the contents list or in the test procedures. Omit any letter that follows or precedes the four digit code number. For example, if the code is 4450WT-H, search 4450. To obtain a printed copy, contact LaMotte by email, phone or fax.

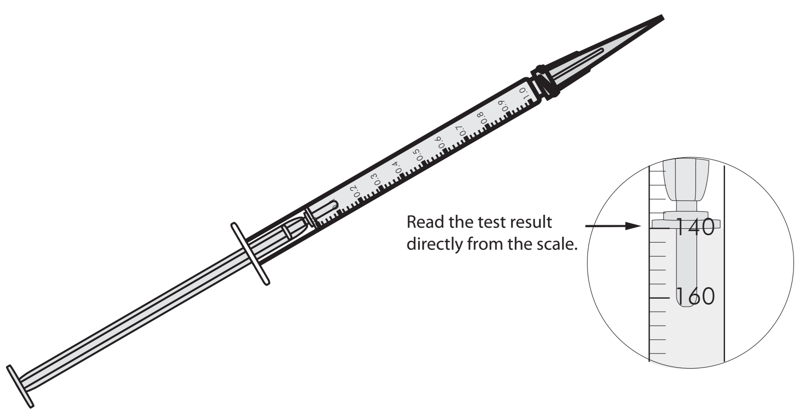
Emergency information for all LaMotte reagents is available from Chem-Tel: (US, 1-800-255-3924) (International, call collect, 813-248-0585).

Introduction

This kit employs two typical quantitative chemical test methods: **colorimetric comparison** with standards of known value or **titration** of the sample with solutions of known value. The reagent systems employed in these testing sets can also be used to make simple qualitative tests where the presence or absence (not the amount) of the factor being investigated is of concern to the investigator. These qualitative tests can be conducted in the field or in the classroom where the overhead projector can be used to project the colorful reactions.

The colorimetric comparison outfits provide color standards of known values. If the color of the test sample does not match the color of one of the standards, but is between two color standards, the value assigned to the test sample is the midpoint between the two standards that bracket the color of the sample. For example, if the color of the test sample is between the colors of 0.2 and 0.6 ppm, the result is read as 0.4 ppm. In the pH test, if the color of the sample is between pH 7.6 and 7.8, the result is read as pH 7.7. When the color of the test sample (other than pH) is greater than the standard of the highest value, the test is repeated on a portion of the test sample that has been diluted on a one-to-one ratio with distilled water. The values of the color standards are multiplied by a factor of 2 to compensate for the dilution. Dilutions of higher ratio can be made; however, it must be remembered that the values of the standards must be multiplied by the ratio of the dilution. A dilution procedure cannot be used when measuring pH.

The titration procedures are performed using a Direct Reading Titrator which accurately measures the amount of titration reagent used. Carefully read the enclosed instruction manual on the Direct Reading Titrator before performing any of the titrations.

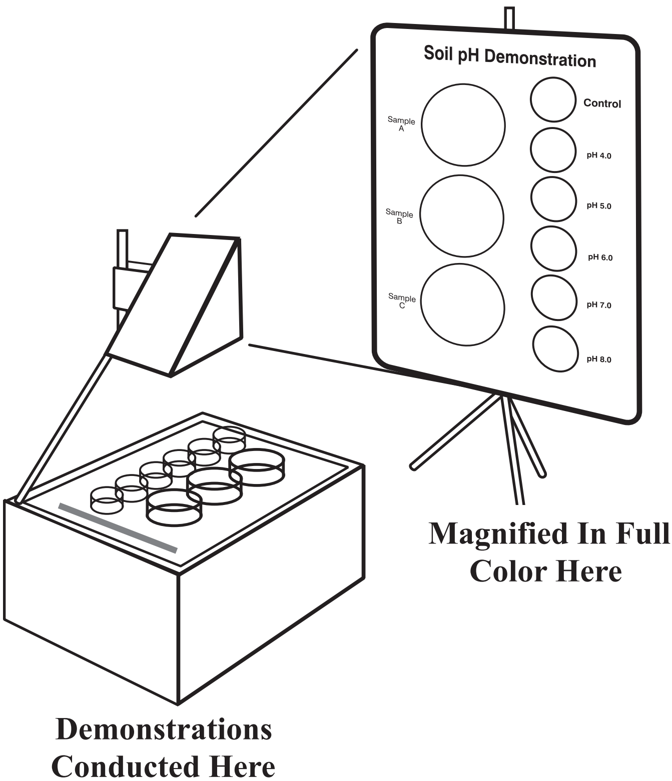


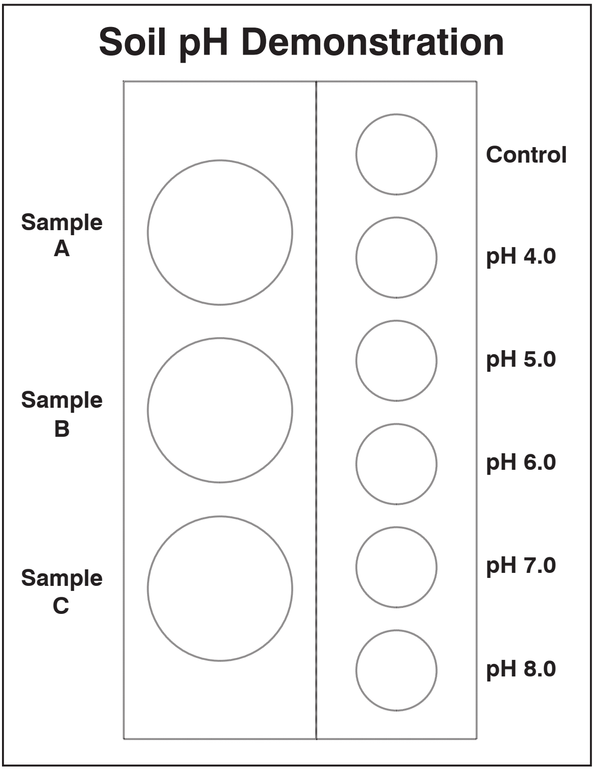
Set Up and Demonstration

Set up

A series of units demonstrate how reactions indicate the chemical content of a water or soil sample. Many of these units use Overhead Projection Demonstration Stages, plastic containers which allow the tests to be done on an overhead projector and demonstrated to a large group.

Before using an Overhead Projection Stage read this instruction manual thoroughly.





Setting Up the Stage for Demonstrations

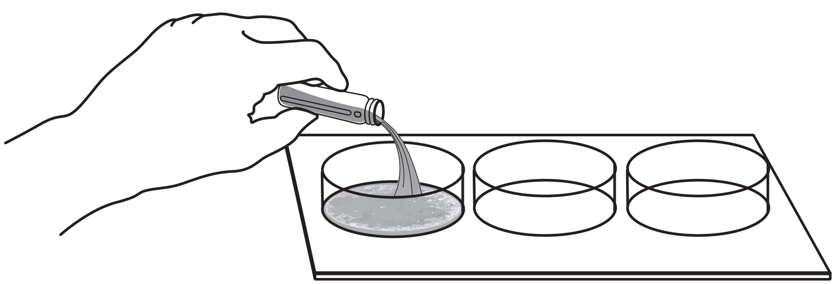
1. Wipe the glass of the overhead projector with a dry cloth.
2. Place a sheet of transparency material on the glass stage. Center the transparency material in the projected image by adjusting the position on the glass stage.
3. Place the plastic Overhead Projection Demonstration Stage on the transparency material.
4. Use a marker to label the transparency as shown above. A downloadable template for the transparency is also available at *www.lamotte.com*. Go to SDS/Instructions. Choose the instructions tab. Go to 5905-01-tran. Print on transparency material.
5. To blank out a portion of the stage during a demonstration, place a piece of paper between the transparency sheet and the Overhead Projection Demonstration Stage. Adjust the paper so only the desired portion of the stage is visible.

