ALKALINITY (ALKAPHOT)

TEST FOR TOTAL ALKALINITY IN NATURAL AND TREATED WATERS

Photometer Method
570 nm
0 - 500 mg/l $CaCO_3$

Natural and treated waters may contain a variety of dissolved alkaline substances such as carbonates, bicarbonates, hydroxides and to a lesser extent, borates, phosphates, and silicates. In water at neutral pH, the alkalinity derives mainly from the presence of bicarbonates.

Total alkalinity is an important test in determining the aggressiveness or scale forming tendency of the water. If the total alkalinity is low, the water may be aggressive and cause corrosion to pipework and structures; if the total alkalinity is high, the water more readily promotes scale formation. Alkalinity control is therefore an important part of many water treatment programs.

The Alkaphot test uses a colorimetric method and covers the total alkalinity range 0 - 500 mg/l $CaCO_3$. The test is particularly suitable for checking natural and drinking waters, swimming pool water, boiler water, etc.

Method

The Alkaphot test is based on a unique colorimetric method and uses a single tablet reagent. The test is simply carried out by adding a tablet to a sample of the water. Under the conditions of the test, a distinctive range of colors from yellow, through green, to blue are produced over the alkalinity range 0 - 500 mg/l $CaCO_3$. The color produced in the test is indicative of the alkalinity of the water and is measured using a Photometer.

Reagents and Equipment

Alkaphot Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program Phot 2

Test Procedure

1. Fill test tube with sample to the 10 ml mark
2. Add one Alkaphot tablet, crush and mix until all of the particles have dissolved.
3. Select wavelength 570 nm on Photometer.
4. Take Photometer reading in the usual manner (see Photometer instructions).
5. Consult Alkaphot calibration chart (Transmittance-display photometer only).

ALKAPHOT				Alkalinity mg/l $CaCO_3$				570 nm		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
80	0	8	13	21	26	30	38	42	47	52
70	56	60	65	73	76	80	85	90	95	100
60	103	108	112	117	121	125	130	135	140	143
50	148	153	158	163	168	173	177	183	188	193
40	200	205	210	215	223	228	233	240	245	250
30	255	260	265	273	278	285	290	300	305	315
20	320	330	340	350	355	363	373	380	395	405
10	413	430	450	470	500	----	----	----	----	----

ALKALINITY M and P (ALKAPHOT M, P)

ALKALINITY M and ALKALINITY P TESTS FOR BOILER WATER AND OTHER INDUSTRIAL WATERS

Photometer Method
570 nm and 520 nm
0 - 500 mg/l $CaCO_3$

The Alkalinity of water is caused by the presence of alkaline substances such as hydroxides, carbonates, bicarbonates and, to a lesser extent, silicates and phosphates. Quantitatively, alkalinity is the capacity of the water to react with acid to a specified pH end point. The value obtained will depend on the pH indicator used. Two measures of alkalinity are conventionally applied -- Alkalinity M (Alkalinity to methyl orange) and Alkalinity P (Alkalinity to phenolphthalein).

Alkalinity is an important test parameter for a number of industrial water uses, most notably, in boiler water treatment. Water systems for boilers and steam raising plants are normally operated under conditions of high alkalinity in order to minimize corrosion, so monitoring alkalinity is an important control test.

The Alkaphot M and Alkaphot P tests provide a simple means of checking Alkalinity M and Alkalinity P levels over the range 0 - 500 mg/l $CaCO_3$. The tests are particularly suited to boiler and industrial waters. The alkalinity specifically due to carbonates, bicarbonates and hydroxides can be calculated from the results.

Method

The Alkaphot M and Alkaphot P tests are both based on unique colorimetric methods utilizing a single tablet reagent containing a standardized amount of acid combined with a color indicator. These methods offer considerable advantages over the titrimetric methods traditionally used to measure these parameters. The tests are carried out by adding the appropriate tablet to a sample of the water under test.

Over the alkalinity range of each test, a distinctive series of colors is produced - from yellow through green to blue in the case of the Alkaphot M test, and from colorless to purple in the case of the Alkaphot P test. The exact color produced in each test depends on the alkalinity of the sample, and is measured using a Photometer.

Reagents and Equipment

Alkaphot M Tablets
Alkaphot P Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibrations

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 37 Alkalinity M
or Phot 38 Alkalinity P

Alkaphot M Test Procedure

1. Filter sample if necessary to obtain a clear solution.
2. Fill the test tube to the 10 ml mark with sample.
3. Add one Alkaphot M tablet, crush and mix. Ensure all particles are dissolved.
4. Select wavelength 570 nm on the Photometer.
5. Take a Photometer reading in the usual manner (see Photometer instructions).
6. Consult Alkaphot M calibration chart (Transmittance-display photometer only).

ALKAPHOT M Alkalinity M mg/l $CaCO_3$ **570 nm**

%T	9	8	7	6	5	4	3	2	1	0
90	----	----	----	----	----	----	----	----	----	0
80	0	10	17	22	30	35	40	45	48	50
70	55	60	65	70	75	80	85	90	95	98
60	102	107	110	115	120	125	130	135	140	145
50	150	155	160	165	170	175	180	183	187	193
40	197	202	208	214	220	225	230	235	240	245
30	252	260	267	273	280	286	293	300	308	315
20	323	334	342	352	362	372	381	390	400	413
10	425	440	460	480	500	----	----	----	----	----

Alkalinity P Test Procedure

1. Filter sample if necessary to obtain a clear solution.
2. Fill the test tube to the 10 ml mark with sample.
3. Add one Alkaphot P tablet, crush and mix to dissolve.
4. Stand for two minutes to allow full color development.
5. Select wavelength 520 nm on the Photometer.
6. Take Photometer reading immediately in the usual manner (see Photometer instructions).
7. Consult Alkaphot P calibration chart (Transmittance-display photometer only).

ALKAPHOT P				Alkalinity P mg/l $CaCO_3$					**520 nm**	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	----	----	----	0	0	8	15	22	29	37
80	45	52	59	65	71	77	83	89	95	100
70	105	110	115	120	124	128	132	136	140	144
60	148	152	156	160	165	170	175	180	185	190
50	195	200	205	210	215	220	225	230	235	235
40	240	245	250	250	255	260	265	270	275	275
30	280	285	290	295	300	305	310	315	320	325
20	330	340	345	350	355	365	370	380	390	400
10	405	415	425	435	445	455	470	485	500	----

Alkalinity Relationships

As noted in the opening discussion, alkalinity may be due to the presence of several substances. The alkalinity present in most waters however, is mainly due to only three chemical classes; namely hydroxides, carbonates and bicarbonates. Using the results of the foregoing procedures, the relative contributions of each of the three main chemical forms of alkalinity can be calculated.

This calculated relationship assumes the absence of other weak forms of alkalinity, and also assumes that hydroxides and bicarbonates are not compatible in the same sample. The chemical forms of alkalinity, expressed as mg/l $CaCO_3$, are calculated using the following relationships:

a) If Alkalinity P = O; Then
Bicarbonate = M
Carbonate = O
Hydroxide = O

b) If Alkalinity P > O and M > 2P; Then
Bicarbonate = M - 2P
Carbonate = 2P
Hydroxide = O

c) If Alkalinity P > O and M < 2P; Then
Bicarbonate = O
Carbonate = 2M - 2P
Hydroxide = 2P - M

Where P is the Alkaphot P result, and M is the Alkaphot M result.

Note:

The expression of alkalinity results sometimes causes confusion. In normal practice, alkalinity test results are expressed as mg/l $CaCO_3$ (calcium carbonate). This is merely a convention to allow the comparison of different results and does not necessarily indicate that the alkalinity present in the water is in this form. The different chemical forms of alkalinity have been referred to in the test instructions.

ALUMINUM

TEST FOR ALUMINUM IN NATURAL AND DRINKING WATER

Photometer Method
570 nm
0 - 0.5 mg/l

Aluminum sulphate is widely used as a coagulant in drinking water treatment. The determination of aluminum (residual alum) is usually required for the control of alum coagulation and filtration processes at water works.

Aluminum salts are found in natural waters. Levels are reported to be increasing, particularly in areas affected by acid rain. High aluminum levels can be toxic to fish and aquatic life. Aluminum determination is necessary, therefore, for environmental control, and for testing water used for fish farms, etc.

The Aluminum test provides a simple method of measuring aluminum levels in natural and drinking waters over the range 0 - 0.5 mg/l.

Method

Aluminum reacts with Eriochrome Cyanine R indicator in slightly acid solution to produce a pink-red complex. The presence of ascorbic acid eliminates interference from iron and manganese. In the Aluminum method, the necessary reagents are incorporated into two test tablets. The test is simply carried out by adding one of each tablet to a sample of the water. The first tablet acidifies the sample to bring any colloidal aluminum into solution, while the second tablet buffers the solution to provide the correct conditions for the test.

Reagents and Equipment

Aluminum No. 1 Tablets
Aluminum No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program Phot 3

Sample Collection

Aluminum is readily absorbed on to the surfaces of sample containers, particularly glass containers. To avoid loss of aluminum, collect samples in plastic bottles, and test as soon as possible after collection. Sample bottles should be acid-rinsed and thoroughly washed with deionised water before re-use.

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Aluminum No. 1 tablet, crush and mix to dissolve.
3. Add one Aluminum No. 2 tablet, crush and mix gently to dissolve. Avoid vigorous agitation.
4. Stand for five minutes to allow full color development.
5. Select wavelength 570 nm on Photometer.
6. Take Photometer reading in the usual manner (see Photometer instructions).
7. Consult Aluminum calibration chart (Transmittance-display photometer only).

ALUMINUM					Aluminum mg/l Al				**570 nm**	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	----	----	----	----	----	0.00	0.01	0.02	0.03	0.04
80	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.17
70	0.18	0.20	0.21	0.22	0.24	0.25	0.27	0.29	0.30	0.32
60	0.33	0.35	0.38	0.41	0.45	0.50	----	----	----	----

Interferences

The presence of polyphosphate or fluoride can lead to low aluminum readings. Polyphosphate is unlikely to be present in significant quantities in normal water samples. Fluoride will only be significant for control samples from water works where fluoridation is practiced. In such cases, samples should preferably be taken before the final fluoridation stage.

For samples taken after fluoridation, such as those from water distribution systems, or for samples containing natural fluoride, the aluminum concentration must be corrected. To obtain the corrected aluminum concentration, multiply the calibration chart value by the factor (1 = 0.4 F) where F is the Fluoride concentration in mg/l F. The fluoride concentration must be determined separately by normal test procedures.

AMMONIA

TEST FOR AMMONIA IN NATURAL DRINKING AND WASTE WATER

Photometer Method
640 nm
0 - 1.0 mg/l N

In natural waters, ammonia occurs as a breakdown product of nitrogenous material. It is also found in domestic effluents and certain industrial waste waters. Ammonia is harmful to fish and other forms of aquatic life, therefore, ammonia levels must be carefully controlled in water used for fish farms and aquariums. Pollution control programs routinely apply ammonia tests to monitor drinking water supplies, effluents and waste waters.

The Ammonia test provides a simple method of measuring ammonia (ammoniacal nitrogen) over the range 0 - 1.0 mg/l N.

Method

The ammonia test is based on an indophenol method. In the presence of chlorine, ammonia reacts with alkaline salicylate to form a green-blue indophenol complex. Incorporated catalysts ensure complete and rapid color development. The reagents are provided as two tablets for maximum convenience. To perform the test, simply add one of each reagent tablet to a sample of the water.

The intensity of the color produced is proportional to the ammonia concentration, and is measured using a Photometer.

Reagents and Equipment

Ammonia No. 1 Tablets
Ammonia No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program Phot 4 Ammonia Nitrogen (N)
or Phot 62 Ammonium (NH_4)

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Ammonia No. 1 tablet and one Ammonia No. 2 tablet, crush and mix to dissolve.
3. Stand for 10 minutes to allow full color development.
4. Select wavelength 640 nm on Photometer.
5. Take Photometer reading in the usual manner (see Photometer instructions).
6. Consult Ammonia calibration chart (Transmittance-display photometer only).

AMMONIA					Ammonia mg/l N			**640 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
80	---	----	----	----	----	0.00	0.00	0.01	0.01	0.02
70	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07
60	0.07	0.08	0.09	0.09	0.10	0.11	0.11	0.12	0.13	0.13
50	0.14	0.15	0.16	0.16	0.17	0.18	0.19	0.20	0.20	0.21
40	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29	0.30	0.31
30	0.32	0.33	0.34	0.36	0.37	0.38	0.39	0.41	0.42	0.44
20	0.45	0.47	0.48	0.50	0.51	0.53	0.55	0.57	0.59	0.61
10	0.63	0.66	0.68	0.71	0.74	0.77	0.80	0.83	0.87	0.91
0	0.96	1.00	----	----	----	----	----	----	----	----

Sea Water Samples

When testing sea water or brackish water samples, Ammonia Conditioning Reagent is required to prevent precipitation of salts. The reagent is supplied in a special "spoon pack" to aid measuring out the powder.

Fill the test tube with sample to the 10 ml mark, and add one level spoonful of conditioning reagent. Mix to dissolve reagent, then continue the test as described in the above test procedure.

Notes

1. At low temperatures the rate of color development in the test may be slower. If the sample temperature is below 20°C allow 15 minutes for the color to develop.
2. Ammonia concentrations can be expressed in a number of different ways. The following factors may be used for the conversion of readings:

   To convert from N to NH_4 multiply by 1.3.

   To convert from N to NH_3 multiply by 1.2.

YSIP 40

BORON

Photometer Method
410 nm
0 - 2.5 mg/l

TEST FOR BORON IN WATER

Boron is an abundant natural element. It usually occurs in the form of calcium or sodium borate. Since borates are widely used in industrial processes, boron may be present in effluent discharges.

Boron is an essential element for plant growth. However, some crops can be highly sensitive to boron at other than very low levels. For this reason, the boron level in irrigation water should be checked.

Method

Under slightly acidic conditions, boron, in the form of borates, reacts with azomethine to form a yellow colored complex. In the Boron method, two test tablets provide the necessary buffer and indicator reagents. A sequestering agent is incorporated to eliminate any interference from cations. The test is simply carried out by adding one of each tablet to a sample of the water. The intensity of the color produced is proportional to the boron concentration, and is measured using a Photometer.

Reagents and Equipment

Boron No. 1 Tablets
Boron No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 40

Test Procedure

1. Fill the test tube with sample to the 10 ml mark.

   Note: For optimum results, perform this test at a temperature of 20° ± 2°c.

2. Add one Boron No. 1 tablet, crush and mix to dissolve.
3. Add one Boron No. 2 tablet, crush and mix to dissolve.
4. Stand for exactly 20 minutes to allow full color development.
5. Select wavelength 410 nm on Photometer.
6. Take Photometer reading in usual manner (see Photometer instructions).
7. Consult Boron calibration chart (Transmittance-display photometer only).

BORON				Boron mg/l B					410 nm	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
70	-	0.00	0.05	0.05	0.10	0.10	0.10	0.15	0.15	0.20
60	0.20	0.25	0.25	0.30	0.30	0.35	0.40	0.40	0.45	0.45
50	0.50	0.50	0.55	0.55	0.60	0.60	0.65	0.65	0.70	0.70
40	0.75	0.80	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15
30	1.20	1.25	1.30	1.35	1.40	1.50	1.55	1.60	1.70	1.75
20	1.85	1.90	2.00	2.05	2.10	2.20	2.30	2.40	2.50	----

BROMINE

TEST FOR FREE, COMBINED AND TOTAL BROMINE IN WATER

Photometer Method
520 nm
0 - 6.0 mg/l

Bromine and bromine releasing compounds are used in disinfecting swimming pool water, and other water treatment systems. Accurate measurement of the bromine residual is an essential aspect of control of these processes.

The bromine level can be expressed in terms of the free bromine, combined bromine, or total bromine residuals. However, both free bromine and combined bromine are considered powerful disinfectants and it is not normally necessary to differentiate between these two forms. Therefore, the measurement of the total residual is sufficient in most applications.

The DPD Bromine method provides a simple means of measuring bromine residuals over the range 0 - 6.0 mg/l. A supplementary procedure can be used to differentiate between free and combined bromine, if desired.

