1.11174.0001

MColortest™

Chlorine and pH Test

Cl_2
pH

for the determination of free chlorine, total chlorine, and pH

1. General

Swimming-pool water is disinfected by means of chlorine-releasing compounds or chlorine gas ("chlorination"). The chlorine content ("total chlorine") of swimming-pool water is made up of the sum of "free chlorine" and "combined chlorine". "Free chlorine" is understood as the sum of dissolved chlorine (Cl_2), hypochlorous acid (HOCl), and hypochlorite ions (ClO^-). The disinfectant effect of free chlorine is essentially due to hypochlorous acid. "Combined chlorine" consists of chloramines which as oxidative substances similarly contribute to the disinfection.
The swimming-pool water must contain **at least 0.3 mg/l of free chlorine** throughout the entire pool to immediately kill off the pathogens and bacteria imported by the bathers.

Chlorination may produce a drop or rise in the pH of the water. As a measure to guarantee an optimal degree of disinfection and to prevent health risks as well as corrosion and lime deposits, a pH in the range of 7.1 - 7.6 is recommended, in the case of very soft waters in the range of 7.0 - 7.5.

2. Method

Colorimetric determination with color-matching vessel
In weakly acidic solution **free chlorine** reacts with diethyl-p-phenylenediamine (DPD) to form a red-violet dye. **Combined chlorine** reacts only after the addition of iodide ions. **This permits free chlorine to be distinguished from combined chlorine.**
The **pH determination** takes place by means of chlorine-resistant phenol red indicator solution, which changes color from yellow to red-violet in the pH range of 6.5 - 8.2.

The chlorine concentration and the pH are each determined **semiquantitatively** by visual comparison of the color of the measurement solution with the color zones of a color-matching vessel.

3. Measuring range and number of determinations

Measuring range / color-scale graduation	Number of determinations
0.1 - 0.3 - 0.6 - 1.0 - **1.5 mg/l Cl_2**	200
pH 6.8 - 7.1 - 7.4 - 7.6 - **7.8**	200

4. Applications

Sample material:
Swimming-pool water
This test is **not suited** for seawater.

5. Reagents and auxiliaries

Please note the warnings on the packaging materials!
The test reagents are stable up to the date stated on the pack when stored closed at +15 to +25 °C.

Package contents:
2 bottles of reagent Cl_2-1
1 bottle of reagent Cl_2-2
1 bottle of reagent Cl_2-3
2 bottles of reagent pH-1
1 graduated 12-ml plastic syringe
1 color-matching vessel
1 card with brief instruction

Other reagents and accessories:
MQuant™ Chlorine Test, Cat. No. 117925,
measuring range 0.5 - 20 mg/l Cl_2
MColorpHast™ Universal indicator strips pH 0 - 14, Cat. No. 109535
Sodium hydroxide solution 1 mol/l TitriPUR®, Cat. No. 109137
Sulfuric acid 0.5 mol/l TitriPUR®, Cat. No. 109072

Refill packs:

Cat. No. 111157
MColortest™ Chlorine and pH Test
Reagents for chlorine (Cl_2-1, Cl_2-2, Cl_2-3) - Refill pack for 111174
(Reagents **without technical accessories** for 200 determinations of free chlorine or total chlorine)

Cat. No. 111143
MColortest™ Chlorine and pH Test
Reagent for pH (pH-1) - Refill pack for 111174
(Reagent **without technical accessories** for 400 pH determinations)

Merck KGaA, 64271 Darmstadt, Germany,
Tel. +49(0)6151 72-2440
www.analytical-test-kits.com

EMD Millipore Corporation, 290 Concord Road,
Billerica, MA 01821, USA, Tel. +1-978-715-4321

6. Preparation

- **Analyze immediately after sampling!**
- Check the chlorine content with the MQuant™ Chlorine Test.
  Samples containing more than 1.5 mg/l Cl_2 must be diluted with distilled water.
- **Determination of free chlorine and total chlorine:**
  The pH must be within the range 4 - 8.
  Adjust, if necessary, with sodium hydroxide solution or sulfuric acid.

7. Procedure

Sampling site: approx. 50 cm from the pool edge,
at a water depth of approx. 20 cm

Determination of free chlorine:

Rinse the color-matching vessel several times with the pretreated sample.		
Reagent Cl_2-1	5 drops[1)]	Place into the color-matching vessel.
Reagent Cl_2-2	1 drop[1)]	Add.
Pretreated sample (**5 - 40 °C**)	10 ml	Add with the syringe, close the vessel with the stopper, and mix.
Immediately hold the color-matching vessel in front of a white background, e.g. the backside of the brief-instruction card, and determine with which color zone of the chlorine scale the color of the measurement solution coincides most exactly.		
Read off the result in mg/l Cl_2 from the vessel: r**esult A (free chlorine)**		

[1)] **Hold the bottle vertically while adding the reagent!**

Determination of total chlorine:

Reagent Cl_2-3	3 drops[1, 2)]	Add to the measurement solution for **free chlorine**, close the vessel with the stopper, and mix.
Leave to stand for 1 min.		
Hold the color-matching vessel in front of a white background, e.g. the backside of the brief-instruction card, and determine with which color zone of the chlorine scale the color of the measurement solution coincides most exactly.		
Read off the result in mg/l Cl_2 from the vessel: **result B (total chlorine)**		

[1)] **Hold the bottle vertically while adding the reagent!**

[2)] In the event that the color of the solution becomes paler or completely disappears after the addition of reagent Cl_2-3, the entire analysis must be repeated, this time increasing the amount of reagent Cl_2-1 by 1 - 2 drops.

Calculation of the content of combined chlorine:

mg/l combined chlorine = result B - result A

Evaluation:

- **The content of free chlorine should be within the range 0.3 - 0.6 mg/l.**
  If the content of free chlorine is lower than 0.3 mg/l, more chlorinating agent must be added.
- **The content of total chlorine should not be higher than 1.0 mg/l.**
  Otherwise the inflow of fresh water must be increased.

Note on the measurement:

If the color of the measurement solution is equal to or more intense than the darkest color on the scale, repeat the measurement using **fresh**, diluted samples until a value of less than 1.5 mg/l Cl_2 is obtained.

Concerning the result of the analysis, the dilution (see also section 6) must be taken into account:

Result of analysis = measurement value x dilution factor

Determination of the pH:

Rinse the color-matching vessel several times with the sample.		
Sample (**15 - 25 °C**)	10 ml	Inject into the color-matching vessel with the syringe.
Reagent pH-1	4 drops[1)]	Add, close the vessel with the stopper, and mix.
Hold the color-matching vessel in front of a white background, e.g. the backside of the brief-instruction card, and determine with which color zone of the pH scale the color of the measurement solution coincides most exactly.		
Read off the pH from the vessel.		

[1)] **Hold the bottle vertically while adding the reagent!**

Evaluation:

If the pH is lower than 7.1, an alkalinizing agent ("pH enhancer"; e.g. sodium hydroxide solution, sodium carbonate) must be added. If the pH is higher than 7.6, acid or a "pH reducer" (e.g. hydrochloric acid, sodium hydrogen sulfate) must be added.

Note on the measurement:

If the color of the measurement solution corresponds to the lowest or highest value on the scale, the actual pH value may lie outside the measuring range.

8. Notes

- Reclose the reagent bottles immediately after use.
- **As a rule rinse the color-matching vessel and the syringe several times with distilled water before every determination and after use, in particular after determining the total chlorine content.**
- **Information on disposal can be obtained at www.disposal-test-kits.com.**