Performing The Demonstration

Follow the step-by-step instructions for each test factor. These instructions specify the amount of material to be added to each cell, the amount of time, if any, to wait for the reaction to proceed, and all other informaiton necessary to perform the test. Since the instructions are easy to follow, the instructor may consider having one or more students participate in the demonstration

Tips To Follow During The Demonstration:

1. Measure all test materials accurately.
2. Add the materials in the order given in the instruction.
3. Add materials to the correct test cell. If the materials are added to the wrong test cell, the cell can be emptied using a pipet.
4. Use a plastic spatula to stir and mix materials in the test cell. When stirring granular materials do not press against the bottom of the cell. This can cause small, distracting scratches on the cell.
5. Wipe spatula clean before stirring a second sample.
6. Do not stare directly down into the overhead projector. View the demonstration from an angle on the side of the projector.
7. Be careful not to spill test materials on the transparency sheet or the overhead projector.



Care Of The Demonstration Stage

The Overhead Projection Demonstration Stages are ruggedly constructed to provide many years of service. Attention to these simple precautions will help prolong its usefulness.

1. Rinse demonstration stage with warm water as soon as possible after completing the demonstration.
2. Dry with a tissue or soft cloth.

Avoid scratching the stage during rinsing and drying. Store stage in a safe place, where it will not be scratched.

Alkalinity Test

The normal conditions of the alkalinity of natural waters are associated with the carbon dioxide, bicarbonate, carbonate and hydroxide components. These factors are characteristic of the source of water and the natural processes taking place at any given time. For particular industrial and domestic use, it is often desirable to change these characteristics by treatments such as aeration, neutralization, softening, etc. The particular treatment and the extent to which it is employed will depend upon the end use of the water.

Alkalinity of a water is determined by titration with a standard acid to successive indicator endpoints, thus permitting the calculation of the various forms of alkalinity.

Field Test Method

Quantity	Contents	Code
15 mL	Total Alkalinity Indicator	2786-E
100	Phenolphthalein Tablets	T-2246-J
30 mL	*Alkalinity Titration Reagent B	*4493-G
1	Test Tube, 5-10-15 mL, glass, w/cap	0778
1	Direct Reading Titrator, 0-200 Range	0382

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

The alkalinity titration tube is calibrated so that the result can be read directly from the scale on the titrator in ppm calcium carbonate ($CaCO_3$). The result can be translated to grains per gallon by multiplying the reading by the factor 0.0585.

Read the LaMotte Direct Reading Titrator Manual before prceeding.

Procedure

1. Fill the test tube (0778) to the 5.0 mL line with the sample water.
2. Add one Phenolphthalein Table (T-2246). Cap and mix until the tablet is disintegrated. If no red color develops, the “P” Alkalinity is zero. If the “P” Alkalinity is zero, go to Step 5.
3. Fill the Direct Reading Titrator (0382) with *Alkalinity Titration Reagent B (4493).
4. Insert the titrator tip into the test tube cap. Slowly add *Alkalinity Titration Reagent B (4493) while swirling to mix, until the red color disappears. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. This is the “P” or

Phenolphthalein Alkalinity. (Do not refill the Titrator for Step 6.)

5. Remove the cap and add 3 drops of Total Alkalinity Indicator (2786) to the test sample. Replace the cap and swirl the tube to mix the indicator with the sample.
6. Continue to add the *Alkalinity Titration Reagent B (4493) with mixing until the color of the sample changes from greenish blue to a definite pink color. This is the "T" or Total Alkalinity reading, also know as the "M" Alkalinity.

Calculation of Alkalinity Relationships

The results obtained from the phenolphthalein and total alkalinity determination offer a means for the nstoichiometric classification of the three principal forms of alkalinity present in many water supplies. The classification ascribes the entire alkalinity to bicarbonate, carbonate, and hydroxide; and assumes the absence of other weak acids of inorganic or organic composition, such as silicic, phosphoric, and boric. This classification system further presupposes the incompatibility of hydroxide and bicarbonate alkalinities in the same sample. Since the calculations are on a stoichiometric basis, ion concentrations in the strictest sense are not represented in the results.

Carbonate alkalinity is present when the phenolphthalein alkalinity is not zero but is less than the total alkalinity.

Hydroxide alkalinity is present if the phenolphthalein alkalinity is more than one-half the total alkalinity.

Bicarbonate alkalinity is present if the phenolphthalein alkalinity is less than one-half the total alkalinity.

The mathematical conversion of the results is shown in the following table:

Relationships Between Phenolphthalein Alkalinity, Total Alkalinity, Carbonate Alkalinity, And Hydroxide Alkalinity:

Result of Titration	Hydroxide Alkalinity as $CaCO_3$	Carbonate Alkalinity as $CaCO_3$	Bicarbonate Alkalinity as $CaCO_3$
P=0	0	0	T
P<½T	0	2P	T-2P
P=½T	0	2P	0
P>½T	2P-T	2(T-P)	0
P=T	T	0	0T

Overhead Projection Demonstration

Quantity	Contents	Code
100	Phenolphthalein Tablets	T-2246-J
15 mL	Total Alkalinity Indicator	2786-E
30 mL	*Alkalinity Titration Reagent B	*4493
1	Test Tube, 5-10-15 mL, glass, w/cap	0778
1	Direct Reading Titrator, 0-100 Range	0381
1	Demonstration Stage, six cell	1038-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Read the LaMotte Direct Reading Titrator Manual before proceeding.

Procedure

1. Place the demonstration stage (1038-P) on the overhead projector and turn on the projector light.
2. Fill the test tube (0778) to the 10 mL line with sample water and transfer to a cell on the demonstration stage (1038-P). (A second cell can be filled with an identical amount of water sample to be used as a “before” color standard. Add the indicator in Step 3, but do not titrate.)
3. Add three drops of Total Alkalinity Indicator (2786) and gently stir the contents of the cell with the stirring rod (0519). If there is any alkalinity present, a blue-green color will appear.
4. Fill the Direct Reading Titrator (0381) with *Alkalinity Titration Reagent B (4493).
5. The titrator is held by hand over the cell. Discharge one drop of the reagent at a time. Stir the mixture after each addition of the titration solution.
6. When the color of the liquid in the cell changes permanently to pink, read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Each minor division equals 2 ppm $CaCO_3$ Alkalinity. This value is the “T” Alkalinity. To determine the “P” Alkalinity, use the procedure described in the field test method on page 6.

Ammonia Nitrogen Test

Ammonia nitrogen is present in variable concentrations in many surface and ground waters, however, any sudden change in the analysis of a supply which has been rather constant composition is cause for suspicion. A product of microbiological activity, ammonia nitrogen is sometimes accepted as chemical evidence of sanitary pollution when encountered in raw surface waters.

Ammonia in water is detected by means of *Nessler's Reagent (4798) which reacts with ammonia to form a yellow color. The amount of color developed is directly proportional to the amount of ammonia present.