Method

The Bromine Test uses the DPD method now internationally recognized as the standard method of testing for disinfectant residuals. In the DPD method, the reagents are provided in tablet form for maximum convenience and simplicity of use.

Bromine reacts with diethyl-p-phenylene diamine (DPD) in buffered solution to produce a pink coloration. The intensity of the color produced is proportional to the total bromine concentration, and is measured using a Photometer.

For the seperate determination of free and combined bromine, a supplementary procedure using sodium nitrite is used. The nitrite first destroys the free bromine in the sample, so the color produced in the DPD test then corresponds to the combined bromine only. The free bromine content is thus obtained as the difference between the total bromine and combined bromine results.

Reagents and Equipment

DPD No. 1 Tablets
DPD Nitrite Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 5*

*The Direct-reading photometer is programmed for both total and free bromine. Use program Phot 5 Total Bromine, then press [*] to continue test for program Phot 6 Free Bromine. The Free Bromine residual is calculated automatically.

Test Procedure -- Total Bromine

1. Rinse test tube with sample leaving two to three drops of sample in the tube.
2. Add one DPD No. 1 tablet, crush tablet and then fill the test tube with sample to the 10 ml mark.
3. Select wavelength 520 nm on the Photometer.
4. Take Photometer reading in the usual manner (see Photometer instructions).
5. Consult Bromine calibration chart. The value corresponding to the observed %T reading represents the **total bromine** residual as milligrams per liter.

Note: For most purposes, the test can be terminated at this stage. If free and combined bromine measurements are required, proceed as indicated in the following section.

BROMINE					Bromine mg/l Br_2				520 nm	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.02	0.04	0.09	0.11	0.13	0.15	0.18	0.22	0.24	0.27
80	0.31	0.33	0.36	0.41	0.42	0.45	0.47	0.49	0.54	0.56
70	0.58	0.60	0.65	0.67	0.72	0.74	0.78	0.81	0.85	0.90
60	0.94	0.99	1.03	1.08	1.12	1.14	1.19	1.23	1.28	1.32
50	1.37	1.42	1.46	1.53	1.57	1.62	1.66	1.71	1.75	1.80
40	1.84	1.91	1.96	2.00	2.05	2.09	2.16	2.20	2.25	2.32
30	2.38	2.45	2.54	2.63	2.70	2.79	2.88	2.95	3.04	3.11
20	3.20	3.29	3.40	3.51	3.69	3.83	3.98	4.15	4.30	4.50
10	4.70	4.85	5.05	5.20	5.40	5.60	5.80	6.00	----	----

Test Procedure - Free and Combined Bromine

1. Fill test tube with sample to the 10 ml mark. Add one DPD Nitrite tablet, crush and mix to dissolve.
2. Take a second clean test tube and add two to three drops of solution from the first tube. Add one DPD No. 1 tablet, crush and then add the remainder of the solution to make up to the 10 ml mark. Mix to dissolve tablet.
3. Select wavelength 520 nm on Photometer.
4. Take Photometer reading in the usual manner.
5. Consult Bromine calibration chart. The value corresponding to the observed %T reading represents the combined residual as milligrams per liter.
6. The free bromine residual is obtained by subtracting the combined bromine residual result from the total bromine residual result.

YSIP 12

CALCIUM HARDNESS (CALCICOL)

TEST FOR CALCIUM HARDNESS IN NATURAL AND TREATED WATER

Photometer Method
570 nm
0 - 500 mg/l $CaCO_3$

Calcium hardness is caused by the presence of calcium ions in the water. Since calcium salts are readily precipitated from water, high levels of calcium hardness tend to promote scale formation in water systems. Proper operation of swimming pool water supplies and industrial water systems such as boilers and steam raising plants requires accurate control of calcium hardness.

The Calcicol test provides a simple method of determining calcium hardness over the range 0 - 500 mg/l $CaCO_3$.

Method

The Calcium Hardness test is based on the Calcicol indicator reagent method. Calcium ions react specifically with Calcicol indicator in alkaline solution to give an orange coloration. The reagent itself is violet in solution. Thus, a distinctive color, ranging from violet to orange, is produced, depending on calcium concentration.

The reagents for the method are provided in the form of two tablets. Simply add one of each reagent tablet to a sample of water. The color produced indicates the calcium hardness, and is measured using a Photometer.

Reagents and Equipment

Calcicol No. 1 Tablets
Calcicol No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 12 Calcium Hardness
or Phot 60 Calcium

Test Procedure

1. Filter sample if necessary to obtain a clear solution.
2. Fill the test tube with sample to the 10 ml mark.
3. Add one Calcicol No. 1 tablet, crush and mix to dissolve.
4. Add one Calcicol No. 2 tablet, crush and mix to dissolve.
5. Stand for two minutes to allow full color development.
6. Select wavelength 570 nm on the Photometer.
7. Take Photometer reading in the usual manner (see Photometer instructions).
8. Consult Calcicol calibration chart (Transmittance-display photometer only).

CALCICOL				Calcium Hardness mg/l $CaCO_3$					570 nm	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
60	500	455	415	380	355	330	305	285	268	250
50	232	215	200	185	175	164	153	143	134	125
40	117	110	102	96	89	83	77	72	66	61
30	56	51	47	42	38	33	29	25	21	18
20	14	11	7	4	0	0	----	----	----	----

Interferences

1. Magnesium hardness (up to 200 mg/l as $CaCO_3$) does not interfere with the test.
2. Iron at levels above 10 mg/l may cause low results, Zinc above 5 mg/l may cause high results.
3. The pH required in the test is controlled by a buffer mixture included in the tablet formulation. To avoid exceeding the buffering capacity when testing highly acid or alkaline samples, adjust so that pH is between 4 - 10, before starting the test.

Notes:

1. The expression of hardness results sometimes causes confusion. In normal practice, hardness test results are expressed as mg/l $CaCO_3$ (calcium carbonate). This is merely a convention to allow the comparison of different results and does not necessarily indicate that the hardness present in the water is in this form.

   Results may also be expressed as mg/l Ca. Multiply mg/l $CaCO_3$ by 0.4 to convert to mg/l Ca.
2. Magnesium hardness may be determined using the Magnecol method (see Phot 21), or by taking the difference between the Total Hardness (Phot 15) and Calcium Hardness test results.

CHLORIDE (CHLORIDOL)

Photometer Method
520 nm
0 - 500 mg/l Cl to
0 - 50,000 mg/l Na Cl

TEST FOR CHLORIDE SALT IN WATER

The Chloridol test provides a simple method for measuring chloride salt levels. Many applications in water technology require determination of chlorides. These procedures include the measurement of low levels of chloride to determine the extent of carry-over in boiler condensates; chloride determination to assess salt build-up in swimming pools or boiler waters; and measurement of high chloride levels for testing sea water or determining the saltiness of brackish waters. Another use is for checking swimming pools where salt has been artificially added to simulate sea water bathing, or where required for the operation of certain types of electrolytic hypochlorite generators.

The test can be used to measure these widely different chloride concentrations by varying the sample size selected. The test covers four ranges, including 0 - 50 mg/l Cl, 0 - 500 mg/l Cl, 0 - 10,000 mg/l NaCl and 0 - 50,000 mg/l NaCl.

Method

The Chloridol test is based on a tablet reagent system containing silver nitrate. Chlorides react with silver nitrate to produce insoluble silver chloride. At the chloride levels encountered in the test, the insoluble silver chloride is observed as turbidity in the test sample. The degree of turbidity is proportional to the chloride concentration and is measured using a Photometer.

The test is carried out under acidic and oxidizing conditions. These conditions eliminate interference from any reducing substances or complexing agents, such as EDTA and polyphosphates, that may be present. Polyacrylates do interfere, however, so avoid testing industrial waters from polyacrylate-based treatment systems.

Reagents and Equipment

Acidifying CD Tablets
Chloridol Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)
Measuring Syringe, 1 ml (YPT361)
Sample Container, 100/50/10 ml plastic (YPT510)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select Program Phot 46 Range 0 - 50 mg/l
or Phot 51 Range 0 - 500 mg/l
or Phot 0 Range 0 - 10,000 mg/l*
or Phot 0 Range 0 - 50,000 mg/l*

*Transmittance Scale - use Calibration Chart

Sample Preparation

a. **Boiler Condensate and Softened Waters:** Range 0 - 50 mg/1 C1
Use 10 ml sample, without dilution.

b. **Natural Waters, Swimming Pools and Boiler Waters:** Range 0 - 500 mg/l Cl
Use the measuring syringe to transfer 1 ml of sample to the test tube. Make-up to the 10 ml mark with deionized water.

c. **Swimming Pool Water using Salt Chlorinator:** Range 0 - 10,000 mg/l NaCl
Use the measuring syringe to transfer 0.5 ml of sample to the sample container (YPT510). Make-up to the 100 ml mark with deionized water. Cap tube and mix.

d. **Sea Water and Brackish Waters:** Range 0 - 50,000 mg/l NaCl
Use the measuring syringe to transfer 0.1 ml of sample to the sample container (YPT510). Make-up to the 100 ml mark with deionized water. Cap tube and mix.

Test Instructions

1. Fill test tube with prepared sample to 10 ml mark (see Sample Preparation).
2. Add one Acidifying CD tablet, crush and mix to dissolve.
3. Add one Chloridol tablet, stand for two minutes, then crush any remaining particles and mix. A cloudy solution indicates the presence of chloride.
4. Select wavelength 520 nm on Photometer.
5. Take the Photometer reading in usual manner (see Photometer instructions). Use the light shield while taking readings.
6. Consult the appropriate Chloridol calibration chart (when using Transmittance-display photometer, or Direct-reading photometer with program Phot 0 only).

Conversion Factors

For some applications, it may be conventional to express the results of chloride tests in difference ways. Use the following conversions as required:

Multiply mg/l Cl by 1.65 to convert to mg/l NaCl
Multiply mg/l NaCl by 0.61 to convert to mg/l Cl
Multiply mg/l Cl by 1.41 to convert to mg/l $CaCO_3$
Multiply mg/l NaCl by 0.85 to convert to mg/l $CaCO_3$

Range 0 - 50 mg/l Cl

	CHLORIDOL				Chloride mg/l Cl			520 nm		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0	0	0	0.4	0.7	1.0	1.2	1.4	1.6	1.8
80	2.0	2.2	2.3	2.5	2.7	2.8	3.0	3.2	3.4	3.6
70	3.8	4.0	4.1	4.2	4.4	4.5	4.6	4.8	5.0	5.2
60	5.4	5.6	5.8	6.0	6.2	6.4	6.6	6.8	7.0	7.2
50	7.4	7.6	7.8	8.0	8.3	8.5	8.7	9.0	9.2	9.4
40	9.7	10.0	10.3	10.6	10.9	11.2	11.5	11.8	12.2	12.6
30	12.9	13.3	13.7	14.0	14.4	14.8	15.2	15.8	16.2	16.6
20	17.1	17.6	18.2	18.8	19.4	20.0	20.5	21.1	21.8	22.5
10	23.2	24.0	25.0	26.0	27.0	28.5	30.0	31.5	33.5	35.5
0	38	41	45	50	----	----	----	----	----	----

Range 0 - 500 mg/l Cl

	CHLORIDOL				Chloride mg/l Cl			520 nm		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0	0	0	4	7	10	12	14	16	18
80	20	22	23	25	27	28	30	32	34	36
70	38	40	41	42	44	45	46	50	50	52
60	54	56	58	60	62	64	66	68	70	72
50	74	76	78	80	83	85	87	90	92	94
40	97	100	103	106	109	112	115	118	122	126
30	129	133	137	140	144	148	152	158	162	166
20	171	176	182	188	194	200	205	211	218	225
10	232	240	250	260	270	285	300	315	335	355
0	380	410	450	500	----	----	----	----	----	----

Range 0 - 10,000 mg/l NaCl

	CHLORIDOL			Chloride mg/l NaCl				520 nm		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0	0	0	130	230	330	400	460	530	600
80	660	730	760	820	890	920	990	1060	1120	1190
70	1250	1320	1350	1380	1450	1480	1520	1580	1650	1710
60	1780	1850	1910	1980	2040	2110	2180	2240	2310	2370
50	2440	2510	2580	2650	2720	2800	2880	2950	3030	3100
40	3200	3300	3400	3500	3600	3700	3800	3900	4000	4150
30	4250	4400	4500	4600	4750	4900	5050	5200	5350	5500
20	5650	5800	6000	6200	6400	6600	6750	6950	7200	7400
10	7650	7950	8250	8550	8900	9400	10000	----	----	----

Range 0 - 50,000 mg/l NaCl

	CHLORIDOL			Chloride mg/l NaCl				520 nm		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0	0	0	650	1150	1650	1980	2310	2640	2970
80	3200	3500	3800	4100	4400	4650	4950	5270	5600	5930
70	6260	6580	6780	6980	7180	7380	7580	7910	8240	8570
60	8900	9230	9560	9890	10200	10500	10900	11200	11500	11800
50	12200	12500	12800	13200	13600	14000	14400	14800	15200	15600
40	16000	16500	17000	17500	18000	18500	19000	19500	20000	20600
30	21300	22000	22600	23200	23800	24500	25200	26000	26700	27400
20	28200	29000	30000	31000	32000	33000	34000	35000	36000	37000
10	38200	39600	41200	42800	44500	47000	50000	----	----	----

CHLORINE (DPD)

TEST FOR FREE, COMBINED AND TOTAL CHLORINE IN WATER

Photometer Method
520 nm
0 - 5.0 mg/l

Chlorine and chlorine releasing compounds are widely used to disinfect drinking water and swimming pools, to control micro-biological growth in cooling water, and in many other water treatments systems. Accurate measurement of the chlorine residual is essential to properly control these chlorination processes.

The chlorine level can be expressed in terms of the free chlorine, combined chlorine, or total chlorine residuals. For the majority of applications, measurement of the free chlorine is the most important. The DPD chlorine method provides a simple means of measuring free, combined and total chlorine residuals over the range 0 - 5 mg/l.

Method

This Chlorine test uses the DPD method developed by Dr. A.T. Palin, and is now internationally recognized as the standard method of testing for chlorine and other disinfectant residuals. In the DPD method, the reagents are provided in tablet form for maximum convenience and simplicity of use.

Free chlorine reacts with diethyl-p-phenylene diamine (DPD) in buffered solution to produce a pink coloration. The intensity of the color is proportional to the free chlorine concentration. Subsequent addition of excess potassium iodide induces a further reaction with any combined chlorine. The color intensity is now proportional to the total chlorine concentration; the increase in intensity represents the combined chlorine concentration. The color intensities are measured using a Photometer.

Reagents and Equipment

DPD No. 1 Tablets
DPD No. 3 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program Phot 7

Test Procedures

1. Rinse test tube with sample leaving two or three drops of sample in the tube.

2. Add one DPD No. 1 tablet, crush tablet and then fill the test tube with sample to the 10 ml mark. Mix to dissolve tablet.
3. Select wavelength 520 nm on Photometer.
4. Take Photometer reading immediately in the usual manner (see Photometer instructions). Consult Chlorine (DPD) calibration chart (Transmittance-display photometer only).

CHLORINE (DPD)				Chlorine mg/l Cl_2				520 nm		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.12
80	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.22	0.24	0.25
70	0.26	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.38	0.40
60	0.42	0.44	0.46	0.48	0.50	0.51	0.53	0.55	0.57	0.59
50	0.61	0.63	0.65	0.68	0.70	0.72	0.74	0.76	0.78	0.80
40	0.82	0.85	0.87	0.89	0.91	0.93	0.96	0.98	1.00	1.03
30	1.06	1.09	1.13	1.17	1.20	1.24	1.28	1.31	1.35	1.38
20	1.42	1.46	1.51	1.56	1.64	1.70	1.77	1.84	1.92	2.00
10	2.08	2.16	2.24	2.32	2.40	2.50	2.60	2.72	2.84	3.00
0	3.20	3.40	3.70	4.00	4.50	5.00	----	----	----	----

5. The result represents the free chlorine residual in milligrams per litre. Stop the test at this stage if only free chlorine determination is required.
6. If measurement of combined or total chlorine residual is required, continue the test on the same test portion. When using Direct-reading photometer, press [*] to continue test program.
7. Add one DPD No. 3 tablet, crush and mix to dissolve.
8. Stand for two minutes to allow full color development.
9. Take Photometer reading in the usual manner. Consult Chlorine (DPD) calibration chart (Transmittance-display photometer only).
10. This result represents the total chlorine residual in milligrams per liter.
11. To find the combined chlorine residual result, subtract the free chlorine residual result from the total chlorine residual result.

    i.e. Combine Chlorine = Total Chlorine -- Free Chlorine

Note: At levels above 10 mg/l, chlorine can cause bleaching of the pink coloration formed in the DPD test and give a false negative result. If a colorless test solution is obtained when chlorine is known to be present, repeat the test on a sample diluted with chlorine-free water to check for this possibility.

