

Hardness C 20 (p/m Alkalinity)**Test kit for the determination of p and m value and carbonate hardness****Method:**

Acid/base titration

Contents of test kit (*refill pack):

sufficient for approx. 200 tests with an average alkalinity of 10 °d or 3.6 mmol/L HCl

10 mL indicator p*

10 mL indicator m*

100 mL titration solution TL C 20*

1 test tube with 5 mL ring mark

1 titration syringe 0–20 °d resp. 0–7.2 mmol/L HCl

(1 graduation mark \pm 0.5 °d resp. 0.2 mmol/L)

2 plastic dropping tips

Hazard warning:

Both indicator solutions contain ethanol 55–75%. For further information, please ask for safety data sheet.

Procedure:

- Rinse test tube several times with the test sample and fill to ring mark.
- Determination of p value (p alkalinity):**
Add **1 drop of indicator p** and mix by shaking. If test sample remains colorless, the p value is 0. If test sample turns **red**, proceed as follows:
- Put dropping tip onto the titration syringe, press down plunger, dip the tip into the titration solution TL C 20 and draw up plunger slowly, until the lower rim of the black plunger O-ring agrees with value 0 on the barrel scale. The small air pocket below the plunger tip does not disturb the determination.
- Addition of the titration solution:** We recommend taking the syringe in the left hand and the test tube in the right hand (see drawing) and adding titration solution dropwise while smoothly shaking the test tube. As soon as the red color vanished completely, read off p value in °d or mmol/L HCl from the syringe barrel (lower rim of the black plunger O-ring) and write down.
- Determination of m value (m alkalinity):**
Add to the remaining water sample in the test tube **1 drop of indicator m** and mix by shaking. If the water turns **red**, the m

value is identical the p value. If the water turns **blue**, determine the m value as follows:

- Continue titrating with the same syringe filling as used for determination of the p value, until the color turns **red**. Read off the m value in °d or mmol/L HCl from the syringe barrel (lower rim of the black plunger O-ring) and write down. After addition of a further drop titration solution the color should not change. If the 1st syringe filling is not sufficient to reach color change, fill up the syringe once more with solution TL C 20 and titrate to color change as described before. Add the additional used syringe content to the value written down.

7. Carbonate Hardness:Normally the m value is identical with the carbonate hardness (mmol/L HCl or °d). **Attention**, do not mix up mmol/L HCl with mmol/L CaO*.

Results a carbonate hardness, which is higher than the total hardness, the result is discarded. In this case the carbonate hardness is equivalent to the total hardness.

This method can be used also for analyzing sea water.

Disposing of the samples:

The used analysis specimens can be flushed down the drain with tap water and channelled off to the local sewage treatment works.

**Remarks:**

- $m > 2p$ → carbonate hardness = m
sample contains CO_3^{2-} , HCO_3^-
- $m = 2p$ → carbonate hardness = m
sample contains CO_3^{2-}
- $p < m < 2p$ → carbonate hardness = $2(m - p)$
sample contains CO_3^{2-} , OH^-
- $m = p$ → carbonate hardness = 0
sample contains OH^-
- $p = 0$ → carbonate hardness = m
sample contains CO_2 , HCO_3^-

- * 1 °d \triangleq 1.25 °e \triangleq 1.78 °f \triangleq 10 mg/L CaO \triangleq 17.8 mg/L CaCO₃
1 mmol/L HCl \triangleq 0.5 mmol/L CaO \triangleq 2.8 °d