CORROSION CONTROL TEST KIT

Code 7436-01

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INTRODUCTION

A formula developed by Dr. Wilfred F. Langelier, of the University of California at Berkeley, is used to keep potable waters in balance to prevent corrosion on the one hand, and scale formation, on the other. This formulation is known variously as the "Saturation Index" or the "Langelier Equation". It is stated as follows:

$$TF + TDSF - CF - AF = pHS$$

$$pH - pHS = \text{Saturation Index}$$

In this equation, the pH is read from a sample of water using the pocket pH meter, and is recorded on the worksheet directly as pH units. Temperature, Calcium Hardness, Alkalinity, and Total Dissolved Solid test procedures are performed on the sample, the correct factor for each result is taken from table on page 4, and the results are recorded on the worksheet.

Temperature and Total Dissolved Solids factors are added together. Alkalinity and Calcium Hardness factors are subtracted from this sum. The result is the solubility pH or pHS. pHS is then subtracted from measured pH to give the corrision index, also known as the saturation index or Langlier index.

NOTE: Phosphate testing is included in this kit, however, phosphate results are not required to calculate a Saturation Index. The test is included if you add a phosphating compound to inhibit corrosion. See page 11 for procedure.

CORROSIVITY INDEX CALCULATIONS

The Corrosivity Index (Langelier's Saturation) is used to determine whether a water supply will support and deposit calcium carbonate. This deposit acts as a buffer against leaching of various metals within the distribution system; the primary concern of which is lead.

The Corrosivity Index is figured using five basic factors: pH, calcium hardness, total alkalinity, temperature, and total dissolved solids. The resulting formula is used to calculate the Corrosivity Index as follows:

$$TF + TDSF - CF - AF = pHS$$

$$\text{Corrosivity Index} = pH - pHS$$

With this information a water supply operator can quickly calculate the Corrosivity Index for any system.

pH	=	pH Factor	Read directly with pH tester
TF	=	Temperature Factor	Read temperature in °C, use Index Calculation Chart
CF	=	Calcium Hardness Factor	Titrate for calcium hardness, use Index Calculation Chart
AF	=	Alkalinity Factor	Titrate for total Alkalinity, use Index Calculation Chart
TDSF	=	Total Dissolved Solids Factor	Use Pocketester and Index Calculation Chart

The Corrosivity Index should be maintained at a positive value between 0 and +0.5.

If the Corrosivity Index is 0, the water is perfectly balanced.

If the Corrosivity Index is negative, corrosion tendencies are predicted.

If the Corrosivity Index is positive, scale forming tendencies are predicted.

NOTE: Use supplied worksheets for Index Calculations.

INDEX CALCULATION CHART

Total Dissolved Solids		Calcium Hardness & Total Alkalinity		Temperature	
ppm =	CF	ppm =	AF	°C =	TF
0	9.70	10	1.00	0.0	2.60
100	9.77	25	1.39	4.0	2.50
200	9.83	50	1.70	8.0	2.40
300	9.85	75	1.87	12.0	2.30
400	9.86	100	2.00	16.0	2.20
600	9.87	150	2.15	20.0	2.10
800	9.89	200	2.30	25.0	2.00
1000	9.90	300	2.48	30.0	1.90
		400	2.60	40.0	1.70
		800	2.90	50.0	1.55
		1000	3.00	—	—

EXAMPLE: A water sample was tested and found to have the following characteristics:

Test	Measured Value	Factor	Factor Value from Chart
Temperature	10.0°C	TF (Temperature Factor)	2.35
Total Dissolved Solids	300 ppm	TDSF (Total Dissolved Solids Factor)	9.85
Calcium Hardness	75 ppm	CF (Calcium Hardness Factor)	1.87
Total Alkalinity	100 ppm	AF (Alkalinity Factor)	2.00
pH	8.5	pH	8.5

CALCULATIONS:

Soluability pH (pHS) = TF + TDSF – CF – AF

pHS = 2.35 + 9.85 – 1.87 – 2.00
pHS = 8.33

Langelier Saturation Index (LSI) = Measured pH – pHS

LSI = 8.5 – 8.33
LSI = 0.17

ALKALINITY

QUANTITY	CONTENTS	CODE
15 mL	*Alkalinity Indicator #1, pH 8.3	*3870-E
15 mL	*Alkalinity Indicator #2, pH 4.5	*3869-E
60 mL	*Alkalinity Titration Reagent B	*4493DR-H
1	Titration Tube, 5 mL, with cap	0778
1	Direct Reading Titrator, 0-200 Range	0382

*WARNING: Reagents marked with a * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents see MSDS CD or www.lamotte.com. To obtain a printed copy, contact LaMotte by email, phone or fax.

NOTE: Carefully read the instruction manual for the LaMotte Direct Reading Titrator before performing the titration as described below. The titrator is calibrated in terms of Alkalinity expressed as parts per million (ppm) calcium carbonate ($CaCO_3$). Each minor division on the titrator scale equals 4 ppm $CaCO_3$.