CHLORINE HR

TEST FOR HIGH CHLORINE LEVELS IN DISINFECTION AND STERILIZING SOLUTIONS

Photometer Method
490 nm
0 - 250 mg/l

Chlorine and chlorine releasing compounds are widely used for disinfection or sterilization of water distribution systems and pipework, food processing plants and equipment, pharmaceutical factories, and similar applications. The chlorine levels used in these applications are higher then those normally used for the simple disinfection of water. These processes require accurate measurement of chlorine levels to ensure their effectiveness. The Chlorine HR test is a simple means of measuring the total chlorine over the range 0 - 250 mg/l.

Method

The Chlorine HR test is based on an iodine release method. Chlorine reacts with potassium iodide in acid solution to release iodine, which is brown in color. The reagents for the test are provided in the form of two tablets for maximum convenience and simplicity of use.

The intensity of the color produced is proportional to the chlorine concentration and is measured using a Photometer.

Reagents and Equipment

Acidifying GP Tablets
Chlorine HR Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 9

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Acidifying GP tablet and one Chlorine HR tablet. Crush tablets and mix to dissolve. Allow any undissolved particles to settle.
3. Select wavelength 490 nm on Photometer.
4. Take Photometer reading in the usual manner (see Photometer instructions).
5. Consult Chlorine HR calibration chart (Transmittance-display photometer only).

Note: For precise determination of low levels of chlorine, up to 5 mg/l, use the Chlorine (DPD) Method.

CHLORINE HR				Chlorine mg/l Cl_2				**490 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.5	1	2	3	4	4.5	5	6	6.5	7
80	8	9	9.5	10	11	12	13	14	14	15
70	16	17	18	19	20	21	22	23	24	25
60	26	27	28	29	30	32	33	34	35	37
50	38	39	41	42	44	45	46	47	48	50
40	51	52	54	55	56	58	60	62	64	66
30	67	69	71	74	76	78	81	84	86	89
20	92	95	98	101	104	107	111	114	118	122
10	126	130	134	138	142	147	153	160	168	178
0	188	200	215	230	250	----	----	----	----	----

CHLORINE/CHLORAMINES (DPD)

TEST FOR FREE CHLORINE, MONO-AND DI-CHLORAMINES IN WATER

Photometer Method
520 nm
0 - 5.0 mg/l

Chlorine and chlorine releasing compounds are widely used to disinfect water. When dissolved in water, chlorine forms hypochlorous acid and hypochlorite ions. Chlorine remaining in the water in this form is known as the free chlorine residual.

Chlorine does, however, react with ammonia and nitrogen-based species to form chloramines. These compounds are poor disinfectants and can also impart a characteristic taste or odour. In certain applications, it is important to be able to distinguish between chlorine residual present as free chlorine and as chloramines.

The DPD Chlorine/Chloramines method provides a simple means of measuring free chlorine ($HOCl/HOCl^{-}$), monochloramine (NH_2Cl) and dichloramine ($NHCl_2$).

Method

The Chlorine/Chloramines test uses the DPD method. This method is internationally recognized as the standard method of testing for chlorine and other residuals. For maximum convenience and simplicity, this method uses reagents in tablet form.

Free chlorine reacts with diethyl-p-phenylene diamine (DPD) in buffered solution to produce a pink coloration. The intensity of the color is proportional to the free chlorine concentration. Addition of a trace amount of potassium iodide induces further reaction with any monochloramine present. The increase in color intensity is therefore proportional to the monochloramine concentration. Subsequent addition of excess potassium iodide causes dichloramine to react in a similar manner. This second increase in color intensity is proportional to the dichloramine concentration.

In this way it is possible to differentiate between the free chlorine, monochloramine and dichloramine residuals present in the sample. The color intensities at each stage of the test are measured using a Photometer.

Reagents and Equipment

DPD No. 1 Tablets
DPD No. 2 Tablets
DPD No. 3 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program Phot 71*

* The Direct-reading photometer is programmed for free chlorine and for the chloramine stages. Use program Phot 71 Free Chlorine then press [*] to continue test for program 72 Monochloramine and press [*] again for program 73 Dichloramine.

Test Procedure

1. Rinse test tube with sample leaving two or three drops of sample in the tube.
2. Add one DPD No. 1 tablet, crush tablet and then fill test tube with sample to the 10 ml mark. Mix to dissolve tablet.
3. Select wavelength 520 nm on Photometer.
4. Take Photometer reading immediately in the usual manner (see Photometer instructions). For Transmittance-display photometer, consult Chlorine (DPD) calibration chart (Result A). The result represents the free chlorine residual as mg/l Cl_2.

CHLORINE DPD				Chlorine mg/l Cl_2				**520 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.12
80	0.14	0.15	0.16	0.18	0.19	0.21	0.21	0.22	0.24	0.25
70	0.26	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.38	0.40
60	0.42	0.44	0.46	0.48	0.50	0.51	0.53	0.55	0.57	0.59
50	0.61	0.63	0.65	0.68	0.70	0.72	0.74	0.76	0.78	0.80
40	0.82	0.85	0.87	0.89	0.91	0.93	0.96	0.98	1.00	1.03
30	1.06	1.09	1.13	1.17	1.20	1.24	1.28	1.31	1.35	1.38
20	1.42	1.46	1.51	1.56	1.64	1.70	1.77	1.84	1.92	2.00
10	2.08	2.16	2.24	2.32	2.40	2.50	2.60	2.72	2.84	3.00
0	3.20	3.40	3.70	4.00	4.50	5.00	----	----	----	----

5. To measure monochloramine, continue the test on the same test portion. When using Direct-reading photometer, press [*] to continue the test program.
6. Add one DPD No. 2 tablet, crush and mix to dissolve.
7. Take Photometer reading immediately. The Direct-reading photometer displays the monochloramine concentration. For Transmittance-display photometer, consul calibration chart (Result B) then:

   Monochloramine (mg/l Cl_2) = Result B - Result A
8. To measure dichloramine, continue the test on the same test portion. When using Direct-reading photometer, press [*] to continue the test program.
9. Add one DPD No. 3 tablet, crush and mix to dissolve. Stand for two minutes to allow full color development.
10. Take the Photometer reading. The Direct-reading photometer displays the dichloramine concentration. For Transmittance-display photometer, consult calibration chart (Result C) then:

    Dichloramine (mg/l Cl_2) = Result C - Result B

Palintest®

TEST INSTRUCTIONS

PHOT. 55.

CHROMIUM (CHROMICOL)

TEST FOR SOLUBLE CHROMIUM IN NATURAL, DRINKING AND INDUSTRIAL WASTE WATER

Photometer Method
520 nm

0 - 1.0 mg/l

Chromium may be present in certain industrial waste waters, such as those from the tanning, plating and coating industries. Chromium may occur in hexavalent form as chromates and dichromates, or in trivalent form as chromium salts. In water supplies hexavalent chromium is a particularly objectionable constituent. Trivalent chromium, although relatively inert, is also regarded as undesirable.

The Palintest Chromicol test provides a means of measuring chromium over the range 0 - 1.0 mg/l. The test is particularly useful since it can be used to differentiate between the concentrations of trivalent (Cr^{III}) and hexavalent (Cr^{VI}) chromium present.

Method

In the Palintest Chromicol method, hexavalent chromium salts in acidic conditions react with diphenylcarbazide to give a purple coloured complex. This provides a measure of the hexavalent chromium (Cr^{VI}) present in the sample. The reagents are provided in tablet form and the test is simply carried out by adding tablets to a sample of the water.

To determine total chromium (Cr^{III}) plus (Cr^{VI}) a fresh sample of the solution is oxidised using a powder reagent to convert the trivalent chromium to the hexavalent form. The test is then repeated to give a measure of the total soluble chromium content of the water. The difference between the two readings gives a measure of trivalent chromium (Cr^{III}).

The intensity of colour produced in the tests is proportional to the chromium concentrations and is measured using a Palintest Photometer.

Reagents and Equipment

For Hexavalent Chromium :-

Palintest Chromicol No 1 Tablets
Palintest Chromicol No 2 Tablets
Palintest Photometer
Palintest Test Tubes, 10 ml glass (PT 515)

For Trivalent and Total Chromium :-

Palintest Chromicol CR Reagent (Spoon Pack)
Palintest Pretreatment Tube, 20 ml plastic (PT 508)
Filtration Kit, 0.45μm (PT 601)

Chromicol CR Reagent and the Pretreatment Tube are additional items required in the tests for total and trivalent chromium. These items are available as a supplementary pack (PM 281/S) for use in conjunction with standard Chromicol reagent packs (PM 281 and AP 281).

A filtration is required during the course of the procedure for total and trivalent chromium. The use of Palintest Filtration Kit (PT 601) is recommended for this purpose. Alternatively standard laboratory equipment with Whatman 0.45μm or equivalent membrane filters may be used.

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program **Phot 55***

*Version 7000.3 onwards

Test Procedure - Hexavalent Chromium

1. Fill round test tube to the 10 ml mark.
2. Add one Chromicol No 1 tablet, crush and mix to dissolve.
3. Add one Chromicol No 2 tablet, crush and mix to dissolve.
4. Stand for 10 minutes without disturbing the solution to allow full colour development and to enable any undissolved particles to settle.
5. Select wavelength 520 nm on the Photometer.
6. Take photometer reading in the usual manner (see Photometer instructions).
7. Consult Chromicol calibration chart (Transmittance-display photometer only). (Result A).
8. The result represents the hexavalent chromium concentration (chromates and dichromates). Stop the test at this stage if only hexavalent chromium determination is required.

Test Procedure - Total Chromium

1. Fill the pretreatment tube with sample to the 20 ml mark.
2. Add one level spoonful of Chromicol CR powder. Replace screw cap and shake tube well for two minutes.

3 Allow tube to stand for two minutes.

4 Filter a portion of the solution <u>dropwise</u> into a round glass test tube. Discard the first few drops and then fill to the 10 ml mark.

5 Add one Chromicol No 1 tablet, crush and mix to dissolve.

6 Add one Chromicol No 2 tablet, crush and mix to dissolve.

7 Stand for 10 minutes without disturbing the solution to allow full colour development and to enable any undissolved particles to settle.

8 Select wavelength 520 nm on Photometer.

9 Take photometer reading in usual manner (see Photometer instructions).

10 Consult Chromicol calibration chart (Transmittance-display photometer only).

11 The result represents the total soluble chromium concentration (trivalent and hexavalent) (Result B).

12 The trivalent Chromium (Cr^{III}) concentration is obtained by subtracting Result A from Result B :

Trivalent Chromium = Result B - Result A

CHROMICOL					Chromium mg/l Cr					**520 nm**
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	-	-	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02
80	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.06
70	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11
60	0.12	0.12	0.13	0.14	0.14	0.15	0.15	0.16	0.17	0.17
50	0.18	0.19	0.19	0.20	0.21	0.21	0.22	0.23	0.23	0.24
40	0.25	0.26	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.33
30	0.34	0.35	0.36	0.37	0.38	0.39	0.40	0.41	0.42	0.43
20	0.45	0.46	0.47	0.49	0.50	0.52	0.54	0.55	0.57	0.60
10	0.63	0.66	0.69	0.72	0.75	0.78	0.82	0.87	0.93	1.00

Interferences

Levels of dissolved iron above 1 mg/l cause low results for chromium. To increase the tolerance, repeat the test using two Chromicol No 1 tablets and one Chromicol No 2 tablet. Tannin causes complexation which prevents a response in the test.

COLOR

Photometer Method
410 nm
10 - 500 mg/l Pt
(10 - 500 mg/l Hazen Units)

TEST FOR COLOR IN NATURAL AND TREATED WATERS

Pure water exhibits a light blue color when viewed in depth. This color may be modified by the presence of organic material, typically to yellow or brown. An estimation of this color intensity is used as a simple means of monitoring natural and treated water.

Method

The color of the water is determined photoelectrically using the Photometer. The sample is filtered before analysis to remove any suspended solids so that the 'true color' due to dissolved matter can be determined.

The color of water is expressed using the platinum/cobalt color scale (Pt/Co scale). Each unit is equivalent to the color produced by 1 mg/l platinum in the form of chloroplatinic acid in the presence of 2 mg/l cobaltous chloride hexahydrate. These units are identical with 'Hazen' units which have been traditionally used to express results from the visual estimation of water color.

Interferences

Samples which contain dyestuffs, metallic impurities, or other industrial pollutants may exhibit a color other than the natural yellow-brown coloration. This test may not be appropriate for such samples.

Reagents and Equipment

Color/Turbidity Set (YPM269)
Photometer

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 47

Test Procedure

1. Filter sample through a GF/B filter paper.
2. Fill a test tube with filtered sample to the 10 ml mark.
3. Fill a test tube with deionized water to the 10 ml mark and retain for use as the BLANK tube.
4. Select wavelength 410 nm on Photometer.
5. Take Photometer reading in usual manner (see Photometer instructions) using the deionized water as the blank.
6. Consult Color calibration chart (Transmittance-display photometer only).

COLOR					mg/l Pt				410 nm	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	10	20	30	40	50	60	70	80	90	100
80	110	120	130	140	150	160	170	180	195	205
70	215	230	240	250	260	275	285	300	315	325
60	340	350	365	380	395	410	425	440	455	470
50	485	500	----	----	----	----	----	----	----	----

COPPER (COPPERCOL)

TEST FOR FREE, CHELATED AND TOTAL COPPER IN WATER

Photometer Method
520 nm
0 - 5.0 mg/l

Copper occurs naturally in many waters and may also result from corrosion of pipes and fittings. The presence of copper in drinking water can give rise to discoloration or an astringent taste.

Chelated copper compounds are extensively used as algicides in swimming pool water, home aquariums and other waters. Electrolytic devices that generate copper and silver ions are used in the purification of swimming pool water.

The Coppercol method provides a simple means of measuring copper in natural and treated waters over the range 0 - 5.0 mg/l. The test is particularly useful since it can be used to measure specifically the concentrations of free and chelated copper present in the water.

Method

In the Coppercol method copper salts are reduced to the cuprous form and then reacted with a 2,2 Biquinoline-4,4-dicarboxylic salt to form a purple colored complex. This provides a measure of the free copper ions present in the sample. In the second stage of the test, a decomplexing agent is introduced and this induces a further reaction with any chelated copper compounds which might be present.

The reagents are provided in tablet form and the test is simply carried out by adding tablets to a sample of the water. The intensity of color produced in the test is proportional to the copper concentration and is measured using a Photometer.

Reagents and Equipment

Coppercol No. 1 Tablets
Coppercol No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 10*

* The direct-reading photometer is programmed for both free and total copper. Use program Phot 10 Free Copper, then press [*] to continue test for program Phot 11 Total Copper.

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Coppercol No. 1 tablet, crush and mix to dissolve.
3. Select wavelength 520 nm on Photometer.
4. Take Photometer reading in the usual manner (see Photometer instructions).
5. The result represents the free copper concentration. Stop the test at this stage if only free copper determination is required.