Field Test Method

Quantity	Contents	Code
30 mL	Ammonia Nitrogen Reagent #1	4797WT-G
30 mL	*Ammonia Nitrogen Reagent #2	*4798WT-G
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Ammonia Nitrogen Color Chart,1.0 and 5.0 ppm	7471-CC

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill the test tube (0106) to the 5.0 mL line with sample water.
2. Add 4 drops of Ammonia Nitrogen Reagent #1 (4797). Cap and mix.
3. Add 8 drops of *Ammonia Nitrogen Reagent #2 (4798). Cap and mix.
4. Match sample color to a color standard on the Ammonia Nitrogen Color Chart (7471-CC). Record as ppm Ammonia Nitrogen.

Overhead Projection Demonstration

Quantity	Contents	Code
30 mL	Ammonia Nitrogen Reagent #1	4797WT-G
30 mL	*Ammonia Nitrogen Reagent #2	*4798WT-G
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Demonstration Stage, six cell	1038-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Place the demonstration stage (1038-P) on the overhead projector and turn on the projector light.
2. Fill test tube (0106) to the 5 mL line with sample water and transfer to a cell on the demonstration stage (1038-P). (As a control, measure 5.0 mL of sample water and add this to a second cell on the stage. Do not add any reagents to the control sample.)
3. Add two drops of Ammonia Nitrogen Reagent #1 (4797) and gently stir with the stirring rod (0519).
4. Add eight drops of *Ammonia Nitrogen Reagent #2 (4798). Mix by stirring with the stirring rod.
5. If ammonia is present, a yellow color will form. High concentrations of ammonia will produce a full yellow color. Lower concentrations will produce varying shades of yellow and a faint yellow tint will indicate the presence of a trace quantity of ammonia.

Calcium, Magnesium, & Total Hardness Test

Calcium, magnesium and total hardness factors of a water should be considered as a group since the total hardness of a water generally represents the total concentration of calcium and magnesium ions expressed as calcium carbonate. Other ions may contribute to the hardness of water, but in natural waters all but calcium and magnesium are present in insignificant quantities. When the hardness of a water is greater than the sum of the carbonate and bicarbonate alkalinity, the amount in excess is called "noncarbonate hardness" and such waters may contain considerable amounts of chloride and sulfate ions. This is an important factor to consider when treating potable water by ion exchange methods. The hardness of water may range from zero to hundreds of milligrams per liter, (or parts per million), depending on the source or the treatment to which it has been subjected.

A knowledge of the hardness of water is of great importance in the industrial uses since it is the chief source of scale in heat exchange equipment, boilers, pipe lines, etc. From the domestic standpoint, hard water consumes excessive quantities of soap, forming curds and depositing a film on hair, fabrics and glassware.

Total Hardness of water is determined by titration with a EDTA solution, using Calmagite as the endpoint indicator. The total hardness minus the calcium hardness equals the magnesium hardness. Calcium is determined by EDTA titration in a manner similar to the total hardness determination.

Drinking water quality standards, as determined by the US Public Health Service, set limits of calcium hardness at 200 ppm and magnesium hardness at 150 ppm. Waters with a total hardness in the range of 0-60 ppm are termed soft; from 60-120 ppm medium hard, from 120-180 ppm hard and above 180 ppm very hard.

Field Test Method - Total Hardness

Quantity	Contents	Code
100	Hardness Reagent #6 Tablets	4484-J
15 mL	*Hardness Reagent #5	*4483-E
15 mL	*Sodium Hydroxide Reagent w/Metal Inhibitor	*4259-E
50	Calcium Hardness Indicator Tablets	T-5250-H
30 mL	Hardness Reagent #7	4487DR-G
1	Test Tube, 12.9 mL, w/cap	0608
1	Direct Reading Titrator, 0-200 Range	0382

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

The Hardness DR Titration Tube (0608) is calibrated so that the hardness can be read directly from the scale on the Direct Reading Titrator in ppm. Each minor division on this scale is equal to 4 ppm. Divide this direct reading by the factor 17.1 to obtain hardness in grains per gallon (gpg).

Read the LaMotte Direct Reading Titrator Manual before proceeding.

Procedure

1. Fill the test tube (0608) to the 12.9 mL line with sample water.
2. Add 5 drops of *Hardness Reagent #5 (4483) and mix. Add 1 Hardness Reagent #6 Tablet (4484) and swirl to disintegrate the tablet. A red color will develop.
3. Fill the Direct Reading Titrator (0382) with the Hardness Reagent #7 (4487).
4. Add Hardness Reagent #7 (4487) one drop at a time, swirling to mix after each drop, until the red color changes to clear blue.
5. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record as Total Hardness as ppm Calcium Carbonate.

Field Test Method—Calcium Hardness

Procedure

1. Fill the test tube (0769) to the 12.9 ml line with the sample water.
2. Add six drops of *Sodium Hydroxide Reagent with Metal Inhibitors (4259).
3. Add one Calcium Hardness Indicator Tablet (5250). Cap and mix until tablet is disintegrated. A red color will appear if calcium is present.
4. Hardness Reagent #7 (4487) is added as described in the Field Test Method for Total Hardness, until the red color changes to blue. The results are read as Calcium Hardness in ppm $CaCO_3$.
5. The Magnesium Hardness level is determined by subtracting the Calcium Hardness level from the Total Hardness level.

Overhead Projection Demonstration

Quantity	Contents	Code
100	Hardness Reagent #6 Tablets	4484-J
15 mL	*Hardness Reagent #5	*4483-E
15 mL	*Sodium Hydroxide Reagent w/Metal Inhibitors	*4259-E
50	Calcium Indicator Tablets	T-5250-H
30 mL	Hardness Reagent #7	4487DR-G
1	Test Tube, 12.9 mL, w/cap	0608
1	Direct Reading Titrator, 0-200 Range	0382
1	Demonstration Stage, six cell	1038-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Read the LaMotte Direct Reading Titrator Manual before proceeding.

Procedure

1. Place the demonstration stage (1038-P) on the overhead projector and turn on the projector light.
2. Fill the test tube (0608) to the 12.9 mL line with sample water and transfer to a cell on the demonstration stage (1038-P). Repeat this operation so that four cells of the demonstration stage are filled. One cell will be used for the Total Hardness test, one cell will be used for the Calcium Hardness test and the other two cells will be used as controls. Number the cells 1, 2, 3 and 4.
3. To cells 1 and 2, add 5 drops of *Hardness Reagent #5 (4483) and mix by stirring with the stirring rod (0519). Add 1 Hardness Reagent #6 Tablet (4484) and stir until tablet is disintegrated. A red color will develop.
4. Fill the Direct Reading Titrator (0382) with the Hardness Reagent #7 (4487). Add one drop at a time to cell 2 until the sample color changes from red to clear blue. Stir the sample after the addition of each drop. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record the result as ppm Total Hardness.

5. To cells 3 and 4, add six drops of *Sodium Hydroxide Reagent with Metal Inhibitors (4259) and stir the contents of the cells with the stirring rod (0519).
6. To cells 3 and 4, add one Calcium Hardness Indicator Tablet (5250) to each and stir until tablets are disintegrated or until the liquid has developed a full red color. Cell 3 will be used as the "before" color change standard.
7. Refill the Direct Reading Titrator with Hardness Reagent #7 and add dropwise to cell 4, stirring the solution after each drop. Continue until the sample color changes from red to blue. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record the result as ppm Calcium Hardness.
8. Subtract the Calcium Hardness level from the Total Hardness level to determine the Magnesium Hardness level.