PROCEDURE

PHENOLPHTHALEIN (P) ALKALINITY

NOTE: P Alkalinity results are not required for Corrosion Index Calculations.

1. Fill titration tube (0778) to 5 mL line with the water sample.
2. Add two drops of *Alkalinity Indicator # 1 (3870) to titration tube. Cap and mix. If a pink to red color does not develop in solution, P alkalinity is zero.
3. If a red color develops, P Alkalinity is determined. Fill the Direct Reading Titrator with Alkalinity Titration Reagent B (4493DR) as described in instruction manual. Insert titrator in center hole of titration tube cap
4. Slowly depress plunger and swirl after each drop until RED color disappears. Read test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Express result as P Alkalinity in ppm $CaCO_3$.

   EXAMPLE: Plunger tip is 3 minor division below line 80. The test result is 80 plus 3 division x 4 equals 92 ppm, since each division is equal to 4 ppm.

5. If plunger tip reaches the bottom line on the titrator scale (200 ppm) before the endpoint color change occurs, refill titrator and continue titration. When recording test results, original amount of reagent titrated (200 ppm) must be included.

   NOTE: Do not move the titrator plunger after P alkalinity endpoint has been obtained, as the T Alkalinity titration is a continuation of the P Alkalinity titration.

TOTAL (T) ALKALINITY

NOTE: If only Total Alkalinity is to be tested, perform Steps 1, 7 and 8 only, using a full titrator in Step 8.

6. Without moving plunger remove titrator and titration tube cap from titration tube containing sample from Step 4.
7. Add two drops *Alkalinity Indicator #2 (3869) to titration tube. Replace cap, swirl to mix. a BLUE color will appear.
8. Re-insert titrator in cap and continue titration until BLUE color changes to GREEN. Read test result as T Alkalinity in ppm $CaCO_3$. Include in test result total amount of titration reagent added. (See Step 5).
9. Record results in Step 8. To calculate AF Factor, refer to chart on page 4.

CALCIUM HARDNESS

QUANTITY	CONTENTS	CODE
15 mL	*Sodium Hydroxide Reagent w/Metal Inhibitors	*4259-E
50	Calcium Hardness Indicator Tablets	T-5250-H
60 mL	Hardness Reagent #7	4487DR-H
1	Test Tube, 5-10-12.9-15-20-25 mL, glass, w/cap	0608
1	Direct Reading Titrator, 0-200 Range	0382

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NOTE: Carefully read the instruction manual for the LaMotte Direct Reading Titrator before performing the titration described below. The Titrator is calibrated in terms of Total Hardness expressed as parts per million (ppm) Calcium Carbonate ($CaCO_3$). Each minor division on the titrator scale equals 4 ppm $CaCO_3$.

PROCEDURE

1. Fill test tube (0608) to 12.9 mL line with the water sample.
2. Add 6 drops of *Sodium Hydroxide Reagent with metal inhibitors (4259) to test sample. Cap and mix.
3. Add one Calcium Hardness Indicator Tablet (T-5250). Cap and gently shake to dissolve tablet. A red color will appear.
4. Fill the Direct Reading Titrator (0382) with Hardness Reagent #7 (4487DR) as described in the instruction manual. Insert Titrator in center hole of test tube cap.
5. Slowly depress plunger and swirl sample after each drop until Red color changes to Blue. Read test result directly from the scale where the larger ring on the Titrator meets the Titrator barrel. Result is expressed as Total Hardness in ppm $CaCO_3$.

   EXAMPLE: Plunger tip is 3 minor divisions below line 80. The test result is 80 plus (3 divisions x 4) equals 92 ppm.

   NOTE: If the plunger tip reaches the bottom line on the titrator scale (200 ppm) before endpoint color change occurs, refill Titrator and continue titration. When recording the test result, be sure to include the value of the original amount of reagent dispensed (200 ppm).

6. Record results in Step 5. To calculate CF Factor, refer to chart on page 4.

TESTR pH10 WATERPROOF

(see individual instruction sheet)

TEMPERATURE

The Model 545 Armored Thermometer is furnished with a protective plastic shield with window openings. Range is –5°C to 45°C in 0.5°C increments.

To use, dip thermometer into sample. Allow a minute or two for the thermometer to stabilize, and read the Temperature on the graduated scale. Record your results in degrees °C to the nearest 0.5 increment.

To calculate TF Factor, refer to Index Calculation Chart on page 4.

NOTE: The protective plastic shield can be removed for added visibility in temperature measurements.

WATERPROOF TDSTestr Low

(see individual instruction sheet)

PHOSPHATE IN WATER

INTRODUCTION

If part of your overall corrosion control program includes the addition of a phosphate compound to inhibit corrosion in your potable water supply, a phosphate test should be performed to measure Orthophosphate. Follow instructions below.