COPPERCOL					Copper mg/l Cu					520 nm
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.00	0.00	0.03	0.06	0.10	0.13	0.17	0.20	0.24	0.27
80	0.30	0.34	0.37	0.40	0.44	0.47	0.51	0.55	0.59	0.63
70	0.67	0.72	0.76	0.80	0.83	0.86	0.90	0.93	0.96	1.00
60	1.04	1.08	1.13	1.18	1.23	1.28	1.32	1.38	1.44	1.48
50	1.52	1.57	1.62	1.68	1.74	1.80	1.86	1.92	1.95	2.02
40	2.07	2.14	2.20	2.27	2.34	2.40	2.46	2.53	2.60	2.68
30	2.78	2.86	2.96	3.06	3.16	3.25	3.34	3.43	3.51	3.60
20	3.70	3.80	3.90	4.00	4.10	4.22	4.34	4.48	4.65	4.80
10	5.00	----	----	----	----	----	----	----	----	----

6. Continue the test on the same test portion, if chelated or total copper concentrations are required. When using Direct-reading photometer press [*] to continue the test program.
7. Add one Coppercol No. 2 tablet, crush and mix to dissolve.
8. Take Photometer reading. Consult Coppercol calibration chart (Transmittance-display photometer only).
9. The result represents the total copper concentration.
10. Subtract the free copper concentration from the total copper concentration to obtain the chelated copper concentration;

    i.e. Chelated Copper = Total Copper - Free Copper

CYANURIC ACID

TEST FOR CYANURIC ACID IN SWIMMING POOL WATER

Photometer Metod
520 nm
0 - 200 mg/l

Cyanuric acid is used extensively as a chlorine stabilizer in swimming pool water. Cyanuric acid itself may be added to the water when the pool is first filled, or may be introduced gradually through the use of chloroisocyanurate-based chlorine donors. Swimming pool water treatment instructions generally recommend a cyanuric acid level within the range 30 - 200 mg/l. In some countries, the maximum recommended level is lower. The Cyanuric Acid test provides a simple method of measuring cyanuric acid level over the range 0 - 200 mg/l.

Method

The Cyanuric Acid test is based on a single tablet reagent containing melamine and a buffer. Cyanuric acid reacts with melamine in buffered solution to form an insoluble complex. At the cyanuric acid levels encountered in pool water, this is observed as turbidity in the test sample. The degree of turbidity is proportional to the cyanuric acid concentration and is measured using a Photometer.

Reagents and Equipment

Cyanuric Acid Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)
Dilution Tube (YPT512)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 13

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Cyanuric Acid tablet and allow to disintegrate for at least two minutes. A cloudy solution indicates the presence of cyanuric acid.
3. Crush any remaining undissolved tablet and mix to ensure uniformity.
4. Select wavelength 520 nm on Photometer.
5. Take Photometer reading in the usual manner (see Photometer instructions).
6. Consult Cyanuric Acid calibration chart (Transmittance-display photometer only).

CYANURIC ACID					mg/l				520 nm	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0	0	0	0	2.0	2.0	2.0	2.5	2.5	3.0
80	3.5	3.5	4.0	4.5	5.0	5.0	5.5	6.0	6.5	7.0
70	7.5	8.0	8.5	9.0	9.5	10.0	11.0	11.5	12.0	12.5
60	13.0	14.0	14.5	15.0	16.0	16.5	17.0	18.0	19.0	19.5
50	20	21	22	23	24	25	26	27	28	29
40	30	31	32	33	34	35	37	38	39	40
30	42	43	45	47	49	50	52	54	56	58
20	60	62	64	67	69	72	75	78	81	84
10	87	91	95	100	110	115	125	135	145	155
0	165	180	200	----	----	----	----	----	----	----

Note:

Although the range of the test is 0 - 200 mg/l, the best accuracy is obtained when the cyanuric acid concentration is below 100 mg/l. When the cyanuric acid concentration is between 100 mg/l and 200 mg/l, YSI recommends the following dilution technique for better accuracy:

1. Fill a Dilution Tube (YPT512) to the x10 mark with a sample of pool water.
2. Add deionized water, or tap water to the 'Deionized Water' mark, and mix.
3. Test the diluted sample using the test procedure described earlier.
4. Multiply the diluted sample concentration by 10 to obtain the original cyanuric acid concentration.

FLUORIDE

TEST FOR FLUORIDE IN NATURAL AND TREATED WATER

Photometer Method
570 nm
0 - 1.5 mg/l

Fluoride occurs naturally in some ground waters and is often introduced into drinking water for the prevention of tooth decay. Excessive amounts of fluoride are objectionable, however, and can cause tooth discoloration.

The Fluoride test provides a simple method of monitoring fluorides in natural waters, and for the control of fluoridation at water works facilities.

Method

Zirconyl Chloride and Eriochrome Cyanine R react in acid solution to form a red colored complex. This complex is destroyed by fluoride ions to give the pale yellow color of the Eriochrone Cyanine. Differing amounts of fluoride thus produce a range of colors from red to yellow.

The particular advantage of this method is that it is substantially free from interferences that normally beset chemical methods of fluoride testing. In particular, interference from aluminum and iron is eliminated by making the solution alkaline in the first stage of the test procedure. This breaks down any aluminum-fluoride and iron-fluoride complexes that may be present. Interference from calcium, phosphates and sulfates generally are not significant at the levels normally encountered in natural and drinking waters.

The Fluoride test uses two reagent tablets. To perform the test, simply add one of each tablet to the water sample. The color produced in the test indicates the fluoride concentration, and is measured using a Photometer.

Reagents and Equipment

Fluoride No. 1 Tablets
Fluoride No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 14

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Fluoride No. 1 tablet, crush and mix to dissolve.
3. Add one Fluoride No. 2 tablet, crush and mix to dissolve.
4. Stand for five minutes to allow full color development.
5. Take Photometer reading in the usual manner (see Photometer instructions).
6. Consult Fluoride calibration chart (Transmittance-display photometer only).

FLUORIDE				Fluoride mg/l F					**570 nm**	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
50	-	-	-	-	-	-	1.50	1.45	1.45	1.40
40	1.40	1.35	1.30	1.30	1.25	1.20	1.20	1.15	1.10	1.10
30	1.05	1.00	1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.65
20	0.60	0.55	0.50	0.40	0.35	0.30	0.25	0.20	0.10	0.05
10	0.00	----	----	----	----	----	----	----	----	----

HARDNESS (HARDICOL)

TEST FOR HARDNESS IN NATURAL AND TREATED WATER

Photometer Method
570 nm
0 - 500 mg/l $CaCO_3$

Water hardness is caused by the presence of calcium and magnesium salts. High hardness levels prevent the formation of lather with soap, and can lead to scaling in water systems - particularly in boilers, heat exchangers, and steam generating plants. Hardness is an important control test in a wide variety of applications.

The Hardness test provides a simple method of checking water hardness over the range 0 - 500 mg/l $CaCO_3$.

Method

The Hardicol test is based on a unique colorimetric method. Since the reagents are provided in tablet form, the test is carried out simply by adding the appropriate tablets to the water sample.

Under the controlled conditions of the test, calcium and magnesium ions react with Hardicol indicator to produce a purple coloration. The intensity of the color is proportional to the total hardness of the water and is measured using a Photometer.

Reagents and Equipment

Hardicol No. 1 Tablets
Hardicol No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 15

Test Procedure

1. Filter sample if necessary to obtain a clear solution.
2. Fill test tube with sample to the 10 ml mark.
3. Add one Hardicol No. 1 tablet, crush and mix to dissolve.
4. Add one Hardicol No. 2 tablet, crush and mix to dissolve. Ensure all particles are completely dissolved.
5. Stand for two minutes to allow full color development.
6. Select wavelength 570 nm on Photometer.
7. Take Photometer reading in the usual manner (see Photometer instructions).
8. Consult Hardicol calibration chart (Transmittance-display photometer only).

HARDICOL				Hardness mg/l $CaCO_3$				**570 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
80	----	----	----	----	0	0	0	0	3	6
70	10	14	18	22	26	30	34	38	42	47
60	52	56	60	65	70	75	80	85	90	95
50	102	108	115	122	130	137	145	155	165	175
40	185	195	210	220	235	250	265	280	300	325
30	355	390	425	465	500	----	----	----	----	----

Interferences

1. Unusually high levels of iron (above 10 mg/l) will cause low results for total hardness.
2. The pH required in the test is controlled by a buffer mixture included in the tablet formulation. To avoid exceeding the buffering capacity when testing highly acid or alkaline samples, adjust so that pH is between 4 - 10, before starting the test.

Notes:

1. The expression of hardness results sometimes causes confusion. In normal practice, hardness test results are expressed as mg/l $CaCO_3$ (calcium carbonate). This is merely a convention to allow the comparison of different results, and does not necessarily indicate that the hardness present in the water is in this form.
2. This test measures total hardness. To specifically measure calcium hardness or magnesium hardness, refer to the Calcicol (Phot 12) and Magnecol (Phot 21) tests respectively.

HYDRAZINE

TEST FOR HYDRAZINE IN INDUSTRIAL WATER

Photometer Method
410 nm
0 - 0.5 mg/l N_2H_4

Hydrazine is used as an oxygen scavenger in high pressure boilers and steam raising plants. Hydrazine is particularly advantageous in that it does not contribute solids to the boiler water.

The Hydrazine test provides a simple means of measuring hydrazine levels in boiler feed water and boiler water over the range 0 - 0.5 mg/l.

Method

The Hydrazine test uses a special reagent powder containing p-dimethylaminobenzaldehyde in an acidic formulation. Hydrazine reacts with this reagent to produce a yellow coloration.

The intensity of the color produced is proportional to the hydrazine concentration and is measured using a Photometer.

Reagents and Equipment

Hydrazine Test Powder
Photometer
Round Test Tubes, 10 ml glass (YPT515)
Scoop, 1g approx. (YPT697)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 41

Test Procedures

1. Filter sample if necessary to obtain clear solution.
2. Take two test tubes A and B.
3. Fill Tube A with sample to the 10 ml mark.
4. Fill Tube B with deionized water to the 10 ml mark.
5. To each tube, add one level scoop (1g) of Hydrazine Test Powder. Mix to dissolve, and cap tubes.
6. Stand for two minutes to allow full color development.
7. Select wavelength 410 nm on Photometer.
8. Take Photometer reading of Tube A in the usual manner (see Photometer instructions). Use Tube B as the blank to set the instrument.
9. Consult Hydrazine calibration chart (Transmittance-display photometer only).

HYDRAZINE				mg/l N_2H_4				**410 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02
80	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04
70	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.06
60	0.06	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.09
50	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.12
40	0.13	0.13	0.13	0.14	0.14	0.15	0.15	0.16	0.16	0.17
30	0.17	0.18	0.18	0.19	0.19	0.20	0.20	0.21	0.21	0.22
20	0.23	0.23	0.24	0.25	0.25	0.26	0.27	0.28	0.29	0.30
10	0.31	0.32	0.33	0.35	0.36	0.37	0.39	0.40	0.42	0.44
0	0.47	0.50	----	----	----	----	----	----	----	----

HYDROGEN PEROXIDE HR

TEST FOR HIGH LEVELS OF HYDROGEN PEROXIDE IN WATER

Photometer Method
490 nm
0 - 100 mg/l

Hydrogen peroxide is used as a bleach and oxidizing agent in a number of industrial processes. Applications include textile bleaching, commercial laundering and paper manufacturing. In such processes, accurate control of the hydrogen peroxide concentration within the correct range is necessary to achieve the desired effect without damaging the product. Hydrogen peroxide is also used in swimming pool water to control algae and improve clarity.

The Hydrogen Peroxide HR test provides a simple means of monitoring hydrogen peroxide levels in water over the range 0 - 100 mg/l.

Method

Hydrogen peroxide reacts with potassium iodide under acid conditions to release iodine which gives a yellow solution. A catalyst is used to speed up the rate of reaction. The intensity of the color produced is proportional to the hydrogen peroxide concentration and is measured using a Photometer.

The Hydrogen Peroxide HR test reagents are provided in the form of two tablets. To perform the test, simply add one of each tablet to a sample of the water.

Reagents and Equipment

Hydrogen Peroxide HR Tablets
Acidifying PT Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 17

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Acidifying PT tablet and one Hydrogen Peroxide HR tablet, crush and mix to dissolve.
3. Select wavelength 490 nm on Photometer.
4. Take Photometer reading in the usual manner (see Photometer instructions).
5. Consult Hydrogen Peroxide HR calibration chart (Transmittance-display photometer only).

Note: To measure low levels of hydrogen peroxide, use the Hydrogen Peroxide LR test (see Phot 16).

HYDROGEN PEROXIDE HR					Hydrogen Peroxide mg/l H_2O_2				**490 nm**	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.2	0.6	0.9	1.3	1.7	2.1	2.5	2.9	3.3	3.7
80	4.1	4.5	5.0	5.4	5.8	6.3	6.7	7.1	7.6	8.1
70	8.5	9.0	9.5	9.9	10.4	10.9	11.4	11.9	12.5	12.9
60	13.5	14.0	14.6	15.1	15.7	16.3	16.9	17.4	18.0	18.7
50	19.3	20	21	21	22	23	23	24	25	26
40	27	27	28	29	31	31	32	33	34	35
30	36	37	38	39	40	41	43	44	45	47
20	48	49	51	53	54	56	57	59	61	63
10	65	67	70	72	75	78	81	84	87	91
0	96	100	----	----	----	----	----	----	----	----

Interferences

The sample should be free of other oxidizing agents such as chlorine, bromine, etc., as they react in a similar manner and will interfere with the test. It is unlikely that these oxidizing agents will be used in conjunction with hydrogen peroxide, however, and will not usually coexist in solution.

HYDROGEN PEROXIDE LR

TEST FOR LOW LEVELS OF HYDROGEN PEROXIDE IN WATER

Photometer Method
520 nm
0 - 2.0 mg/l

Hydrogen peroxide is used in various water treatment processes. In such applications, it is important to ensure that the hydrogen peroxide level is maintained within the correct range to ensure optimum operation of the water treatment process.

The Hydrogen Peroxide LR test provides a simple means of measuring hydrogen peroxide levels over the range 0 - 2.0 mg/l.

Method

Hydrogen peroxide reacts with potassium iodide under slightly acid conditions, and in the presence of a catalyst, to release iodine into solution. The iodine then reacts with diethyl-p-phenylene diamine (DPD) to produce a pink coloration. The intensity of the color produced is proportional to the hydrogen peroxide concentration and is measured using a Photometer.

In this method, the reagents are combined in the form of a single tablet. To perform the test, simply add a reagent tablet to a sample of the water.

Reagents and Equipment

Hydrogen Peroxide LR Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 16

Test Procedure

1. Rinse test tube with sample leaving two to three drops of sample in the tube.
2. Add one Hydrogen Peroxide LR tablet, crush and then fill tube with sample to the 10 ml mark. Mix to dissolve tablet.
3. Stand for two minutes to allow full color development.
4. Select wavelength 520 nm on Photometer.
5. Take Photometer reading in the usual manner (see Photometer instructions).
6. Consult Hydrogen Peroxide LR calibration chart (Transmittance-display photometer only).

Note: To measure high levels of hydrogen peroxide in industrial processes, use the Hydrogen Peroxide HR test (see Phot 17).

HYDROGEN PEROXIDE LR	Hydrogen Peroxide LR mg/l H_2O_2									**520 nm**
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.06	0.06
80	0.07	0.08	0.08	0.09	0.10	0.10	0.11	0.11	0.12	0.12
70	0.13	0.14	0.15	0.15	0.16	0.17	0.18	0.18	0.19	0.20
60	0.21	0.21	0.22	0.23	0.24	0.25	0.26	0.26	0.27	0.28
50	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38
40	0.39	0.40	0.41	0.42	0.44	0.45	0.46	0.47	0.48	0.49
30	0.51	0.52	0.53	0.55	0.57	0.79	0.61	0.63	0.65	0.67
20	0.70	0.73	0.75	0.78	0.82	0.85	0.88	0.92	0.95	0.98
10	1.01	1.05	1.09	1.13	1.17	1.22	1.30	1.40	1.50	1.60
0	1.72	1.85	2.00	----	----	----	----	----	----	----

Interferences

The sample should be free of other oxidizing agents such as chlorine, bromine, etc., as they react in a similar manner and will interfere with the test. It is unlikely that these oxidizing agents will be used in conjunction with hydrogen peroxide, however, and will not usually coexist in solution.

YSIP 19

IRON HR

TEST FOR HIGH LEVELS OF IRON IN NATURAL AND TREATED WATER

Photometer Method
570 nm
0 - 10 mg/l

Iron occurs widely in nature, and is found in many natural and treated waters. In industrial settings, iron salts occur through corrosion of plant and equipment, and in manufacturing processes. Iron is an objectionable constituent in both domestic and industrial water supplies. The presence of iron affects the taste of beverages and causes unsightly staining of laundered clothing, plumbing fittings, swimming pool surfaces, and the like. The formation of insoluble iron deposits is troublesome in many industrial and agricultural applications.