Free Carbon Dioxide Test

Surface waters normally contain less than 10 ppm free carbon dioxide while some ground waters may easily exceed that concentration. Corrosion is the principal difficulty caused by high concentrations of carbon dioxide due to lowering of pH when carbon dioxide dissolves in water to form carbonic acid.

Free carbon dioxide is determined by a titration procedure using a base solution with phenolphthalein as the endpoint indicator.

Field Test Method

Quantity	Contents	Code
15 mL	*Phenolphthalein Indicator, 1%	*2246-E
30 mL	*Carbon Dioxide Reagent B	*4253-G
1	Test Tube, 5-10-12.9-15-20-25 mL, glass, w/cap	0608
1	Direct Reading Titrator, 0-50 Range	0380

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Read the LaMotte Direct Reading Titrator Manual before proceeding.

Procedure

1. Fill test tube (0608) to the 20 mL line with sample water. For best results the test should be made on a freshly obtained sample, preferably a sample obtained with a minimum of contact with the air (avoid splashing, etc.)
2. Add 2 drops *Phenolphthalein Indicator, 1% (2246). If the test sample turns red, no free carbon dioxide is present.
3. If the solution is colorless, titrate with *Carbon Dioxide Reagent B (4253) until a faint but permanent pink color is produced and persists for at least 30 seconds. Swirl the sample gently during the titration. Read the result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record the result in ppm Carbon Dioxide.

Overhead Projection Demonstration

Quantity	Contents	Code
15 mL	*Phenolphthalein Indicator, 1%	*2246-E
30 mL	*Carbon Dioxide Reagent B	*4253-G
1	Test Tube, 5-10-12.9-15-20-25 mL, glass, w/cap	0608
1	Direct Reading Titrator, 0-50 Range	0380
1	Demonstration Stage, three cell	1039-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Read the LaMotte Direct Reading Titrator Manual before proceeding.

Procedure

1. Place the demonstration stage (1039-P) on the overhead projector and turn on the projector light.
2. Fill the test tube (0608) to the 20 mL line with sample water and transfer this liquid to a cell on the demonstration stage (1039-P).
3. Add two drops *Phenolphthalein Indicator, 1% (2246) and gently stir the contents of the cell with the stirring rod (0519).
4. If the solution turns red, no free carbon dioxide is present. If the solution is colorless, it is titrated to determine the amount of carbon dioxide present.
5. Fill the Direct Reading Titrator (0382) with *Carbon Dioxide Reagent B (4253).
6. The Titrator is held by hand over the cell. Discharge one drop of the reagent at a time from the titrator. Stir the mixture after the addition of each drop. Add the titration reagent until a permanent pink color is produced and persists for at least 30 seconds. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record the result as ppm Carbon Dioxide.

   NOTE: The accuracy of the test method for carbon dioxide is reduced with the overhead projection demonstration because of the increased exposure of the sample to the air.

Chloride Test (also see Salinity Test page 40)

Chloride is one of the major anions to be found in water and sewage. Its presence in large amounts may be due to natural processes such as the passage of water through natural salt formations in the earth or it may be an indicator of pollution from sea water or industrial and domestic wastes. Any change from the normal chloride content of a natural water should be reason for suspecting pollution from one of these sources. US Public Health Service Drinking Water Standards recommend a maximum chloride content of 250 ppm as chloride.

Chloride is determined by titrating the sample with a silver nitrate solution using potassium chromate as the endpoint indicator.

The same test reagents are used in both the Chloride and the Salinity determinations.
The chloride test is run on an undiluted sample. The salinity test is run on a sample that has been diluted with chloride-free water.

Field Test Method

Quantity	Contents	Code
15 mL	*Chloride Reagent #1	*4504-E
60 mL	*Chloride Reagent #2	*4505DR-H†
1	Test Tube, 5-10-15 mL, glass, w/cap	0778
1	Direct Reading Titrator, 0-200 Range	0382

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

† Chloride Reagent #2 (4505DR) contains Silver Nitrate, which will cause a dark stain where it contacts the skin. Care should be taken to avoid spilling.

Read the LaMotte Direct Reading Titrator Manual before proceeding.

Fill the test tube (0778) to 15 mL line so that the result may be read directly from the scale on the Direct Reading Titrator in ppm Chloride. Each minor division on the scale is equal to 4 ppm chloride. The chloride content in grains per gallon (gpg) may be obtained by dividing the titrator reading by a factor of 17.1.

Procedure

1. Fill the test tube (0778) to the 15 mL line with sample water.
2. Add three drops of *Chloride Reagent #1 (4504). Cap and swirl to mix. A yellow color will result.
3. Fill the Direct Reading Titrator (0382) with *Chloride Reagent #2 (4504). Insert the titrator in the center hole of the cap.
4. Add the *Chloride Reagent #2 (4505) until the yellow color is permanently changed to pinkish-brown.
5. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Read the result as ppm Chloride.

Overhead Projection Demonstration

The reaction of the Chloride-Salinity test procedure does not work satisfactorily on the overhead projector. A precipitate is formed in this reaction. This precipitate blocks out the passage of light through the cell and a blank circle is projected.

Chlorine Test

Chlorine in the form of chlorine gas, hypochlorite, chloramines and organic chlorine compounds is widely used for sterilization and disinfection. Chlorine is not present in natural waters and is found only as a result of chlorination of a water supply. The presence of any amount more than would normally be used to sterilize water could be considered evidence of pollution from chlorine treated effluents from a process in which high concentrations of chlorine are used.

The most widely used method for detecting chlorine is based on its reaction with the DPD indicator to produce a pink color.

Field Test Method

Quantity	Contents	Code
50	*Chlorine DPD #4R Tablets	*6899A-H
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Chlorine DPD Color Chart, 0.1 and 0.4 ppm	4551-CC

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill a test tube (0106) to the 5 mL line with the sample water.
2. Add 1 *Chlorine DPD #4R Tablet (6899A). Cap tube and invert to disintegrate tablet.
3. Chlorine is present if a pink color develops. Immediately match sample color to a color standard on the Chlorine DPD Color Chart (4551-CC). Record as ppm Chlorine.

Overhead Projection Demonstration

Quantity	Contents	Code
50	*Chlorine DPD #4R Tablets	*6899A-H
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Demonstration Stage, six cell	1038-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Place the Overhead Projection Stage (1038-P) on the overhead projector and turn on the projector light.
2. Fill a test tube (0106) to the 10 mL line with sample water, and transfer the sample to a cell on the demonstration stage. Repeat this operation, filling a second cell with 10 mL of water to be tested. The first cell will be used as a control (nothing more is added to this cell) and the second cell will be used for the test.
3. Add one *Chlorine DPD #4R Tablet (6899A). Stir the mixture with the stirring rod (0519) until the tablet disintegrates.
4. If the chlorine is present in the water sample, a color will develop. The color may range from very light pink (trace) to a deep pink color that indicates a high chlorine content.

Chromium (Chromate) Test

Chromium may be present in water containing waste from industry such as the plating industry. It is considered to be a toxic chemical, and if present in an amount of over 0.5 ppm it is evidence that contamination is from untreated or incompletely treated waste. This calls for more careful waste disposal control by the offending plant. It is determined colorimetrically by a reaction with diphenylcarbohydrazide in acid solution to produce a pink or red color.

Field Test Method

Quantity	Contents	Code
30g	*Chromate Indicator Powder	*4431-G
1	Spoon, 0.25g	0695
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Chromate Color Chart, 0.5 and 2.0 ppm	7484-CC

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill a test tube (0106) to the 5 mL line with the sample water.
2. Use the 0.25g spoon (0695) to add one level measure of the Chromate Indicator Powder (4431) to the water sample. Mix until the powder is dissolved. Wait two minutes for color development.
3. March sample color to a color standard on the Chromate Color Chart (7484-CC).

