

ALKALINITY M and P

Tablet Count Method

**TESTS FOR ALKALINITY M, P AND
CAUSTIC IN BOILER WATER AND
OTHER INDUSTRIAL WATERS**

0 – 1000 mg/l

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 in a number of industrial water uses, notably in boiler water treatment. Boilers and steam raising plant are normally operated under conditions of high alkalinity in order to minimise corrosion and the monitoring of alkalinity is an important control test.

The Palintest Alkalinity M and Alkalinity P tests provide a simple means of checking alkalinity levels over the range 0 - 1000 mg/l CaCO_3 and are particularly suited to boiler and industrial waters. A variant of the Alkalinity P test is used to determine caustic (hydroxide) alkalinity. The alkalinities specifically due to carbonates and bicarbonates can be calculated from the various data obtained.

Method

The Palintest Alkalinity M and Alkalinity P tests are each based on the use of a single tablet reagent containing a precisely standardised amount of acid combined with the appropriate colour indicator. The tests are carried out simply by adding the reagent tablets one at a time to a sample of the water until the appropriate colour change takes place.

For the measurement of Caustic Alkalinity, also known as hydroxide alkalinity, the Alkalinity P tablets are used in conjunction with a supplementary tablet containing barium chloride. The latter precipitates carbonates and the test then responds to the hydroxides only.

Reagents and Equipment

Palintest Alkalinity M Tablets

Palintest Alkalinity P Tablets

Palintest Alkalinity P (BaCl₂) Tablets

Palintest Sample Container, 100/50/10 ml plastic (PT 510)

or Palintest Sample Container, 200/100/50 ml glass (PT 505)

The individual alkalinity tests will only require one or two of the above reagents - see the instructions for the alkalinity test to be carried out.

Test Range

The tests may be carried out on a 50 ml, 100 ml or 200 ml sample depending on the range of alkalinity under test. The table below indicates the sample size appropriate to various alkalinity test ranges :-

<i>Test Range</i>	<i>Sample Size</i>
0 - 250 mg/l CaCO ₃	200 ml
0 - 500 mg/l CaCO ₃	100 ml
0 - 1000 mg/l CaCO ₃	50 ml

Alkalinity M

- 1 Select the sample size appropriate to the Alkalinity M range under test. Take a sample of the correct size in the Palintest sample container.
- 2 Add one Alkalinity M tablet and shake the container until the tablet disintegrates.
- 3 Continue adding tablets one at a time in this manner until the colour of the solution changes from yellow to bright red. (Ignore any intermediate orange-pink coloration).
- 4 Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken :-

Sample Size	Calculation - Alkalinity M (mg/l CaCO ₃)
200 ml	= (No of Tablets x 20) - 10
100 ml	= (No of Tablets x 40) - 20
50 ml	= (No of Tablets x 80) - 40

Alkalinity P

- 1 Select the sample size appropriate to the Alkalinity P range under test. Take a sample of the correct size in the Palintest sample container.
- 2 Add one Alkalinity P tablet and shake the container until the tablet disintegrates.
- 3 Continue adding tablets one at a time in this manner until the colour of the solution changes from blue to yellow.
- 4 Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken :-

Sample Size	Calculation - Alkalinity P (mg/l CaCO ₃)
200 ml	= (No of Tablets x 20) - 10
100 ml	= (No of Tablets x 40) - 20
50 ml	= (No of Tablets x 80) - 40

Caustic Alkalinity

- 1 Select the sample size appropriate to the Caustic Alkalinity range under test. Take a sample of the correct size in the Palintest sample container.
- 2 Add one Alkalinity P (BaCl₂) tablet per 50 ml of sample taken, ie for a 50 ml sample add one tablet, for a 200 ml sample add four tablets. Shake the container until the tablets disintegrate. A blue colour indicates the presence of Caustic Alkalinity.
- 3 Add one Alkalinity P tablet and shake the container until the tablet disintegrates.
- 4 Continue adding Alkalinity P tablets one at a time in this manner until the colour of the solution changes from blue to yellow.
- 5 Note the number of Alkalinity P tablets used and calculate the result from the formula below appropriate to the sample volume taken :-

Sample Size	Calculation - Caustic Alkalinity (mg/l CaCO ₃)
200 ml	= (No of Tablets x 20) - 10
100 ml	= (No of Tablets x 40) - 20
50 ml	= (No of Tablets x 80) - 40

CAUTION - ALKALINITY P (BaCl₂) TABLETS ARE HARMFUL IF INGESTED. EACH TABLET CONTAINS 450 mg BARIUM CHLORIDE. AVOID HANDLING TABLETS AND WASH HANDS AFTER USE.

Alkalinity Relationships

From the results obtained from the foregoing alkalinity measurements it is possible to classify the sample into the three main chemical forms of alkalinity present in most waters, namely hydroxides, carbonates and bicarbonates. 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 CaCO₃, are calculated by the following equations :-

$$\text{Hydroxide} = C$$

$$\text{Carbonate} = 2P - 2C$$

$$\text{Bicarbonate} = M - 2P$$

Where C, P and M are the results of the Caustic Alkalinity, Alkalinity P and Alkalinity M tests respectively. Note that bicarbonate is only present if M is greater than 2P.

Note

The expression of alkalinity results sometimes causes confusion. It is normal practice to express the result as mg/l CaCO₃ (calcium carbonate). This is merely a convention to allow the comparison of different results and does not necessarily indicate that the alkalinity is present in the water in this form. The different chemical forms of alkalinity have been referred to in the test instructions.