Measuring iron is therefore an important step, when monitoring effluents, waste waters, and natural and drinking waters. Measurement of iron levels is also useful for controlling corrosion in industry. The Iron HR test provides a simple test for the determination of low levels of iron in water over the range 0 - 10 mg/l Fe. The test responds to both ferrous and ferric iron, and thus gives a measure of the total iron content of the water.

Method

The Iron HR test is based on a single tablet reagent containing an alkaline thioglycollate. To perform the test, simply add a reagent tablet to a sample of the water under test. The thioglycollate reduces ferric iron to ferrous iron and this, together with any ferrous iron already in the sample, reacts to give a pink coloration.

The intensity of the color produced is proportional to the iron concentration and is measured using a Photometer.

Reagents and Equipment

Iron HR Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 19

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Iron HR tablet, crush and mix to dissolve.
3. Stand for one minute to allow full color development.
4. Select wavelength 570 nm on Photometer.
5. Take Photometer reading in the usual manner (see Photometer instructions).
6. Consult Iron HR calibration chart (Transmittance-display photometer only).

	IRON HR				Iron mg/l Fe				**570 nm**	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	----	----	----	----	----	0.0	0.05	0.15	0.20	0.25
80	0.30	0.40	0.45	0.50	0.60	0.65	0.70	0.80	0.85	0.90
70	1.00	1.05	1.15	1.20	1.30	1.35	1.45	1.50	1.60	1.65
60	1.75	1.85	1.90	2.00	2.10	2.15	2.25	2.35	2.45	2.55
50	2.65	2.70	2.80	2.90	3.00	3.10	3.25	3.35	3.45	3.55
40	3.70	3.80	3.90	4.00	4.15	4.25	4.40	4.55	4.70	4.80
30	4.95	5.10	5.25	5.40	5.55	5.70	5.90	6.05	6.25	6.40
20	6.60	6.80	7.00	7.20	7.45	7.70	7.90	8.15	8.40	8.70
10	9.00	9.30	9.60	10.0	----	----	----	----	----	----

Iron Complexes

The test color development will normally be complete within one minute. Continued color development after this time indicates the presence of more strongly bound iron complexes. In such cases, the test solution should stand for a longer period, 10 - 15 minutes, until color development is complete.

In certain industrial applications, strong complexing agents are added to act as corrosion inhibitors. Moreover, some samples may contain precipitated iron complexes or particles of metallic iron. Use a standard laboratory procedure to pre-treat these samples if a total iron determination is required. The usual method of pre-treatment is acidification (with or without boiling, depending on the nature of the sample).

To use the Iron HR test after acidification pre-treatment procedures, add the Iron HR tablet to the acidified sample, adjust to pH 6.0 - 9.0 using ammonia or sodium hydroxide, then take the photometer reading in the normal manner.

IRON LR

TEST FOR LOW LEVELS OF IRON IN NATURAL AND TREATED WATER

Photometer Method
520 nm
0 - 1.0 mg/l

Iron occurs widely in nature, and is found in many natural and treated waters. In industrial settings, iron salts occur through corrosion of plant and equipment, and in manufacturing processes. Iron is an objectionable constituent in both domestic and industrial water supplies. The presence of iron affects the taste of beverages and causes unsightly staining of laundered clothing, plumbing fittings, swimming pool surfaces, and the like. The formation of insoluble iron deposits is troublesome in many industrial and agricultural applications.

Measuring iron is therefore an important step, when monitoring effluents, waste waters, and natural and drinking waters. Measurement of iron levels is also useful for controlling corrosion in industry. The Iron LR test provides a simple test for the determination of low levels of iron in water over the range 0 - 1 mg/l Fe. The test responds to both ferrous and ferric iron, and thus gives a measure of the total iron content of the water.

Method

The Iron LR test is based on a single tablet reagent containing 3-(2-Pyridyl)-5,6-bis (4-phenyl-sulphonic acid)-1,2,4-triazine (PPST) and a decomplexing/reducing agent in an acid buffer. The test is simply carried out by adding a tablet to a sample of the water under test. The decomplexing/reducing agent breaks down weakly complexed forms of iron, and reduces ferric iron to the ferrous form. The ferrous iron reacts with PPST to form a pink coloration.

The intensity of the color produced is proportional to the iron concentration and is measured using a Photometer.

Reagents and Equipment

Iron LR Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program Phot 18

Test Procedure

1. Fill the test tube with sample to the 10 ml mark.
2. Add one Iron LR tablet, crush and mix to dissolve.
3. Stand for one minute to allow full color development.
4. Select wavelength 520 nm on Photometer.
5. Take Photometer reading in the usual manner (see Photometer instructions).
6. Consult Iron LR calibration chart (Transmittance-display photometer only).

IRON LR				Iron mg/l Fe					**520 nm**	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.00	0.00	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.07
80	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16
70	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26
60	0.28	0.29	0.30	0.31	0.33	0.34	0.35	0.36	0.38	0.39
50	0.40	0.41	0.43	0.44	0.45	0.47	0.48	0.50	0.52	0.54
40	0.55	0.57	0.59	0.61	0.63	0.65	0.67	0.68	0.70	0.72
30	0.74	0.77	0.79	0.81	0.83	0.85	0.88	0.90	0.92	0.95
20	0.97	1.00	----	----	----	----	----	----	----	----

Iron Complexes

The test color development will normally be complete within one minute. Continued color development after this time indicates the presence of more strongly bound iron complexes. In such cases, the test solution should stand for a longer period, 10 - 15 minutes, until color development is complete.

In certain industrial applications, strong complexing agents are added to act as corrosion inhibitors. Moreover, some samples may contain precipitated iron complexes or particles of metallic iron. Use a standard laboratory procedure to pre-treat these samples if a total iron determination is required. The usual method of pre-treatment is acidification (with or without boiling, depending on the nature of the sample).

To use the Iron LR test after acidification pre-treatment procedures, add the Iron LR tablet to the acidified sample, adjust the pH 3.5 - 4.0 using ammonia or sodium hydroxide, then take the photometer reading in the normal manner.

MAGNESIUM (MAGNECOL)

TEST FOR MAGNESIUM IN WATER

Photometer Method
520 nm
0 - 100 mg/l

Magnesium is a widely occurring natural element found in most water supplies. Magnesium salts contribute to the hardness of water. Higher levels of magnesium will be found therefore in hard water areas. Magnesium salts in the water promote scale formation in heating and steam raising equipment. The scale forming tendency of magnesium salts, however, is lower than that of calcium salts.

The Magnecol test provides a simple means of measuring magnesium levels in water over the range 0 - 100 mg/l Mg.

Method

The Magnecol test is based on a simple colorimetric procedure. Magnesium reacts with an organic reagent to produce an orange colored complex. The reagent itself is yellow and thus over the range of the test a series of colors from yellow through orange are produced.

The color produced in the test indicates the magnesium concentration and is measured using a Photometer.

Reagents and Equipment

Magnecol Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)
Measuring Syringe, 1 ml (YPT361)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 21 Magnesium (Mg)
or Phot 61 Magnesium Hardness ($CaCO_3$)

Test Procedure

1. Using the measuring syringe, take a 1 ml sample of the water under test. Transfer to the round test tube and make up to the 10 ml mark with deionized water.
2. Add one Magnecol tablet, crush and mix to dissolve.
3. Stand for two minutes to allow full color development. Do not disturb during the standing period.
4. Select wavelength 520 nm on Photometer.
5. Take Photometer reading in usual manner (see Photometer instructions).
6. Consult the Magnecol calibration chart (Transmittance-display photometer only).

MAGNECOL					**Magnesium mg/l Mg**				**520 nm**	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
70	----	----	----	----	0.0	1.0	2.5	4.0	5.0	6.0
60	7.0	7.5	8.0	8.5	9.0	9.0	9.5	9.5	10.0	10.0
50	10.5	10.5	11.0	11.5	12.0	12.5	12.5	13.0	13.5	14.0
40	14.5	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.5	20
30	21	22	23	24	25	26	27	28	30	31
20	32	33	34	35	37	38	40	41	42	44
10	45	47	48	50	53	57	60	64	67	72
0	78	90	100	----	----	----	----	----	----	----

Note:

To express the result in terms of ‘magnesium hardness as $CaCO_3$’ multiply the test result obtained by 4.2.

MANGANESE

TEST FOR TOTAL MANGANESE IN WATER

Photometer Method
640 nm
0.030 mg/l

Manganese-containing minerals occur widely and manganese salts are commonly found in many natural waters. Manganese is an objectionable constituent in water used for domestic purposes or industrial applications. In domestic situations, manganese will cause brown or black staining to laundry or plumbing fittings, even at very low concentrations. In process applications, such as paper manufacturing or textile finishing, similar staining can occur. Manganese salts may impart an astringent taste to drinking water supplies, and in swimming pool applications, can give an aesthetically displeasing brown coloration to the water.

In most cases where manganese salts occur naturally in the water, special methods of removal must be employed before the water can be used for domestic or industrial purposes. The Manganese test provides an extremely sensitive method of measuring low concentrations of manganese for the assessment of natural waters and monitoring the effectiveness of manganese removal operations. The test measures total manganese over the range 0 - 0.030 mg/l.

Method

Manganese may occur in water in various valency states. In the first stage of the test, manganese in lower valency states is oxidized to form permanganate by the action of an oxidizing agent. In the second stage the permanganate is further reacted with leucomalachite green to form an intense turquoise complex. Catalysts and inhibitors are incorporated into the reagent tablet to eliminate interferences and ensure that the color reaction proceeds correctly.

The intensity of color produced is proportional to the total manganese concentration and is measured using a Photometer.

Reagents and Equipment

Manganese No. 1 Tablets
Manganese No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 20

Sample collection

Manganese is readily absorbed onto the surfaces of sample containers. To avoid loss of manganese, test the sample as soon as possible after collection.

Because of the extreme sensitivity of the test, all glassware used for the sample collection and test procedure must be scrupulously clean. For most accurate results in laboratory use, YSI recommends that all glassware be acid-rinsed and then thoroughly rinsed with deionized water before use.

Test Procedure

1. Fill test tube with sample to the 10 ml mark (see Note 1).
2. Add one Manganese No.1 tablet, crush and mix to dissolve.
3. Add one Manganese No.2 tablet, crush and mix to dissolve then cap the tube.
4. Stand for 20 ± 1 minute to allow full color development (see Note 2).
5. Select wavelength 640 nm on Photometer.
6. Take Photometer reading in the usual manner (see Photometer instructions).
7. Consult Manganese calibration chart (Transmittance-display photometer only).

MANGANESE				Manganese mg/l Mn				**640 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	----	----	----	----	----	----	0.000	0.000	0.001	0.001
80	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.005	0.006	0.006
70	0.007	0.007	0.008	0.008	0.009	0.009	0.010	0.010	0.011	0.011
60	0.012	0.012	0.013	0.013	0.014	0.014	0.015	0.015	0.016	0.016
50	0.017	0.018	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.026
40	0.027	0.028	0.030	----	----	----	----	----	----	----

Notes:

1. Color formation is extremely sensitive to temperature. For optimum results, maintain the temperature of the sample at 20° ± 1°C during the test.
2. Time the 20 ± 1 minute color development period carefully for optimum test results. Ignore any continued color development or change after this period.

MOLYBDATE HR

TEST FOR HIGH LEVELS OF MOLYBDATE IN INDUSTRIAL WATERS AND EFFLUENTS

Photometer Method
410 nm
0 - 100 mg/l MoO_4

Formulations containing molybdate are used as corrosion inhibitors in industrial water treatment. In particular, molybdate finds application in closed recirculating systems such as hot water heating systems and chilled water systems. Molybdate-based formulations have replaced older forms of corrosion inhibitor such as chromate.

When using molybdate treatment, it is necessary to control the molybdate concentration within specified levels depending on the application involved. Moreover, since molybdates are widely used in water treatment and in industrial processes, monitoring molybdate levels is increasingly important for effluents and industrial discharges.

The Molybdate HR test provides a simple means of measuring high levels of molybdate in industrial waters and effluents and covers the range 0 - 100 mg/l MoO_4.

Method

Molybdates react with thioglycollate under acid conditions to give a yellow colored complex. Slightly oxidizing conditions are maintained during the acidification stage in order to keep the molybdate in a fully oxidized state. Iron does not interfere under the conditions of the test, and there is no significant interference from other metals at levels likely to be found in industrial water systems. The reagents are provided in the form of two tablets for maximum convenience. The test is simply carried out by adding one of each tablet to a sample of water.

The intensity of the color produced is proportional to the molybdate concentration, and is measured using a Photometer.

Reagents and Equipment

Molybdate No. 1 HR Tablets
Molybdate No. 2 HR Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 22

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Molybdate No. 1 HR tablet, crush and mix to dissolve.
3. Add one Molybdate No. 2 HR tablet, crush and mix to dissolve.
4. Select wavelength 410 nm on Photometer.
5. Take Photometer reading in the usual manner (see Photometer instructions).
6. Consult Molybdate HR calibration chart (Transmittance-display photometer only).

MOLYBDATE HR				Molybdate mg/l MoO_4				**410 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.0	0.3	0.6	0.8	1.0	1.3	1.6	2.0	2.3	2.6
80	2.9	3.2	3.5	3.8	4.2	4.6	5.1	5.6	6.1	6.6
70	7.1	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.1	11.7
60	12.3	13.0	13.6	14.2	14.9	15.7	16.5	17.2	18.0	18.8
50	19.5	20	21	22	23	24	24	25	26	27
40	28	29	30	31	32	33	34	35	36	37
30	39	41	42	44	46	48	50	51	53	55
20	57	60	63	65	68	70	73	75	78	81
10	84	87	91	95	100	----	----	----	----	----

Note: Molybdate concentrations can be expressed in a number of different ways. The following factors may be used for the conversion of readings:

Multiply by 1.3 to convert from MoO_4 to Na_2MoO_4.
Multiply by 0.6 to convert from MoO_4 to Mo.

MOLYBDATE LR

TEST FOR LOW LEVELS OF MOLYBDATE IN INDUSTRIAL WATERS AND EFFLUENTS

Photometer Method
410 nm
0 - 20 mg/l MoO_4

Formulations containing molybdate are used as corrosion inhibitors in industrial water treatment. In particular, low level molybdate treatment finds application in cooling systems. Molybdate based formulations have replaced older forms of corrosion inhibitors.

When using molybdate treatment, it is necessary to control the molybdate concentration within specified levels, depending on the application involved. Moreover, since molybdates are widely used in water treatment and in industrial processes, molybdate is an increasingly important test for effluents and industrial discharges.

The Molybdate LR test provides a simple means of measuring low levels of molybdate in industrial water and effluents and covers the range 0 - 20 mg/l MoO_4 (0 - 12 mg/l Mo).

Method

Under slightly acid conditions molybdates react with a dihydroxybenzene disulphonic acid salt to give a yellow colored complex. The intensity of the color produced in the test is proportional to the molybdate concentration and is measured using a Photometer. The reagents are provided in the form of two tablets for maximum convenience. To perform the test, simply add one of each tablet to the water sample.

Interferences

Under the conditions of the test, iron does not interfere, and there is no significant interference from other metals at levels likely to be found in industrial water systems (See notes).

1. Copper, zinc, calcium and phosphate do not interfere at levels up to 20 mg/l.
2. Iron and chlorine at levels of 10 mg/l cause slightly high blank readings (equivalent to 0.6 mg/l MoO_4). They do not, however, cause any interference when in the presence of molybdate.

Reagents and Equipment

Molybdate No. 1 LR Tablets
Molybdate No. 2 LR Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 42

Test Procedure

1. Filter sample if necessary to obtain a clear solution.
2. Fill test tube with sample to the 10 ml mark.
3. Add one Molybdate No. 1 LR tablet, crush and mix to dissolve.
4. Add one Molybdate No. 2 LR tablet, crush and mix to dissolve.
5. Stand for two minutes to allow full color development.
6. Select wavelength 410 nm on the Photometer.
7. Take Photometer reading in the usual manner (see Photometer instructions).
8. Consult Molybdate LR calibration chart (Transmittance-display photometer only).