The readings on the color chart are in terms of Sodium Chromate. To convert Sodium Chromate reading to Hexavalent Chromium, multiply the color chart value by 0.32.

Overhead Projection Demonstration

Quantity	Contents	Code
30 g	*Chromate Indicator Powder	*4431-G
1	Spoon, 0.5 g	0698
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Demonstration Stage, six cell	1038-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Place the demonstration stage (1038-P) on the overhead projector and turn on the projector light.
2. Fill a test tube (0106) to the 5.0 mL line with sample water, and transfer to a cell on the demonstration stage (1038-P). Repeat this operation so that two cells are filled with 5.0 mL of the sample water. One cell will act as a control and no chromate indicator is added to it.
3. Use the 0.5g spoon (0698), to add one level spoonful of Chromate Indicator (4431) to the cell to be used for measuring the test sample. Stir the mixture with the stirring rod (0519) until all the powder is dissolved. If a trace of chromium or chromate is present in the water sample, a slight pink color will develop. Greater amounts of chromium or chromate in the water sample will cause a deep red or purple color to form.

Copper Test

The copper content of drinking water generally falls below 0.03 ppm and a copper content as low as 1.0 ppm can impart a bitter taste to water. Waters testing as high as 1.0 ppm copper have probably been treated with a copper compound, as used in the control of algae, or have become contaminated from untreated industrial wastes. Acid waters and those high in free carbon dioxide may cause the corrosion of copper, brass and bronze pipe and fittings. This results in the introduction of copper into the water supply. Presence of copper in water in amounts as small as 0.05 ppm can be detected by a chemical reaction with an indicator which forms a color in proportion to the amount of copper present.

Field Test Method

Quantity	Contents	Code
15 mL	*Copper 1	*6446-E
2 x 15 mL	Copper 2	6613-E
2	Test Tubes, "A & B"	0804

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill a test tube (0804) to the upper line marked "A" with the sample water.
2. Add 5 drops of *Copper 1 (6446) and mix. A yellow color indicates the presence of copper.
3. Fill the second test tube (0804) to the lower line marked "B" with distilled water.
4. Add Copper 2 (6613) to the second tube of distilled water, one drop at a time, counting the drops and mixing after each addition. Hold the two tubes about one-half inch above a plain white surface and look down through the tubes to compare the colors. Continue adding the color reagent to the second tube until the color matches the reaction in the first tube.
5. The test result is calculated as:

Copper (ppm) = 0.025 x Number of Drops Copper 2

Overhead Projection Demonstration

Quantity	Contents	Code
15 mL	*Copper 1	*6446-E
2 x 15 mL	Copper 2	6613-E
2	Test Tubes, “A & B”	0804
1	Demonstration Stage, three cell	1039-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill a test tube (0804) to the upper line marked “A” with the sample water.
2. Add 5 drops of *Copper 1 (6446) and mix. A yellow color indicates the presence of copper. Pour this into one of the cells of the demonstration stage (1039-P). Mark this cell “Test Sample.”
3. Fill the second test tube (0804) to the lower line marked “B” with distilled water. Pour this into a second cell of the demonstration stage (1039-P). Mark this cell “Reference Sample.”
4. Add Copper 2 (6613) to the Reference Sample in the second cell, one drop at a time, stirring the solution with the stirring rod (0519) after each drop. Count the drops and continue the addition until the Reference Sample color matches the Test Sample color.
5. The test result is calculated as:

Copper (ppm) = 0.025 x Number of Drops Copper 2

Cyanide Test

Cyanide may be present in water containing waste from a metal finishing plant. It is very toxic and cannot be tolerated, even at the lowest levels. A positive test is evidence of untreated or incompletely treated waste which calls for more careful waste disposal control by the offending plant. Presence of cyanide in amounts as small as 0.05 ppm can be detected by a chemical reaction with an indicator which forms a color in proportion to the amount of cyanide present.

Field Test Method

Quantity	Contents	Code
25 mL	*Cyanide Reagent #1	*7388-G
25 mL	*Cyanide Reagent #2	*7389-G
25 mL	*Cyanide Reagent #3	*7390-G
2	Test Tubes, “A & B”	0804
1	Funnel, plastic	0459
1	Filter Paper, 9 cm	0465

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

WARNING: This cyanide test is a field test designed to screen samples for the presence of cyanide. Oxidizing agents, as well as certain metal complexes formed with iron, copper, manganese and platinum, may produce a false positive result. All positive tests for cyanide should be verified or confirmed by an independent laboratory using the appropriate procedures given in the most recent edition of *Standard Methods for the Examination of Water and Wastewater*.

1. Fill test tube (0804) to the upper line marked “A” with the sample water.
2. Add two drops of *Cyanide Reagent #1 (7388). Cap and mix. Add two drops of *Cyanide Reagent 2 (7389). Cap and mix. If a precipitate forms, filter the solution into the second test tube (0804) until the tube is filled to the line marked “B.” A pink color indicates the presence of Cyanide.
3. Rinse the first test tube carefully and then fill it to the line marked “B” with deionized or cyanide-free tap water.
4. Add two drops of *Cyanide Reagent #2 (7389) to the deionized or cyanide-free tap water sample and mix the contents.

5. Add *Cyanide Reagent #3 (7390) to the distilled water sample test tube (from step 4) one drop at a time until the color of the liquid matches the color of the test sample (from step 2). Match the colors by looking down through the test tubes held about a half inch above a plain white surface. Count the number of drops of *Cyanide Reagent #3 (7390) that were required to match the color of the test sample. Each drop of *Cyanide Reagent #3 (7390) added is equal to 0.05 ppm Cyanide.

Overhead Projection Demonstration

Quantity	Contents	Code
30 mL	*Cyanide Reagent #1	*7388-G
30 mL	*Cyanide Reagent #2	*7389-G
30 mL	*Cyanide Reagent #3	*7390-G
2	Test Tubes, "A & B"	0804
1	Funnel, plastic	0459
1	Filter Paper, 9 cm	0465
1	Funnel Holder	0694
1	Demonstration Stage, three cell	1039-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill a test tube (0804) to the upper line marked "A" with the sample water.
2. Add two drops of *Cyanide Reagent #1 (7388) and mix with the stirring rod (0519). Add 2 drops of *Cyanide Reagent #2 (7389) and mix.
3. Place the demonstration stage (1039-P) on the overhead projector and turn on the projector light.
4. Place the Funnel (0459) in the Funnel Holder (0694) and place the funnel holder inside one of the cells of the stage. Insert a piece of Filter Paper (0465) in the funnel. The contents of the test tube from Step 2 are filtered directly into the cell of the demonstration stage. It is not necessary to collect the last few drops that may remain on the filter paper. A pink color in the filtrate indicates the presence of Cyanide. Mark this as the "Test Sample."

5. Fill a second test tube (0804) to the lower line marked “B” with deionized or cyanide free tap water and add this amount to a second cell on the demonstration stage. Mark this as the “Reference Sample.” Compare the colors of the liquid in the two cells.
6. Add two drops of *Cyanide Reagent #2 (7389) to the Reference Sample and mix by stirring with the stirring rod (0519).
7. Add *Cyanide Reagent #3 (7390) one drop at a time, stirring after each drop, to the Reference Sample until the color matches the color of the Test Sample. Each drop of *Cyanide Reagent #3 (7390) added is equal to 0.05 ppm Cyanide.