QUANTITY	CONTENTS	CODE
60 mL	*Phosphate Acid Reagent	*V-6282-H
5 g	*Phosphate Reducing Reagent	*V-6283-C
2	Test Tube, 10 mL	0843
1	Spoon, measuring, 0.1 g	0699
2	Pipets, 1.0 mL, plastic	0354
1	Demineralizer Bottle	1151
1	Phosphate Comparator, 0.5 - 10 ppm	3115

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NOTES:

- This test determines levels of Orthophosphates only.
- This test should be run on clear samples only.
- Best results are obtained when solution temperatures are 23- 25°C.

PROCEDURE

RANGE: 0.5 - 10 ppm Phosphate (PO_4)

1. Fill the test tube (0843) to the mark with the water sample.
2. Use the 1.0 mL pipet (0354) to add 1.0 mL of *Phosphate Acid Reagent (6282). Cap and mix.
3. Use the 0.1 g measuring spoon (0699) to add one level measure of *Phosphate Reducing Reagent (6283). Cap and mix until dissolved.
4. Wait 5 minutes for the color to develop. Insert the tube into the Comparator (3115) and compare the color to the standards to obtain the result in ppm Phosphate.

RANGE: 5-100 ppm Phosphate (PO_4) - 1:10 Dilution

1. **Use the 1.0 mL pipet (0354) to add 1.0 mL of water sample to the test tube (0843).**
2. **Add deionized water from the Demineralizer Wash Bottle (1151) to fill to the 10 mL mark.**
3. **Use the 1.0 mL pipet (0354) to add 1.0 mL *Phosphate Acid Reagent (6282) to the diluted test sample. Cap and mix.**
4. **Use the 0.1g measuring spoon (0699) to add one level measure of Phosphate Reducing Reagent (6283). Cap and mix until dissolved.**
5. **Wait 5 minutes for the color to develop. Insert the tube into the Comparator (3115).the color to the standards. Multiply the value by 10 to determine the result in ppm Phosphate.**

RECOMMENDED STANDARDIZATION PRACTICES

The Corrosion Control Kit tests for Alkalinity, Calcium Hardness, Phosphate, pH, and TDS. This outfit was designed specifically for field testing purposes. In order to check the performance and accuracy of the equipment it is recommended that the equipment be checked against reference standards. Routine performance checks will enable the operator to keep track of the accuracy and be able to address any problems in the testing methods or the equipment, and guarantee that the performance specifications are being achieved.

The age of the reagents can be determined from the lot number, a 6 or 7 digit number found on the reagent bottle. Only the first three digits are important. The first two digits refer to the week of the year. The third digit refers to the last digit of the year. For example: 061 would refer to the sixth week of 2001.

To determine the performance, check for Alkalinity, Calcium Hardness, and Phosphate. Concentrated standard solutions are available for each analyte. The operator dilutes the concentrate using good laboratory practices to a level which can be correctly tested by the method provided. The concentrated standards are made according to APHA or EPA specifications, and use reagent grade chemicals to provide the necessary analyte in a stabilized chemical form.

The electrometric methods for measuring pH and TDS are subjected to the same type of performance test. The pH Tester is checked against a standard buffer solution that is provided with the kit. This buffer is prepared from salts that are traceable to NIST buffers. The TDS solutions are also prepared from salts that are traceable to NIST standards.

It is a good practice and highly recommended that the operator keep a journal or log of all performance test results: dates tested, and age of all the reagents used in the tests. *See suggested Log Form*.

To conduct performance tests on the equipment and the methods based on the reference standards, the following recommended procedures are provided:

ALKALINITY STANDARD • CODE 5168

Fill 100 mL volumetric flask to ½ volume with Deionized water. Use pipet to dispense 1.0 mL of standard into flask. Dilute to volume and mix.

Diluted standard = 100 ppm Total Alkalinity

CALCIUM HARDNESS STANDARD • CODE 6185

Fill 100 mL volumetric flask to ½ volume with Deionized water. Use pipet to dispense 10 mL of standard into flask. Dilute to volume and mix.

Diluted standard = 100 ppm Calcium Hardness

PHOSPHATE STANDARD • CODE 6184

Prepare two 100 mL volumetric flasks by filling to ½ volume with distilled water. Use pipet to dispense 10 mL of standard to first flask. Dilute to volume and mix. Use another pipet to dispense 6 mL from first flask into second flask. Dilute to volume and mix.

Diluted standard = 6 ppm Phosphate

pH BUFFER 7.0 • CODE 2881

pH Buffer 7.0 is provided with each kit and should be used periodically to check the performance of the tester. Other buffer solutions can be provided to cover different pH ranges of interest.

TDS

TDS solutions can be selected from a list of different strengths:

74 MMHOS (52 ppm) – Code 6416

718 MMHOS (503 ppm) – Code 6417

1413 MMHOS (989 ppm) – Code 6354

Following the instructions for the tester, periodically check the response of the tester to guarantee proper performance.

TEMPERATURE

The thermometer (Code 1066) should be periodically checked against a reference thermometer that is NIST certified. Any deviation from the reference temperature should be noted.