MOLYBDATE LR				Molybdate mg/l MoO_4				410 nm		
%T	9	8	7	6	5	4	3	2	1	0
90	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
80	1.10	1.20	1.30	1.40	1.50	1.65	1.75	1.85	2.00	2.15
70	2.25	2.40	2.55	2.70	2.85	3.00	3.10	3.25	3.40	3.55
60	3.70	3.90	4.04	4.20	4.35	4.50	4.65	4.80	5.00	5.20
50	5.40	5.55	5.75	5.90	6.10	6.30	6.50	6.65	6.85	7.00
40	7.20	7.40	7.60	7.80	8.00	8.20	8.50	8.70	9.00	9.20
30	9.50	9.80	10.0	10.4	10.7	11.1	11.5	11.8	12.3	12.8
20	13.3	13.8	14.3	14.7	15.3	15.8	16.3	16.8	17.3	17.8
10	18.4	19.0	19.5	20.0	----	----	----	----	----	----

Note:

Molybdate concentrations can be expressed in a number of different ways. Use the following factors to express results in the appropriate form:

Multiply mg/l MoO_4 by 1.3 to convert to mg/l Na_2MoO_4.
Multipy mg/l MoO_4 by 0.6 to convert to mg/l Mo.

Palintest®
TEST INSTRUCTIONS

PHOT. 53.

NICKEL (NICKELTEST)

TEST FOR NICKEL IN NATURAL AND TREATED WATER

Photometer Method
520 nm

0 - 10 mg/l

Nickel does not occur naturally in water but is found in many industrial waste waters, such as those from the steel and plating industries. It is considered an undesirable constituent of water and hence requires close and careful monitoring. The EC maximum admissible concentration for drinking water (MAC) is 0.05 mg/l.

The Palintest Nickeltest method provides a simple test for the determination of nickel in water over the range 0 - 10 mg/l Ni. The test responds to both Ni^{2+} and Ni^{4+} and thus gives a measure of total soluble inorganic nickel content of the water.

Method

In the Palintest Nickeltest method, nickel salts are reduced to the nickelous form and then reacted with nioxime indicator to give a pink coloured complex. Reagents are included to prevent copper interference, and a complexing powder is provided to prevent iron interference.

The reagents are provided in tablet form and the test is simply carried out by adding tablets to a sample of the water. The intensity of colour produced in the test is proportional to the nickel concentration and is measured using a Palintest Photometer.

Reagents and Equipment

Palintest Nickeltest PR Powder (Spoon Pack)
Palintest Nickeltest No 1 Tablets
Palintest Nickeltest No 2 Tablets
Palintest Photometer
Round Test Tubes, 10 ml glass (PT 515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program **Phot 53***
*Version 7000.3 onwards

Test Procedure

1 Fill test tube with sample to the 10 ml mark.

2 Add one Nickeltest No 1 tablet, crush and mix to dissolve. Ensure tablet is completely dissolved before proceeding.

3 If iron is thought to be present in the sample, add one level spoonful of Nickeltest PR powder and mix.

4 Add one Nickeltest No 2 tablet, crush and mix to dissolve.

5 Stand for two minutes to allow full colour development.

6 Select wavelength 520 nm on Photometer.

7 Take photometer reading in usual manner (see Photometer instructions).

8 Consult Nickeltest calibration chart (Transmittance-display photometer only). The

NICKELTEST					Nickel mg/l Ni					**520 nm**
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.00	0.00	0.00	0.06	0.12	0.18	0.25	0.32	0.39	0.46
80	0.53	0.61	0.68	0.75	0.82	0.89	0.97	1.05	1.13	1.21
70	1.29	1.37	1.45	1.54	1.63	1.72	1.81	1.90	1.99	2.08
60	2.17	2.26	2.35	2.45	2.55	2.65	2.75	2.85	2.95	3.05
50	3.16	3.28	3.40	3.52	3.65	3.78	3.92	4.06	4.20	4.35
40	4.50	4.65	4.80	4.95	5.10	5.25	5.41	5.57	5.73	5.90
30	6.08	6.27	6.46	6.65	6.84	7.04	7.25	7.46	7.67	7.88
20	8.09	8.30	8.55	8.81	9.08	9.35	9.67	10.00	-	-

Interferences

1 The presence of cobalt at 0.5 mg/l gives a positive response in the test.

2 The presence of significant levels of EDTA (at least 25 mg/l) complexes nickel and reduces response in the test. Complexing agents used in water treatment, such as polyphosphates, do not affect the results.

NITRATE (NITRATEST)

TEST FOR NITRATE IN NATURAL, DRINKING AND WASTE WATER

Photometer Method
570 nm
0 - 1 mg/l N
0 - 20 mg/l N

Nitrates are normally present in natural, drinking, and waste waters. Nitrates enter water supplies from the breakdown of natural vegetation, the use of chemical fertilizers in modern agriculture, and from the oxidation of nitrogen compounds in sewage effluents and industrial wastes.

Nitrate is an important control test for water supplies. Drinking waters containing excessive amounts of nitrates can cause methaemoglobinaemia in bottle-fed infants (blue babies).

The Nitratest method provides a simple test for nitrate nitrogen over the range 0 - 1 mg/l N. By employing a simple dilution technique, however, the test can be extended to cover the range 0 - 20 mg/l.

Method

In the Nitratest method, nitrate is first reduced to nitrite using the unique, zinc-based Nitratest Powder and Nitratest Tablet, which promotes rapid flocculation after a one minute contact period. The test is conducted in a special Nitratest Tube - a graduated sample container with hopper bottom to facilitate settlement and decanting of the sample.

The clear supernatant liquid from the reduction stage is decanted into a round test tube, where the nitrite reacts with sulphanilic acid in the presence of N-(1-naphthyl)-ethylene diamine to form a reddish dye. These reagents are provided in a single Nitricol tablet that is simply added to the test solution.

The intensity of the color produced is proportional to the nitrate concentration and is measured using a Photometer.

Reagents and Equipment

Nitratest Powder (spoon pack)
Nitratest Tablets
Nitricol Tablets
Nitratest Tube, 20 ml (YPT508)
Photometer
Round Test Tubes, 10 ml (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart

Direct-reading photometer -- select program Phot 23 Nitrate Nitrogen (N)
or Phot 63 Nitrate (NO_3)

Test Procedure

1. Fill the Nitratest Tube with sample to the 20 ml mark.
2. Add one level spoonful of Nitratest Powder and one Nitratest tablet. Do not crush the tablet. Replace screw cap and shake tube well for one minute.
3. Allow tube to stand for about one minute then gently invert three or four times to aid flocculation. Allow tube to stand for two minutes or longer to ensure complete settlement.
4. Remove screw cap and wipe around the top of the tube with a clean tissue. Carefully decant the clear solution into a round test tube, filling to the 10 ml mark.
5. Add one Nitricol tablet, crush and mix to dissolve.
6. Stand for 10 minutes to allow full color development.
7. Select wavelength 570 nm on Photometer.
8. Take Photometer reading in the usual manner (see Photometer instructions).
9. Consult Nitratest calibration chart (Transmittance-display photometer only).

Note:

Multiply by 4.4 to convert mg/l N to mg/l NO_3.

NITRATEST				Nitrate mg/l N				570 nm		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	-	-	-	-	.000	.003	.006	.009	.012	.015
80	.018	.021	.024	.028	.032	.036	.040	.043	.047	.051
70	.055	.059	.063	.068	0.72	0.76	.080	.085	.089	.094
60	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.14
50	0.15	0.15	0.16	0.17	0.17	0.18	0.18	0.19	0.20	0.20
40	0.21	0.22	0.22	0.23	0.24	0.24	0.25	0.26	0.27	0.28
30	0.30	0.31	0.32	0.33	0.34	0.35	0.37	0.38	0.40	0.42
20	0.43	0.45	0.47	0.50	0.53	0.55	0.58	0.60	0.65	0.70
10	0.75	0.80	0.85	0.90	0.95	1.00	----	----	----	----

High Nitrate Concentrations

Concentrations of nitrate greater than 1.0 mg/l may be determined by diluting the original sample with deionized water. The test range can be extended to cover 0 - 20 mg/l N as follows:

Using a pipette or graduated dropper, add 1 ml of sample to a clean Nitratest Tube. Fill the Nitratest Tube to the 20 ml mark with deionized water. Continue the test procedure as given in steps 2 to 9 above. Multiply the resulting concentration by 20 to obtain the nitrate concentration in the original sample.

Nitrite Correction

The Nitratest method will also respond to any nitrite present in the sample. In most natural and drinking waters, the amount of nitrite will be small in comparison to the nitrate concentration. If correction is necessary, determine nitrite concentration (as mg/l N) normally (see Phot 24), and deduct from the nitrate concentration (as mg/l N) obtained from this procedure.

NITRITE (NITRICOL)

TEST FOR NITRITE IN NATURAL, DRINKING AND WASTE WATER

Photometer Method
520 nm
0 - 0.5 mg/l N
(0 - 1.6 mg/l NO_2)

Nitrites are found in natural waters as an intermediate product in the nitrogen cycle. Nitrite is harmful to fish and other forms of aquatic life and the nitrite level must be carefully controlled in water used for fish farms and aquariums. The nitrite test is also applied for pollution control in waste waters, and for the monitoring of drinking water.

The Nitricol test provides a simple method of measuring Nitrite Nitrogen levels over the range 0 - 0.5 mg/l N. Higher concentrations can be determined by diluting the sample.

Method

Nitrites in acid solution react with sulphanilic acid. The resulting diazo compound couples with N-(1-naphthyl)-ethylene diamine to form a reddish dye. The color intensity is proportional to the nitrite concentration and is measured using a Photometer.

The Nitricol method features a single tablet reagent containing both reagents in an acidic formulation. Simply add a tablet to the water sample to carry out the test.

Reagents and Equipment

Nitricol Tablets
Photometer
Round Test Tube, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program Phot 24 Nitrite Nitrogen (N)
or Phot 64 Nitrite (NO_2)

Test Procedure

1. Fill round test tube with sample to the 10 ml mark.
2. Add one Nitricol tablet, crush, and mix to dissolve.
3. Stand for 10 minutes to allow full color development.
4. Select wavelength 520 nm on Photometer.
5. Take Photometer reading in the usual manner (see Photometer instructions).
6. Consult Nitricol calibration chart (Transmittance-display photometer only).

Note:

To convert from mg/l N to mg/l NO_2 multiply result by 3.3

NITRICOL					Nitrite mg/l N				520 nm	
%T	9	8	7	6	5	4	3	2	1	0
90	.000	.001	.003	.004	.006	.007	.009	.011	.012	.014
80	.016	.018	.019	.021	.023	.025	.027	.028	.030	.032
70	.034	.036	.038	.040	.042	.044	.046	.048	.051	.053
60	.055	.057	.060	.062	.064	.067	.069	.072	.074	.077
50	.079	.082	.084	.087	.090	.093	.096	.099	.102	.105
40	.108	.111	.114	.118	.121	.124	.128	.132	.135	.139
30	.143	.147	.151	.155	.160	.164	.169	.173	.178	.183
20	.189	.194	.200	.205	.212	.218	.224	.231	.238	.246
10	.254	.262	.271	.280	.290	.301	.312	.325	.338	.353
0	.369	.387	.408	.431	.460	.500	----	----	----	----

NITRITE (NITRIPHOT)

Photometer Method
490 nm
0 - 1500 mg/l $NaNO_2$

TEST FOR NITRITE IN COOLING WATER

Nitrites and nitrite-based formulations are widely used for corrosion control in cooling water systems. The Nitriphot test provides a simple means of measuring nitrite for controlling these treatment products in the cooling water. The test covers the range 0 - 1500 mg/l $NaNO_2$.

Method

The Nitriphot method is based on a colorimetric procedure employing an iodide containing reagent system. Under mildly acid conditions, nitrites catalyze the oxidation of iodide to iodine, producing a brown coloration. Over the range of the test, a series of colors from colorless through yellow to brown is produced.

The intensity of the color produced in the test is proportional to the nitrite concentration, and is measured using a Photometer.

Interferences

Chlorine in excess of 30 mg/l may give slight positive interference. However, nitrite and chlorine are incompatible and do not normally coexist.

Reagents and Equipment

Nitriphot No. 1 Tablets
Nitriphot No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)
Measuring Syringe 1 ml (YPT361)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 43

Test Procedure

1. Filter sample if necessary to obtain a clear solution.

   Note: For the most accurate results, perform the test at a temperature below 30°C.

2. Using the measuring syringe, transfer 1 ml of the sample to the test tube, and make-up to the 10 ml mark with deionized water.
3. Add one Nitriphot No. 1 tablet, crush and mix to dissolve.
4. Add one Nitriphot No. 2 tablet, crush and mix to dissolve. Cap tube immediately.
5. Stand for two minutes to allow full color development.
6. Select wavelength 490 nm on the Photometer.
7. Take Photometer reading in the usual manner (see Photometer instructions).
8. Consult Nitriphot calibration chart (Transmittance-display photometer only).

NITRIPHOT			Sodium Nitrite mg/l $NaNO_2$					**490 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0	0	0	5	5	10	10	10	10	15
80	15	15	15	20	20	20	20	25	25	25
70	30	30	30	35	35	35	40	40	40	45
60	45	50	50	55	60	60	65	70	70	75
50	80	80	85	90	95	100	105	115	125	140
40	160	180	210	250	290	320	355	400	435	470
30	505	545	585	625	670	710	750	800	855	910
20	970	1030	1095	1160	1230	1300	1380	1470	1540	----

ORGANOPHOSPHONATE (OP)

TEST FOR ORGANOPHOSPHONATE IN COOLING WATER

Photometer Method
640 nm
0 - 20 mg/l PO_4

The use of organophosphonate compounds as inhibitors in cooling systems has become widespread in recent years. It is essential to monitor the active organophosphonate content of the cooling water to ensure the treatment is fully effective.

The OP test provides a reliable means of monitoring organophosphonate levels over the range 0 - 20 mg/l PO_4. The test has been developed for use with commercially available organophosphonate products, such as those based on amino trimethyl phosphonic acid and hydroxyethane diphosphonic acid.

Method

In the OP test, organophosphonates are first converted to orthophosphate by a catalyzed cold oxidation process. Excess oxidizing agent is removed from the sample by precipitation and filtration. The orthophosphate formed in the reaction is then determined using the 'molybdenum blue' method. The intensity of the blue coloration formed is proportional to the organophosphonate concentration and is determined using a Photometer.

A separate correction procedure is employed for samples where the presence of orthophosphate is known or suspected. This compensates for the orthophosphate originally present in the sample so that a true value for organophosphonate concentration can be obtained.

The reagents for both procedures are provided in tablet form, so the test is performed simply by adding the appropriate tablets in sequence to a diluted water sample.

Interferences

Chloride in excess of 350 mg/l will cause low results for organophosphonate. Dilute samples containing chloride levels higher than 350 mg/l prior to the start of the test, and apply a corresponding dilution factor to the result.

Note:

The results of this test are expressed in terms of mg/l (ppm) active phosphate content. Commercial products are normally sold as aqueous formulations with a specified active content. To utilize the test results, the active phosphate content of the product in use must be considered.

Reagents and Equipment

Oxidizing OP Tablets
OP-A Tablets
OP-B Tablets
OP-AX Tablets
Photometer
Test Tube, 20 ml plastic (YPT508)
Round Test Tubes, 10 ml glass (YPT515)
Filtration Kit (YPT600)

Although YSI recommends using Filtration Kit (YPT600), standard laboratory equipment with Whatman GF/B or equivalent papers may be used.

Test Calibrations

Transmittance-display photometer -- use calibration charts.
Direct-reading photometer -- select program Phot 44.

The Direct-reading photometer is programmed for both Organophosphonate and correction calibrations, and will automatically calculate the corrected concentration of organophosphonate. Use program Phot 44 Organophosphonate, then press [*] to continue test for program Phot 45 Correction Factor.

Sample Preparation and Dilution

1. Filter sample if necessary to obtain a clear solution.
2. Prepare x5 dilution* of the sample using the dilution tube.

* This diluted sample is used for both the organophosphonate and the correction procedures. The test calibrations take this dilution into account, so it is not necessary to apply a dilution factor in the result calculation.