   NOTE: If a strong oxidizing agent, such as chlorine, bromine, hydrogen peroxide, or permanganate, is present in the sample to be tested, the cyanide test may give a false positive indication that cyanide is present. It is strongly recommended that positive cyanide test results be verified by a distillation procedure as given in “Standard Methods,” APHA, 15th Edition.

Iron Test

Most natural waters contain some iron. Its presence may vary from the smallest trace to very large amounts in water which is contaminated by acid mine wastes. For domestic use, the concentration should not exceed 0.2 ppm and for some industrial applications, not even a trace of iron can be tolerated. There are many means available for removing or reducing the iron content of waters. Water softening resins are effective for removing small amounts of iron and special ion exchange materials are selective for iron removal. High concentrations of iron can be removed by such chemical processes as oxidation and lime or lime-soda softening. Because of the many means of removing or reducing the amount of iron in water, the particular method employed will depend largely on the form of iron which is present and the end use of the finished water. The chemical test for iron is based on a very sensitive chemical reaction with bipyridal to produce a pink to deep red color, depending upon the amount of iron in the water.

Field Test Method

Quantity	Contents	Code
15 mL	*Iron Reagent #1	*4450-E
4.5g	*Iron Reagent #2	*4451-S
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Spoon, 0.05 g	0696
1	Iron Color Chart, 0.5 and 2.0 ppm	7474-CC

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill a test tube (0106) to the 5 mL line with sample water.
2. Add 5 drops of *Iron Reagent #1 (4450). Cap and mix.
3. Use the 0.05g spoon (0696) to add one level measure of *Iron Reagent #2 Powder (4451). Mix until the powder dissolves. Wait 3 minutes.
4. If Iron is present in the water sample, a pink or red color will develop. Match sample color to a color standard on the Iron Color Chart (7474-CC).

Overhead Projection Demonstration

Quantity	Contents	Code
15 mL	*Iron Reagent #1	*4450-E
4.5g	*Iron Reagent #2	*4451-S
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Spoon, 0.05g	0696
1	Demonstration Stage, six cell	1038-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Place the demonstration stage (1038-P) on the overhead projector and turn on the projector light.
2. Fill a test tube (0106) to the 5 mL line with sample water and transfer to a cell on a demonstration stage (1038-P).
3. Add five drops of *Iron Reagent #1 (4450). Stir the mixture with the stirring rod (0519).
4. Use the 0.05g spoon (0696) to add one level measure of *Iron Reagent #2 (4451). Stir the contents of the cell until the powder has completely dissolved.
5. If iron is present in the water sample, a pink or red color will develop. A trace of iron will cause a faint pink color to appear. Greater concentration will produce a full pink color and very high concentrations will produce a deep red color.

Magnesium Test

(See Calcium, Magnesium & Total Hardness p. 14).

Nitrate Test

Nitrogen is essential for plant growth but the presence of excessive amounts in water supplies presents a major pollution problem. Nitrogen compounds that may enter water as nitrates, or be converted to nitrates, can originate from agricultural fertilizers, sewage, industrial and packing house wastes, drainage from livestock feeding areas, farm manures and legumes. Nitrates in large amounts can cause “blue babies” (methemoglobinemia) in infants less than six months of age and is an important factor to be considered in livestock production, where, in addition to causing methemoglobinemia, it is responsible for many other symptoms arising from the intake of nitrates in water supplies. Nitrates, in conjunction with phosphates, stimulate the growth of algae with all of the related difficulties associated with excessive algae growth.

US Public Health Service Drinking Water Standards state that 10 ppm Nitrate Nitrogen is a limit which should not be exceeded. However, to the sanitary and industrial engineer, the concentration which is of concern is less than 1 ppm.

In the chemical test for nitrates, a red dye is formed by the coupling of two chemical intermediates through the action of nitrates derived from the reduction of the nitrate ion.

Field Test Method

Quantity	Contents	Code
60 mL	*Mixed Acid Reagent	*V-6278-H
5g	*Nitrate Reducing Reagent	*V-6279-C
1	Spoon, 0.1g	0699
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Nitrate-N Color Chart, 2 and 10 ppm	7493-CC
1	Pipet	0352
1	Dispenser Cap	0692

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

NOTE: Place dispenser cap (0692) on *Mixed Acid Reagent (V-6278-H). Save this cap for refill reagents.

Procedure

1. Fill a test tube (0106) to the 2.5 mL line with the sample water.
2. Add *Mixed Acid (V-6278) until the tube is filled to the 5.0 mL line. Cap and mix. Wait two minutes.
3. Use the 0.1g spoon (0699) to add one level measure of *Nitrate Reducing Reagent (V-6279) to the mixture in the test tube. Invert the test tube 50-60 times in one minute. Wait 10 minutes.
4. A very light pink color indicates a trace of Nitrate Nitrogen present in the sample. High concentrations of Nitrates will produce a deep magenta color. Match sample to a color standard on the Nitrate-N Color Chart (7493-CC).

Overhead Projection Demonstration

Quantity	Contents	Code
60 mL	*Mixed Acid Reagent	*V-6278-H
5g	*Nitrate Reducing Reagent	*V-6279-C
1	Spoon, 0.1g	0699
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Demonstration Stage, six cell	1038-P
1	Stirring Rod, plastic	0519
1	Pipet	0352

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Place the demonstration stage (1038-P) on an overhead projector and turn on the projector light.
2. Fill a test tube (0106) to the 5 mL line with sample water and transfer this liquid to a cell on the demonstration stage (1038-P).
3. Because the invert/shaking of this test is critical, the sample must be reacted in the tube. Follow instructions from the Field Test Method and pour over into second cell on demonstration stage.
4. A faint pink color will indicate that a trace of Nitrate is present. High concentrations of Nitrates will produce a deep magenta color.

pH Test

Most natural waters will have pH values from pH 5.0-8.5. Acidic, freshly fallen rain water may have a pH value of pH 5.5-6.0. If it reacts with soils and minerals containing weak alkaline materials, the hydroxyl ions will increase and the hydrogen ions decrease; the water may become slightly alkaline with a pH of pH 8.0-8.5. Sea water will have a pH value close to pH 8.0.

Waters more acidic than pH 5.0 and more alkaline than pH 8.5-9.0 should be viewed with suspicion. Mine drainage and acid industrial wastes are the principal factors in increasing the acidity of water, and alkaline industrial wastes are the cause of high pH values.

The pH test, which is one of the most important tests for detecting industrial pollution, is also one of the simplest to perform. *Range Finding Indicator Solution (2220-H) contains several indicators. A specific color forms at each pH as a result of the reaction between the water sample and the indicators

Field Test Method

Quantity	Contents	Code
60 mL	*Range Finding Indicator Solution	*2220-H
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill test tube (0106) to the 5.0 mL line with the sample water.
2. Add ten drops of the *Range Finding pH Indicator Solution (2220-H).
3. The color that results from the mixture will indicate the approximate pH value of the sample. Check the color of the sample with the table below:

pH 3.0	Red
pH 4.0	Red-Orange
pH 5.0	Orange
pH 6.0	Yellow
pH 7.0	Yellow-Green

pH 8.0	Green
pH 9.0	Blue-Green
pH 10.0	Blue
pH 11.0	Purple

Overhead projection demonstration

Quantity	Contents	Code
60 mL	*Range Finding Indicator Solution	*2220-H
1	Demonstration Stage, six cell	1038-P
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

NOTE: Buffer solutions of various pH values are available separately that may be used to develop reference color standards at their pH values.

