

TOTAL HARDNESS

Method

The hardness (total hardness) of water is due to its content of salts of the alkaline earth metals calcium, magnesium, strontium, and barium (“hardening constituents”). Since strontium and barium are generally present in waters only in traces, the hardness is defined as the content in a water of calcium ions, Ca^{2+} , and magnesium ions, Mg^{2+} (“hardness ions”). The conventional procedure is to relate the statement of the water hardness only to calcium, in other words to express also the content of magnesium ions as calcium content.

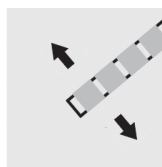
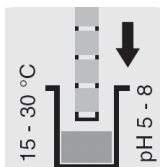
The units for the water hardness relate to calcium or its compounds CaO ($1^\circ\text{d} = 10 \text{ mg/l CaO}$) or CaCO_3 ($1^\circ\text{e} = 14.25 \text{ mg/l CaCO}_3$; $1^\circ\text{f} = 10 \text{ mg/l CaCO}_3$), with the magnesium content being expressed as calcium content and included in the calculation accordingly.

In the presence of a green indicator, the hardness ions Ca^{2+} und Mg^{2+} react with ethylenedinitrilotetraacetic acid disodium salt dehydrate to form a colorless, stable complex. The hardness ions that are present in excess relative to ethylenedinitrilotetraacetic acid disodium salt dehydrate react with the indicator to form a red complex. The reaction zones of the test strip, which are impregnated with differing amounts of ethylenedinitrilotetraacetic acid disodium salt dehydrate, thus assume a green to red color, depending on the hardness of the water sample. The hardness is measured **semi-quantitatively** by visual comparison of the reaction zones with the color rows of a color scale.

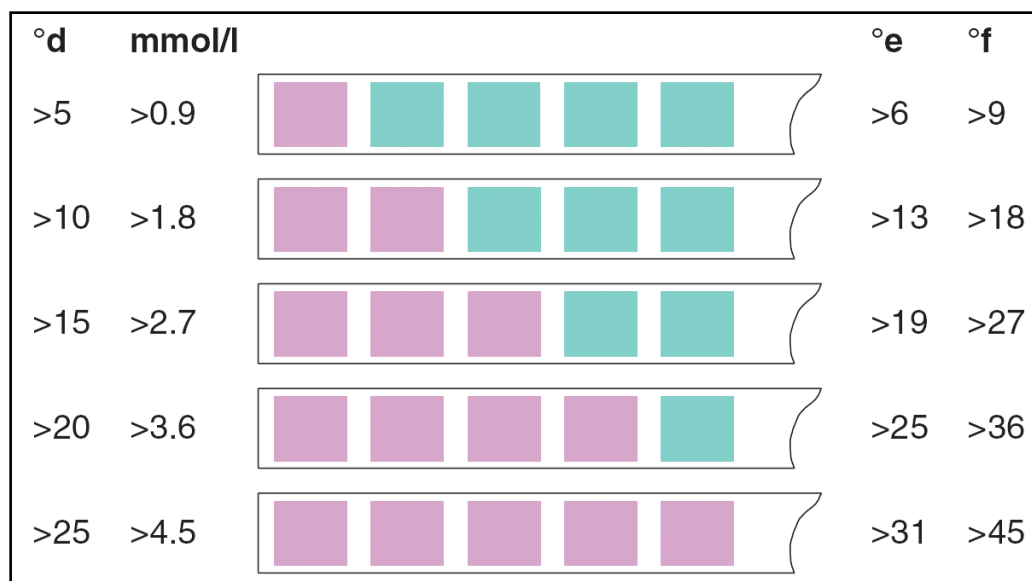
Preparation

The pH must be within the range 5 - 8. Adjust, if necessary, with sodium hydroxide solution or hydrochloric acid.

Procedure



1. Immerse all reaction zones of the test strip in the pretreated sample (15 - 30 °C) for 1 sec (not in running water!).
2. Shake off excess liquid from the strip
3. Wait 1 min
4. Determine with which color row on the label the colors of the reaction zones coincides most exactly. Read off the corresponding result or, if necessary, estimate an intermediate value.



• Notes on the measurement: The colors of the reaction zones may continue to change after the specified reaction time has elapsed. This must not be considered in the measurement.

Results

Table 1: Assessment

Hardness range	Mg/l CaCO ₃	Mmol/l CaCO ₃ (Ca)	°e
soft	<150	<1,5	<10,5
moderately hard	150 - 250	1,5 - 2,5	10,5 - 17,6
hard	>250	>2,5	>17,6

Table 2: Conversions

	1 mg/l(ppm) CaCO ₃	1 mmol/l CaCO ₃ (Ca)	1 mg/l (ppm) Ca	1 English degree °e	1 French degree °f	1 German degree °d
1 mg/l(ppm) CaCO ₃	1	0,01	0,4	0,07	0,1	0,056
1 mmol/l CaCO ₃ (Ca)	100,1	1	40,08	7,02	10,01	5,61
1 mg/l (ppm) Ca	2,5	0,025	1	0,175	0,25	0,14
1 English degree °e	14,25	0,142	5,71	1	1,43	0,799
1 French degree °f	10	0,1	4	0,702	1	0,56
1 German degree °d	17,85	0,178	7,15	1,25	1,78	1

Note

To check test strips and handling:

Dissolve 3.67 g of calcium chloride dihydrate in distilled water, make up to 1000 ml with distilled water, and mix. Ca content: 1000 mg/l (= 175 °e). Dilute this standard solution to 100 mg/l Ca (= 18 °e) and analyze as described in section 4. Reclose the tube containing the test strips immediately after use.