Organophosphonate Test Procedure

1. Fill the plastic tube with diluted sample to the 20 ml mark.
2. Add one Oxidizing-OP tablet. Replace the screw cap, and shake tube until tablet dissolves.
3. Allow the tube to stand for five minutes.
4. Add one OP-A tablet. Replace screw cap, and shake test tube until tablet dissolves.
5. Allow tube to stand for two minutes.
6. Filter a portion of the solution into a round glass test tube filling to the 10 ml mark.
7. Add one OP-B tablet, crush tablet and mix to dissolve.
8. Stand for five minutes to allow full color development.
9. Select wavelength 640 nm on Photometer.
10. Take Photometer reading in the usual manner (see Photometer instructions).
11. Consult the Organophosphonate calibration chart (Result A) (Transmittance-display photometer only).

    The test may be terminated at this stage if the original sample is known not to contain orthophosphate.

ORGANOPHOSPHONATE Active PO_4 mg/l **640 nm**										
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	----	----	----	----	----	----	----	----	0.00	0.00
80	0.10	0.20	0.30	0.45	0.55	0.70	0.80	0.90	1.05	1.20
70	1.30	1.40	1.55	1.65	1.80	1.90	2.05	2.20	2.30	2.45
60	2.60	2.70	2.85	3.00	3.15	3.30	3.45	3.60	3.75	3.90
50	4.10	4.25	4.40	4.60	4.75	5.00	5.15	5.35	5.55	5.75
40	6.00	6.20	6.40	6.60	6.85	7.10	7.35	7.60	7.85	8.15
30	8.30	8.55	8.80	9.00	9.25	9.50	9.75	10.0	10.4	10.7
20	11.0	11.4	11.8	12.2	12.6	13.0	13.4	13.9	14.4	14.9
10	15.5	16.1	16.8	17.5	18.4	19.2	20.0	----	----	----

Correction Factor Test Procedure

Perform the following correction if orthophosphate is, or may be, present in the sample. When using direct-reading photometer, press [*] to continue the test program.

1. Fill a round glass test tube with diluted sample to the 10 ml mark.
2. Add one OP-AX tablet, crush and mix to dissolve.
3. Add one OP-B tablet, crush and mix to dissolve.
4. Stand for five minutes to allow full color development.
5. Select wavelength 640 nm on Photometer.
6. Take Photometer reading in the usual manner.

7a. Consult Correction Chart to obtain correction factor (Result B) (Transmittance-display photometer only). Subtract this value from the organophosphonate concentration obtained previously (Result A).

i.e. Corrected Organophosphonate (mg/l PO_4) = Result A - Result B

7b. Direct-reading photometer - Instrument displays the corrected active organophosphonate concentration as mg/l PO_4.

CORRECTION FACTOR										640 nm
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.00	0.00	0.00	0.10	0.20	0.30	0.45	0.55	0.65	0.75
80	0.85	1.00	1.10	1.20	1.30	1.45	1.55	1.65	1.75	1.90
70	2.00	2.10	2.20	2.35	2.45	2.55	2.70	2.80	2.90	3.05
60	3.15	3.30	3.40	3.55	3.70	3.80	3.95	4.10	4.25	4.35
50	4.50	4.65	4.80	4.95	5.10	5.25	5.45	5.60	5.75	5.95
40	6.10	6.30	6.50	6.75	6.95	7.10	7.30	7.50	7.70	7.90
30	8.10	8.35	8.60	8.80	9.10	9.35	9.65	9.90	10.3	10.6
20	10.9	11.2	11.5	11.9	12.2	12.6	13.0	13.4	13.9	14.4
10	14.9	15.5	16.2	17.4	18.7	20.0	----	----	----	----

OZONE

TEST FOR OZONE IN WATER

Photometer Method
520 nm
0 - 2.0 mg/l

Ozone is used for the disinfection of swimming pool water, and in many other water treatment systems. In swimming pool water treatment, ozone is normally introduced into the circulation system and then removed before the water is returned to the pool. In other water treatment systems, an ozone residual may be maintained in the water. In all cases, accurate measurement of ozone residual is essential for the control of the system, or to ensure that the ozone has been removed.

The DPD Ozone method provides a simple means of measuring ozone residuals up to a level of 2.0 mg/l. Other disinfectants such as chlorine and bromine are frequently used in conjunction with ozone. Supplementary procedures are therefore provided for the separate determination of these residuals.

Method

The Ozone test uses the DPD method now internationally recognized as the standard method of testing for disinfectant residuals. In the DPD method the reagents are provided in tablet form for maximum convenience and simplicity of use.

Ozone reacts with diethyl-p-phenylene diamine DPD in buffered solution in the presence of potassium iodide to produce a pink coloration. The intensity of the color is proportional to the ozone concentration and is measured using a Photometer.

A supplementary procedure using glycine is required to determine ozone in the presence of chlorine or bromine. The glycine destroys the ozone in the sample and the color produced in the DPD test corresponds to the chlorine or bromine only. The ozone content is the difference between the test readings with and without glycine.

Reagents and Equipment

DPD No. 4 Tablets
DPD Glycine Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 25

Test Procedures

1. Rinse test tube with sample, leave two to three drops of sample in the tube.
2. Add one DPD No. 4 tablet, crush tablet, then add sample to the 10 ml mark. Mix to dissolve tablet.
3. Select wavelength 520 nm on Photometer.
4. Take Photometer reading in the usual manner (see Photometer instructions).
5. Consult Ozone calibration chart (Transmittance-display photometer only). The result represents the ozone residual as milligrams per liter (Result A).

Note: The test may be terminated at this stage for systems treated with ozone alone. For waters containing both ozone and chlorine or bromine, a correction should be made as indicated in the following section. When using Direct-reading photometer, press [∗] to continue the test program.

OZONE				Ozone mg/l O_3				**520 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.00	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.07	0.08
80	0.09	0.10	0.10	0.12	0.13	0.14	0.14	0.15	0.16	0.16
70	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.27
60	0.28	0.29	0.31	0.32	0.33	0.34	0.35	0.37	0.38	0.39
50	0.41	0.42	0.44	0.46	0.47	0.48	0.50	0.51	0.52	0.54
40	0.55	0.57	0.58	0.60	0.61	0.62	0.64	0.66	0.67	0.69
30	0.71	0.73	0.76	0.79	0.81	0.83	0.86	0.88	0.91	0.93
20	0.96	0.98	1.02	1.05	1.11	1.15	1.19	1.24	1.29	1.35
10	1.40	1.46	1.51	1.57	1.62	1.69	1.76	1.84	1.92	2.00

Correction for Chlorine or Bromine

1. Fill a test tube with sample to the 10 ml mark. Add one DPD Glycine tablet, crush and mix to dissolve.
2. Take a second clean test tube and add two to three drops of solution from the first tube. Add one DPD No. 4 tablet, crush, and then add the remainder of the solution to make up to the 10 ml mark. Mix to dissolve tablet.
3. Select wavelength 520 nm on Photometer, and take Photometer reading.
4. Consult Ozone calibration chart (Transmittance-display photometer only).
5. The result represents the ozone equivalent of the chlorine or bromine present (Result B). To obtain the corrected ozone residual, subtract this value from Result A (Transmittance-display photometer only):

   i.e. Ozone (mg/l) = Result A - Result B

pH (PHENOL RED)

TEST FOR pH VALUE OF WATER AND AQUEOUS SOLUTIONS

Photometer Method
520 nm
6.8 - 8.4

The measurement of pH in water and aqueous solutions is one of the most frequently performed tests. The phenol red indicator method provides a simple colorimetric means of pH determination for neutral and slightly alkaline waters of pH 6.8 - 8.4. The Phenol Red pH test is particularly applicable to testing swimming pools and spas.

Method

The Phenol Red test uses a tablet reagent containing the precise amount of phenol red indicator required for the test. Phenol red reacts in water to produce a range of colors from yellow to red, depending on the pH. The color of the test solution is indicative of the pH value and is measured using a Photometer.

Phenol Red reagent tablets also contain a dechlorinating agent so the test can be used with water containing normal levels of chlorine or other disinfectant residuals.

Reagents and Equipment

Phenol Red Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart.
Direct-reading photometer - select program Phot 27

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Phenol Red tablet, crush and mix to dissolve.
3. Select wavelength 520 nm on Photometer.
4. Take Photometer reading in the usual manner (see Photometer instructions).
5. Consult Phenol Red calibration chart (Transmittance-display photometer only).

PHENOL RED				pH Units					**520 nm**	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
60	6.80	6.80	6.85	6.85	6.90	6.90	6.95	6.95	6.95	7.00
50	7.00	7.05	7.05	7.10	7.10	7.15	7.15	7.20	7.20	7.20
40	7.25	7.25	7.30	7.30	7.35	7.35	7.40	7.40	7.45	7.45
30	7.50	7.50	7.50	7.55	7.55	7.60	7.60	7.65	7.65	7.70
20	7.70	7.70	7.75	7.75	7.80	7.80	7.85	7.85	7.90	7.90
10	7.95	8.00	8.05	8.10	8.15	8.20	8.25	8.30	8.40	----

Notes:

1. The color range of the phenol red test is yellow, through orange, to red. Formation of an intense purple color shows the indicator has been affected by high chlorine or other disinfectant residual levels. Disregard the reported result in such cases.
2. Phenol red does not show any further color change at pH values below 6.8 or above 8.4. Therefore, if the reported pH is 6.8, the actual sample pH may be much lower; and if the reported pH is 8.4, the actual sample pH may be significantly higher.
3. Ionic strength, temperature, and other factors may affect pH readings. This test has been calibrated for conditions most likely to be encountered in a typical swimming pool at 30°C.

PHOSPHATE HR

TEST FOR HIGH LEVELS OF PHOSPHATE IN BOILER WATER

Photometer Method
490 nm
0 - 100 mg/l

Phosphates are used extensively for treating water in boilers and steam raising plants. Phosphates are added to control the accumulation of sediment and deposits within the boiler. Monitoring phosphate levels is an essential component of the treatment program, and helps ensure effective deposition control.

The Phosphate HR test provides a simple method of measuring phosphate levels in boiler waters over the range 0 - 100 mg/l PO_4.

Method

The Phosphate HR test is based on the vanadomolybdate method. The distinct advantage of this method is that all of the reagents required are provided in the form of a test tablet. The test is carried out by adding a single tablet to a sample of the boiler water.

In the test, phosphates react with ammonium molybdate, in the presence of ammonium vanadate, to form the yellow phosphovanadomolybdate. The intensity of the color produced is proportional to the phosphate concentration and is measured using a Photometer.

Sample Collection

Samples drawn from boiler sampling points may be hot and contain particulate matter. Prior to analysis, samples should be cooled below 25°C, and filtered through a Whatman No. 42 filter paper.

Reagents and Equipment

Phosphate HR Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 29

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Phosphate HR tablet, crush and mix to dissolve.
3. Stand for 10 minutes to allow full color development.
4. Select wavelength 490 nm on Photometer.
5. Take Photometer reading in the usual manner (see Photometer instructions).
6. Consult Phosphate HR calibration chart (Transmittance-display photometer only).

PHOSPHATE HR				**Phosphate mg/l PO_4**				**490 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	----	----	----	0.0	0.7	1.8	2.9	4.1	5.2	6.4
80	7.5	8.7	9.9	11	12	14	15	16	18	19
70	20	21	23	24	26	27	28	30	31	33
60	34	36	38	39	41	42	44	46	47	49
50	51	53	55	56	58	60	62	64	66	68
40	71	73	75	77	80	82	84	87	89	92
30	95	97	100	----	----	----	----	----	----	----

PHOSPHATE LR

TEST FOR LOW LEVELS OF PHOSPHATE IN NATURAL AND DRINKING WATER

Photometer Method
640 nm
0 - 4.0 mg/l

Phosphates are used extensively in formulations for detergents and washing powders. Phosphates also find widespread application in the food processing industry and industrial water treatment processes. Agricultural fertilizers normally contain phosphate minerals, and phosphates also arise from the breakdown of the plant materials and in animal wastes.

Phosphates can therefore enter water courses through a variety of routes - particularly domestic and industrial effluents and run-off from agricultural land. Phosphate testing is an important control when monitoring natural and drinking waters.

While phosphates are not generally considered harmful for human consumption, they do exhibit a complex effect on the natural environment. In particular, phosphates are associated with eutrophication of water and with rapid plant growth in rivers and lakes. Phosphates present in natural water pass through into drinking water supplies.

The Phosphate LR test provides a simple method of measuring phosphate levels over the range 0 - 4 mg/l PO_4.

Method

In the Phosphate LR method, the phosphate reacts under acid conditions with ammonium molybdate to form phospho-molybdic acid. This compound is reduced by ascorbic acid to form the intensely colored "molybdenum blue" complex. A catalyst is incorporated to ensure complete and rapid color development, and an inhibitor is used to prevent interference from silica. The reagents are provided in the form of two tablets for maximum convenience. The test is simply carried out by adding one of each tablet to a sample of the water.

The intensity of the color produced in the test is proportional to the phosphate concentration, and is measured using a Photometer.

Reagents and Equipment

Phosphate No. 1 LR tablets
Phosphate No. 2 LR tablets
Photometer
Round Test Tubes, 10 ml, glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program Phot 28

Test Procedure

1. Fill the test tube with sample to the 10 ml mark.
2. Add one Phosphate No. 1 LR tablet, crush and mix to dissolve.
3. Add one Phosphate No. 2 LR tablet, crush and mix to dissolve.
4. Stand for 10 minutes to allow full color development.
5. Select wavelength 640 nm on Photometer.
6. Take Photometer reading in the usual manner (see Photometer instructions).
7. Consult Phosphate LR calibration chart (Transmittance-display photometer only).

PHOSPHATE LR				Phosphate mg/l PO_4				**640 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	----	----	----	0.00	0.02	0.03	0.04	0.06	0.07	0.08
80	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28
70	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48
60	0.51	0.54	0.56	0.58	0.61	0.64	0.67	0.70	0.72	0.75
50	0.78	0.81	0.84	0.86	0.89	0.91	0.94	0.97	1.00	1.03
40	1.06	1.09	1.12	1.16	1.20	1.23	1.26	1.30	1.34	1.38
30	1.42	1.46	1.50	1.54	1.58	1.62	1.67	1.72	1.77	1.82
20	1.88	1.94	2.00	2.06	2.13	2.22	2.31	2.40	2.49	2.58
10	2.68	2.79	2.92	3.05	3.20	3.35	3.50	3.75	4.00	----

Note:

Phosphate concentrations can be expressed in a number of different ways. Use the following factors to convert readings:

Multiply mg/l PO_4 by 0.75 to convert to mg/l P_2O_5.
Multiply mg/l PO_4 by 0.33 to convert to mg/l P.

POTASSIUM

TEST FOR POTASSIUM IN NATURAL AND TREATED WATER

Photometer Method
520 nm
0 - 12.0 mg/l

Potassium in an abundant natural element. However, in fresh water, potassium levels are normally low. Higher levels can be observed in brackish waters.

The Potassium test provides a simple means of testing potassium levels in water over the range of 0 - 12.0 mg/l.

Method

The Potassium test is based on a simple tablet reagent containing sodium tetraphenylboron. Potassium salts react with sodium tetraphenylboron to form an insoluble white complex. At the potassium levels encountered in the test, this is observed as turbidity in the test sample. The degree of turbidity is proportional to the potassium concentration and is measured using a Photometer.

Reagents and Equipment

Potassium K Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 30

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Potassium K tablet, crush and mix to dissolve. A cloudy solution indicates the presence of potassium.
3. Select wavelength 520 nm on Photometer.
4. Take Photometer reading in the usual manner (see Photometer instructions).
5. Consult Potassium calibration chart (Transmittance-display photometer only).

POTASSIUM					Potassium mg/l K			**520 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.0	0.4	0.8	1.1	1.3	1.5	1.6	1.7	1.8	1.8
80	1.9	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.4	2.4
70	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.7	2.8	2.8
60	2.9	2.9	3.0	3.0	3.1	3.1	3.1	3.2	3.2	3.3
50	3.4	3.4	3.5	3.5	3.6	3.6	3.7	3.7	3.8	3.9
40	3.9	4.0	4.1	4.1	4.2	4.3	4.4	4.4	4.5	4.6
30	4.7	4.8	4.9	5.0	5.2	5.3	5.4	5.6	5.7	5.9
20	6.0	6.2	6.4	6.6	6.8	7.1	7.4	7.7	8.0	8.3
10	8.8	9.2	9.6	10.0	11.0	12.0	----	----	----	----

SILICA

TEST FOR SILICA IN NATURAL, TREATED AND INDUSTRIAL WATER

Photometer Method
640 nm
0 - 4.0 mg/l SiO_2

Silicon, in the form of silica, is one of the earth's most abundant elements. Silicon is found widely in natural waters as colloidal silica or soluble silicates.