Procedure

1. Place the demonstration stage (1038-P) on the overhead projector and turn on the projector light.
2. Fill test tube (0106) to the 5 mL line with sample water and transfer this liquid to a cell on the demonstration stage (1038-P).
3. Add ten drops of the *Range Finding pH Indicator Solution (2220-H), stir the mixture with the stirring rod (0519). The characteristic color will appear immediately. Check the color of the solution with the table of colors listed in Step 3. (If buffer solutions are used, add 5.0 mL of the buffer solution to a cell on the stage, add ten drops of the pH indicator and mix. Note the pH value of the buffer solution on the side of the stage near the cell.)

Phosphorus (Phosphate) Test

Phosphorus is an important nutrient for aquatic plants. The amount found in water is generally not more than 0.1 ppm unless the water has become polluted from waste water sources or excessive drainage from agricultural areas. When phosphorus is present in excess of the concentrations required for normal aquatic plant growth, a process called eutrophication takes place. This creates a favorable environment for the increase in algae and weed nuisances that produce scums and odors. When algae cells die, oxygen is used in the decomposition and fish kills often result. Rapid decomposition of dense algae scums with associated organisms give rise to foul odors and hydrogen sulfide gas. Inorganic phosphate, which is largely the form of phosphorus required for plant growth, is determined by its reaction with a molybdate solution to form a phosphomolybdate which, when reduced, forms a blue color which is the basis for a very sensitive test for phosphorus. The production of more than a faint blue color in this test is cause for suspicion of phosphate pollution, and when the other factors such as available nitrogen, iron, trace metals, etc. are present, will cause the conditions described above.

Field Test Method

Quantity	Contents	Code
60 mL	*VM Phosphate Reagent	*4410-H
5 mL	Reducing Reagent	6405-C
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Pipet, 1.0 mL	0354
1	Pipet, unmarked	0352
1	Phosphate Color Chart, 1.0 and 5.0 ppm	7482-CC

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill test tube (0106) to the 5 mL line with the sample water.
2. Use the 1.0 mL pipet (0354) to add 1.0 mL of *VM Phosphate Reagent (4410) to the test sample. Cap and mix. Wait 5 minutes. A light yellow color may appear at this point.
3. Use the pipet (0352) to add 3 drops of Reducing Reagent (6405) to the mixture. Invert to mix the contents.

4. If Phosphate is present, a blue color will form immediately. Match sample color to a color standard on the Phosphate Color Chart (7482-CC).

Overhead Projection Demonstration

Quantity	Contents	Code
60 mL	*VM Phosphate Reagent	*4410-H
5 mL	Reducing Reagent	6405-C
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Pipet, 1.0 mL	0354
1	Pipet, unmarked	0352
1	Demonstration Stage, six cell	1038-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Place the demonstration stage (1038-P) on the overhead projector and turn on the projector light.
2. Fill test tube (0106) to the 5 mL line with sample water and transfer to a cell on the demonstration stage (1038-P).
3. Use the 1.0 mL pipet (0354) to add 1.0 mL of the *VM Phosphate Reagent (4410). Stir the contents of the cell with the stirring rod (0519). Wait five minutes. A light yellow color may appear.
4. Use the pipet (0352) to add 3 drops of the Reducing Reagent (6405). Stir the contents of the cell.
5. If Phosphate is present, a blue color will form. High concentrations of Phosphates will produce a deep blue color. Lower concentration will produce varying shades of light blue and a faint blue tint will indicate the presence of trace quantities.

Salinity Test (also see Chlorides page 20)

The extent of contamination of a fresh water supply in areas adjacent to salt water sources can be easily detected by a determination of its salinity. Salinity, in this case, is a term used to describe the total solids content of sea water and has a different meaning than the term as used to describe the solids content of fresh water used for agricultural purposes. Because of the relatively constant chemical balance of sea water, its salinity can be determined by a measure of its total halide content, which is principally in the form of chlorides.

The salinity of a water can be completely removed by distillation or demineralization by ion exchange resins. Also, practical use has been made of special ion exchange membrane systems for reducing the salt content to within limits permissible for potable purposes.

The chemical test for salinity involves titration of the test sample with silver nitrate using potassium chromate as the indicator.

The same test reagents are used in both the chloride and the salinity determinations. The chloride test is run on an undiluted sample. The salinity test is run on a sample that has been diluted with chloride-free water.

Field Test Method

Quantity	Contents	Code
60 mL	*Chloride Reagent #1	*4504-E
15 mL	*Chloride Reagent #2	*4505DR-H†
1	Test Tube, 5-10-15 mL, glass, w/cap	0778
1	Direct Reading Titrator, 0-20 Range	0378
1	Pipet, plain	0352

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

† Chloride Reagent #2 (4505DR) contains Silver Nitrate, which will cause a dark stain where it contacts the skin. Care should be taken to avoid spillage

Read the LaMotte Direct Reading Titrator Manual before proceeding.

Procedure

6. Use the pipet (0352) to add three drops of the sample water to the test tube (0778).
7. Carefully add chloride-free water until the tube is filled to the 15 mL line. (This is a one part to one hundred part (1:100) dilution.)
8. Add three drops of the *Chloride Reagent #1 (4504). Cap and mix. A yellow color will result.
9. Fill the Direct Reading Titrator (0378) with *Chlroide Reagent #2 (4505). Insert the titrator in the center hole of the cap.
10. Add *Chloride Reagent #2 (4505) until the color of the solution changes from yellow to pinkish-brown. Swirling to mix after each addition.
11. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record the result as ppt Salinity. Each minor division equals 0.4 ppt.

Overhead Projection Demonstration

The reaction of the Chloride-Salinity test procedure does not work satisfactorily on the overhead projector. A precipitate is formed in this reaction. This precipitate blocks out the passage of light through the cell and a blank circle is projected.

Sulfide Test

Sulfide occurs in many well water supplies and sometimes is formed in lakes or surface waters. In distribution systems it may be formed as a result of bacterial action on organic matter under anaerobic conditions. It may also be found in waters receiving sewage or industrial wastes. Concentrations of a few hundredths of a milligram per liter cause a noticeable odor. Removal of sulfide odor is accomplished by aeration or chlorination. Hydrogen sulfide is a toxic substance acting as a respiratory depressant in both humans and fish.

Hydrogen sulfide or soluble sulfides are detected by treating the sample with para-aminodimethylaniline and ferric chloride in acid solution to form the well known dye Methylene Blue. The reaction is sensitive to very small traces of sulfide and can be applied to the determination of hydrogen sulfide in air.

NOTE: The sample should be collected with a minimum of aeration and should be analyzed promptly. *Sulfide Reagent A (4458) is a strong acid solution and should be handled with great care.

Field Test Method

Quantity	Contents	Code
15 mL	*Sulfide Reagent A	*4458-E
15 mL	Sulfide Reagent B	4459-E
30 mL	Sulfide Reagent C	4460-G
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Pipet, 1.0 mL	0354
1	Sulfide Color Chart, 0.2 and 2.0 ppm	7477-CC

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Fill test tube (0106) to the 5 mL line with sample water.
2. Add 15 drops of *Sulfide Reagent A (4458). Cap and mix. Remember that the test sample now has a high acid content.
3. Add three drops of Sulfide Reagent B (4459). Cap and mix. Wait one minute.
4. Use the 1.0 mL pipet (0354) to add 1.0 mL of Sulfide Reagent C (4460). Cap and mix.

5. If sulfide is present, a blue color will develop. Match sample color to a color standard on the Sulfide Color Chart (7477-CC).

Overhead Projection Demonstration

Quantity	Contents	Code
15 mL	*Sulfide Reagent A	*4458-E
15 mL	Sulfide Reagent B	4459-E
30 mL	Sulfide Reagent C	4460-G
1	Test Tube, 2.5-5-10 mL, plastic, w/cap	0106
1	Pipet, 1.0 mL	0354
1	Demonstration Stage, six cell	1038-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Procedure

1. Place the demonstration stage (1038-P) on the overhead projector and turn on the projector light.
2. Fill test tube (0106) to the 5 mL line with sample water and transfer this liquid to a cell on the demonstration stage (1038-P).
3. Add 15 drops of *Sulfide Reagent A (4458) to the sample in the cell. Stir with the stirring rod (0519). Remember that this is a strongly acidic solution.
4. Add 3 drops of Sulfide Reagent B (4459) and stir. Wait one minute.
5. Add 1.0 mL of Sulfide Reagent C (4460) and stir the contents of the cell.
6. If sulfide is present, a blue color will develop. Traces of sulfide will produce faint blue colors and high concentrations will produce deep blue colors.

Total Dissolved Solids Test

Dissolved solids in a natural water are usually composed of the sulfate, bicarbonate and chlorides of calcium, magnesium and sodium. The US Public Health Service recommends that the total solids of a potable water be limited to 500 ppm, but if such a water is not available a total solids content of up to 1000 ppm may be permitted. From the standpoint of irrigation of agricultural crops. total solids of 185 ppm or less would be considered low; between 175 and 500 medium; 500 to 1500 high; and above 1500 ppm very high. The term salinity is also used to describe the solids content of irrigation water. In addition to potable and irrigation uses, a high solids content is undesirable in most industrial process waters. While sodium-hydrogen zeolite softening and lime-soda softening may affect a reduction in dissolved solids, for complete removal, however, it is necessary to employ demineralization or distillation.

Dissolved solids are determined by electrical conductivity methods; by weighing the residue after evaporation and by ion exchange methods. A combination of ion exchange and direct titration is used here to estimate the solids content of a water.

Field Test Method

The Direct Reading Titrators used in this procedure are calibrated so that the test result is read directly from the scale on the Titrator in ppm Total Dissolved Solids.

Quantity	Contents	Code
60 mL	*TDS Reagent A	*4802-H
60 mL	*TDS Reagent B	*4803-H
2	Resin Column	1079
15 mL	Methyl Orange Indicator with Halidex	2299-E
2	Test Tube, 5-10-15 mL, glass, w/cap	0778
60 mL	Deionized Water	5115PT-H
2	Direct Reading Titrators, 0-1000 Range	0384
1	Pipet, 1.0 mL	0354

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Read the LaMotte Direct Reading Titrator Manual before proceeding.

Procedure

1. Fill test tube (0778) to the 10 mL line with the sample water.
2. Add 3 drops of Methyl Orange Indicator with Halidex (2299). Cap and mix.
3. Fill a Direct Reading Titrator (0384) with *TDS Reagent A (4802). Insert the Titrator in the center hole of the test tube cap.
4. Add the *TDS Reagent A (4802) until the yellow color changes to pink, swirling to mix after each addition. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. This is result "A." Discard this portion of the test sample and wash the test tube.

The second part of the TDS test involves passing the sample through an ion exchange column which exchanges the various cations (Na, Ca, Mg, etc.) for hydrogen ions which are then titrated with *TDS Reagent B (4803) (Standard Sodium Hydroxide Solution).

This kit is furnished with two ready-to-use resin columns. Each resin column can be used for twenty water samples, after which it should be discarded. Keep a record of the number of times the resin column is used.

5. Suspend the resin column (1079) in the second test tube (0778).
6. Use 1 mL pipet (0354) to add 3-4 mL of deionized water (5115) to the resin column.
7. Use the 1 mL pipet (0354) to add 5 mL of sample water. Discard all of the solution that has passed through the column then continue adding the water sample until at least 10 mL has been collected.
8. Water that has passed through the resin column is now poured into the first test tube (0778) and the volume adjusted to exactly 10 mL.
9. Add 3 drops of Methyl Orange Indicator with Halidex (2299). Cap and mix.
10. The second Titrator (0384) is filled with *TDS Reagent B (4803). The *TDS Reagent B (4803) is added until the red color changes to yellow, swirling to mix after each addition. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. This is result "B."
11. Add result "A" to result "B." The sum is equal to the total dissolved solids in parts per million expressed as calcium carbonate.

Care of Resin Column

At the conclusion of any test, the resin column should be treated with Distilled Water (5115) as in step 6, then stoppered and capped until used again.

Overhead Projection Demonstration

Quantity	Contents	Code
60 mL	*TDS Reagent A	*4802-H
60 mL	*TDS Reagent B	*4803-H
2	Resin Column	1079
15 mL	Methyl Orange Indicator with Halidex	2299-E
1	Test Tube, 5-10-15 mL, glass, w/cap	0778
60 mL	Deionized Water	5115PT-H
2	Direct Reading Titrators, 0-1000 Range	0384
1	Pipet, 1.0 mL	0354
1	Demonstration Stage, three cell	1039-P
1	Stirring Rod, plastic	0519

*WARNING: Reagents marked with an * are considered to be potential health hazards. See page 4 for more safety information.

Read the LaMotte Direct Reading Titrator Manual before proceeding.

Procedure

1. Place the demonstration stage (1039-P) on the overhead projector and turn the projector light on.
2. Fill the test tube (0778) to the 10 mL line with sample water and transfer to a cell on the demonstration stage (1039-P).
3. Add three drops of Methyl Orange Indicator with Halidex (2299) to the cell and stir with the stirring rod (0519).
4. Fill a Direct Reading Titrator (0384) with *TDS Reagent A (4802), add one drop at a time, while stirring until the yellow color changes to pink. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. This is result "A." Rinse the titraton tube.
5. Suspend the resin column (1079) in the second test tube (0778).
6. Use the 1 mL pipet (0354) to add 3-4 mL of deionized water (5115) to the resin column.
7. Use the 1 mL pipet (0354) to add 5 mL of sample water. Discard all of the solution that has passed through the column then continue adding the water sample until at least 10 mL has been collected.
8. Water that has passed through the resin column is now poured into the first test tube and the volume adjusted to exactly 10 mL.

9. Transfer to a second cell on the demonstration stage.
10. Add three drops of Methyl Orange Indicator with Halidex (2299) to the second cell and mix by stirring with the stirring rod (0519).
11. Use the other Titrator (0384) to add TDS Reagent B (4803) to the second cell, stirring after each addition, until the red color changes to yellow. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. This result is "B."
12. Add result "A" to result "B." The sum is equal to the total dissolved solids content of the sample given in parts per million expressed as Calcium Carbonate.

Care of Resin Column

At the conclusion of any test, the resin column should be treated with Deionized Water (5115) as in step 6 then stoppered and capped until used again.

LaMOTTE COMPANY
Helping People Solve Analytical Challenges

PO Box 329 • Chestertown • Maryland • 21620 • USA
800-344-3100 • 410-778-3100 (Outside USA) • Fax 410-778-6394
Visit us on the web at *www.lamotte.com*

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