Silica and silicates do not normally cause any problems in water intended for domestic consumption. However their presence is undesirable in water used in a variety of industrial applications. This is because such water tends to form a hard scale on equipment. Silica and silicate containing waters are particularly troublesome in steam generating plants such as high pressure boilers, since silica scale can build up on turbine blades.

The Silica test provides a simple means of measuring silica and silicate levels in natural, treated and industrial waters over the range 0 - 4.0 mg/l SiO_2.

Method

Ammonium molybdate reacts with silica under acid conditions to produce molybdosilicic acid. In the presence of a reducing agent, this compound is reduced to form an intense blue complex. Phosphate reacts in a similar manner. Interference by phosphate is prevented by introducing a reagent which destroys any molybdophosphoric acid which may form.

The reagents for the method are provided in tablet form and the test is carried out simply by adding tablets to a sample of water. The intensity of the color produced in the test is proportional to the silica concentration and is measured using a Photometer.

Reagents and Equipment

Silica No. 1 Tablets
Silica No. 2 Tablets
Silica PR Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 31

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Silica No. 1 tablet, crush and mix to dissolve. Stand for five minutes to allow the silica to react.
3. Add one Silica PR tablet, crush and mix to dissolve. (This stage may be omitted if the sample is known to be completely free of phosphate).
4. Add one Silica No. 2 tablet, crush and mix to dissolve. Stand for one minute to allow full color development.
5. Select wavelength 640 nm on Photometer.
6. Take Photometer reading in the usual manner (see Photometer instructions).
7. Consult Silica calibration chart (Transmittance-display photometer only).

	SILICA				Silica mg/l SiO_2			**640 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	0.00	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.15	0.16
80	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.36
70	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.54	0.56	0.58
60	0.60	0.62	0.64	0.68	0.70	0.74	0.76	0.80	0.82	0.84
50	0.88	0.92	0.94	0.98	1.00	1.04	1.08	1.12	1.14	1.18
40	1.22	1.26	1.30	1.34	1.38	1.42	1.44	1.48	1.52	1.56
30	1.60	1.64	1.70	1.74	1.80	1.84	1.88	1.92	2.00	2.04
20	2.10	2.18	2.24	2.30	2.40	2.48	2.58	2.70	2.78	2.86
10	2.96	3.06	3.16	3.26	3.36	3.46	3.60	3.75	3.88	4.00

SULFATE

TEST FOR SULFATE IN NATURAL AND TREATED WATERS

Photometer Method
520 nm
0 - 200 mg/l

Sulfates occur naturally in many waters. Sulfates are introduced into treated waters by the use of such chemicals as aluminum sulfate, sodium bisulfate (dry acid) and sulfuric acid. The presence of high levels of sulfate can be undesirable for a number of reasons.

In industrial waters containing sulfate localized corrosion of iron, steel and aluminum in plant and pipework can occur through the action of sulfate-reducing bacteria. These bacteria, which generate sulfides, cause a characteristic pitting of the metal surface.

High sulfate levels can also cause damage to concrete and cement based materials through the formation of calcium sulfoaluminate. This causes expansion and crumbling of the cement. It can affect concrete structures and pipes in water distribution systems carrying sulfate-bearing ground waters; and can attack grouting in tiled swimming pools using sodium bisulfate for pH adjustment.

The Sulfate test provides a simple method of measuring sulfates over the range 0 - 200 mg/l SO_4. Higher levels may be determined by diluting the sample.

Method

The Sulfate test is based on a single tablet reagent containing barium chloride in a slightly acidic formulation. Barium salts react with sulfates to form insoluble barium sulfate. At the sulfate levels encountered in the test, this is observed as turbidity in the test sample. The degree of turbidity is proportional to the sulfate concentration and is measured using a Photometer.

Reagents and Equipment

Sulphate Turb Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 32

Test Procedure

1. Fill test tube with sample to the 10 ml mark.
2. Add one Sulphate Turb tablet, crush and mix to dissolve. A cloudy solution indicates the presence of sulfate.
3. Stand for five minutes then mix again to ensure uniformity.
4. Select wavelength 520 nm on Photometer.
5. Take Photometer reading in the usual manner (see Photometer instruction).
6. Consult Sulfate calibration chart (Transmittance-display photometer only).

	SULFATE			Sulfate mg/l SO_4				**520 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	3	5	7	8	9	10	12	13	14	15
80	16	17	18	19	20	21	22	24	25	26
70	27	28	29	30	31	32	33	34	35	36
60	37	38	39	40	42	43	45	46	48	49
50	50	52	53	54	56	57	59	60	62	64
40	65	67	68	70	72	74	75	77	79	81
30	83	85	87	90	93	95	97	100	103	107
20	110	113	116	120	124	128	133	138	143	148
10	155	162	170	178	185	193	200	----	----	----

Caution

Each Sulphate Turb tablet contains 20 mg Barium Chloride. These tablets are harmful if ingested. Avoid handling tablets whenever possible. Always wash hands after use.

SULFIDE

TEST FOR SULFIDE IN NATURAL AND WASTE WATER

Photometer Method
640 nm
0 - 0.5 mg/l

Natural waters containing dissolved hydrogen sulfide and other sulfides are found in certain parts of the world, particularly in areas having hot springs. Sulfides are constituents of many industrial wastes such as those from tanneries, gas plants and chemical works. Sulfides can be toxic to fish and aquatic life; and their presence in water supplies gives rise to undesirable tastes and odors.

The Sulfide test provides a simple method of measuring total available sulfide over the range 0 - 0.5 mg/l and is particularly applicable to natural and drinking waters. Higher levels, such as those found in effluents and waste waters, can be determined by diluting the sample.

Method

This simplified method for the determination of sulfide is based on a reagent containing diethyl-p-phenylene diamine (DPD) and potassium dichromate. Sulfide reacts with this reagent in acid solution to produce a blue colored complex. In the absence of sulfide the reagent produces a pink color. Chlorine, and other oxidizing agents which normally react with DPD, do not interfere with the test. The reagents are provided in the form of two tablets and the test is simply carried out by adding one of each tablet to the water sample.

Reagents and Equipment

Sulphide No. 1 Tablets
Sulphide No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Sample Collection

To prevent loss of sulfide, collect the sample carefully with a minimum of agitation or aeration. Test the sample as soon as possible after collection.

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 33

Test Procedure

1. Fill test tube with sample to 10 ml mark.
2. Add one Sulphide No. 1 tablet and one Sulphide No. 2 tablet, crush and mix gently to dissolve tablets. Gentle mixing is essential to avoid loss of sulfide.
3. Stand for 10 minutes to allow full color development.
4. Select wavelength 640 nm on Photometer.
5. Take Photometer reading in usual manner (see Photometer instructions).
6. Consult Sulfide calibration chart (Transmittance-display photometer only).

Note: Multiply mg/l S by 1.06 to convert to mg/l H_2S.

	SULFIDE				Sulfide mg/l S				**640 nm**	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
70	-	-	-	-	0.00	0.00	0.01	0.01	0.01	0.01
60	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04
50	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.08
40	0.08	0.08	0.08	0.09	0.09	0.09	0.10	0.10	0.10	0.11
30	0.11	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.15	0.15
20	0.16	0.16	0.17	0.17	0.18	0.19	0.19	0.20	0.21	0.21
10	0.22	0.23	0.24	0.25	0.26	0.26	0.27	0.28	0.29	0.30
0	0.31	0.33	0.34	0.36	0.41	0.50	----	----	----	----

SULFITE (SULPHITEST)

TEST FOR SULFITE IN BOILER WATER

Photometer Method
570 nm
0 - 500 mg/l Na_2SO_3

Oxygen is a major cause of corrosion in boilers and steam raising plants. Sodium sulfite and catalyzed sulfite formulations are extensively used as oxygen scavengers in boiler water treatment.

The Sulphitest test provides a simple means of measuring sulfite levels for the control of such treatments in boiler plants. The test covers the range of 0 - 500 mg/l Na_2SO_3.

Method

The Sulphitest method is based on a colorimetric procedure involving the reduction of an indicator dye. Sulfites react with the indicator dye under buffered conditions to destroy the original purple coloration. The degree of color loss observed in the test is proportional to the sulfite concentration and is measured using a Photometer.

An advantage of the Sulphitest method is that it does not respond to other reducing species, as do traditional iodometric methods.

Reagents and Equipment

Sulphitest No. 1 Tablets
Sulphitest No. 2 Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 34

Test Procedure

1. Filter sample if necessary to obtain a clear solution.
2. Fill the test tube with sample to the 10 ml mark.
3. Add one Sulphitest No. 1 tablet, crush and mix to dissolve.
4. Add one Sulphitest No. 2 tablet, crush and mix to dissolve. Cap tube immediately.
5. Stand for two minutes to allow full color reduction to take place.
6. Select wavelength 570 nm on the Photometer.
7. Take Photometer reading in the usual manner (see Photometer instructions).
8. Consult Sulphitest calibration chart (Transmittance-display photometer only).

Notes: Multiply mg/l Na_2SO_3 by 0.63 to express sulfite concentrations as mg/l SO_3. To prevent staining, wash equipment immediately after use, use a detergent if necessary.

SULPHITEST				Sulfite mg/l Na_2SO_3				**570 nm**		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
80	----	----	----	----	----	----	----	----	500	475
70	450	420	390	362	337	310	285	260	242	225
60	212	200	190	180	172	162	152	145	137	130
50	124	117	112	107	102	97	93	89	86	82
40	78	75	72	69	67	63	61	58	56	53
30	51	49	47	45	43	41	39	37	35	33
20	31	29	27	25	23	21	19	18	16	14
10	12	10	8	6	3	1	0	0	0	----

Interferences

1. This test is not affected by the presence of other reducing species such as nitrite (up to 200 mg/l) ferrous iron (up to 20 mg/l) and sulfide (up to 10 mg/l); or by the presence of polyacrylates.
2. Chlorine over 250 mg/l may cause interference. Since sulfite and chlorine do not normally co-exist, however, chlorine does not usually cause problems.
3. Reported results will be low if tannin or tannic acid are present in the sample.

TURBIDITY

Photometer Method
520 nm
5 - 400 Turbidity Units

TEST FOR TURBIDITY IN NATURAL AND TREATED WATERS

Turbidity is an important parameter for characterizing water quality. Turbidity is caused by the scattering of light by suspended matter such as clay, silt, or finely divided organic and inorganic matter. Knowledge of a sample's turbidity facilitates estimation of the concentration of undissolved substances.

Method

The turbidity of the water is determined photoelectrically using the Photometer. In many samples, both color and turbidity will be present. In order to separate the effects of turbidity and color, the sample is compared against a filtered portion of the same sample.

This photometer method has been calibrated against the widely recognized formazin turbidity solutions. Turbidity is expressed in terms of Formazin Turbidity Units (FTU). These units are broadly equivalent to Jackson Turbidity Units (JTU) and Nephelometric Turbidity Units (NTU).

Reagents and Equipment

Color/Turbidity Set (YPM269)
Photometer

Test Calibration

Transmittance-display photometer -- use calibration chart
Direct-reading photometer -- select program Phot 48

Test Procedure

1. Filter a portion of the sample through a GF/B filter paper.
2. Fill a test tube with filtered sample and retain for use as the BLANK tube.
3. Fill a test tube with unfiltered sample to the 10 ml mark.
4. Select wavelength 520 nm on Photometer.
5. Take Photometer reading in usual manner (see Photometer instructions) using the filtered sample as the blank.

Note: When performing the turbidity test under bright or variable lighting conditions, use the light shield to eliminate interferences due to ambient light entering the photocell. The light shield is not required when testing indoors, or under shaded outdoor light.

6. Consult Turbidity calibration chart (Transmittance-display photometer only).

TURBIDITY					FTU				520 nm	
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	5	8	11	14	17	20	23	26	29	32
80	35	38	41	44	47	50	54	57	61	64
70	68	72	76	80	83	87	91	95	100	105
60	110	110	115	120	125	130	135	140	150	155
50	160	165	170	175	180	190	195	200	210	215
40	220	230	235	240	250	260	270	280	290	300
30	310	320	330	335	345	355	365	380	390	400

ZINC

TEST FOR ZINC IN NATURAL AND TREATED WATER

Photometer Method
640 nm
0 - 4.0 mg/l

Zinc compounds are used as corrosion inhibitors in industrial cooling systems and similar applications. Control of the zinc level is an important aspect of corrosion control in such systems. Zinc and zinc containing alloys are widely used in industry and zinc salts are commonly found in industrial effluents.

The Zinc test provides a simple means of testing zinc levels over the range 0 - 4 mg/l and is suitable for testing cooling waters and industrial effluents, and for monitoring natural and drinking waters.

Method

Zinc reacts with 5-(o-carboxyphenyl)-3-phenyl-formazan (Zincon) in alkaline solution to give an intense blue color. The reagent itself is orange in solution. A distinctive color, from orange through purple to blue is produced, depending on the zinc concentration. The color is measured using a Photometer.

In the Zinc test, a tablet reagent containing both Zincon and an alkaline buffer is used for maximum convenience. The test is simply carried out by adding a tablet to a sample of the water. Samples containing high chlorine residuals are pre-treated with a special dechlorinating tablet to prevent bleaching of the test colors.

Although copper reacts in a manner similar to zinc, a correction procedure using EDTA can be applied to samples containing both zinc and copper. EDTA destroys the color complex formed with zinc.

Reagents and Equipment

Zinc Tablets
Zinc-Dechlor Tablets
EDTA Tablets
Photometer
Round Test Tubes, 10 ml glass (YPT515)

Test Calibration

Transmittance-display photometer - use calibration chart
Direct-reading photometer - select program Phot 35*

* The direct-reading photometer is programmed for both zinc and the copper correction procedures. Use program Phot 35 Zinc (+Copper), then press [*] to continue test for program Phot 36 Corrected Zinc. The corrected zinc value is calculated automatically.

Test Procedure

1. Fill test tube to the 10 ml mark with sample.
2. **FOR CHLORINE CONTAINING SAMPLE ONLY.** Add one Zinc-Dechlor tablet, crush and mix to dissolve.
3. Add one Zinc tablet, crush and mix to dissolve.
4. Allow the sample to stand for five minutes, then mix again to ensure complete dissolution of the indicator.
5. Select wavelength 640 nm on Photometer.
6. Take Photometer reading in the usual manner (see Photometer instructions). Consult Zinc calibration chart (Transmittance-display photometer only).

ZINC				Zinc mg/l Zn				640 nm		
%T	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
90	-	-	-	0.00	0.01	0.02	0.03	0.04	0.05	0.06
80	0.07	0.08	0.10	0.11	0.12	0.14	0.15	0.17	0.18	0.20
70	0.22	0.23	0.25	0.26	0.28	0.30	0.31	0.33	0.35	0.37
60	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56
50	0.58	0.60	0.62	0.64	0.67	0.69	0.71	0.74	0.76	0.79
40	0.81	0.84	0.86	0.89	0.92	0.95	0.97	1.00	1.03	1.06
30	1.10	1.13	1.16	1.20	1.23	1.27	1.30	1.34	1.38	1.42
20	1.47	1.51	1.55	1.60	1.65	1.70	1.75	1.81	1.87	1.94
10	2.00	2.08	2.15	2.23	2.31	2.40	2.50	2.60	2.70	2.82
0	3.00	3.25	3.50	3.75	4.00	----	----	----	----	----

CORRECTION PROCEDURE FOR COPPER CONTAINING SAMPLES

7. Continue the test on the same test portion. When using Direct-reading photometer, press [*] to continue the test program.
8. Add one EDTA tablet, crush and mix to dissolve.
9. Take Photometer reading in usual manner.
10. The Direct-reading photometer displays the corrected zinc concentration. For Transmittance-display photometer, consult calibration chart. Subtract this value from the previous result to find the corrected zinc concentration.