Application Report
pH Value in Raw Water / Treated Water

All life on earth is strongly influenced by the pH value. Everyone has already encountered this term in various forms. The term pH originates from Latin and is the abbreviation of „potentia hydrogenii“ = effectiveness of the hydrogen.

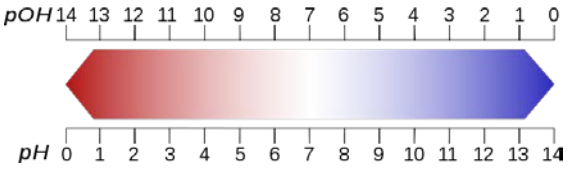
Aqueous solutions always comprise ion pairs, namely hydrogen H^+ and hydroxide OH^-:

$$H_2O \; <----> \; H^+ \; + \; OH^-$$

The activities (a) of these ions are closely related with the ionic product (I) of the water.
The following applies:

$I_{25°C} = (a_{H^+}) * (a_{OH^-}) = 10^{-14}$

The number of a_{H^+}+ is measured in mol/litre and can amount to between 1 and 10^{-14}.
To put it simple, the pH value is a measure for the amount of H^+ ions in water. Since the number can be very small, this is represented logarithmically. The negative logarithm (log10) is called pH value; it is a dimensionless figure and lies between 0 and 14. If a liquid has a pH value of 7.0, it is termed “neutral”. Lower values are called “acidic”, higher values are called “alkaline”.



Picture 1: pH scale

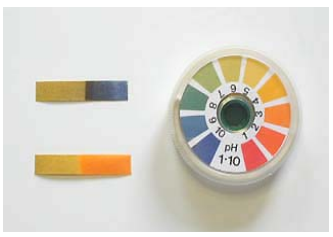
In water treatment, the pH value is measured at various places. If needed, the value is adjusted by the addition of chemicals. In the European Union, the threshold values of drinking water have been specified to be in the range of pH 6.5 and 9.5. Water typically has a pH value of 6.8 – 8.2.

How to measure the pH value

There are two typical kinds of measurement:

- With pH paper
- With a glass electrode

Depending on which kind is used, the pH paper supplies only an evaluation of the pH value, which may sometimes be good enough (litmus test) depending what is needed.

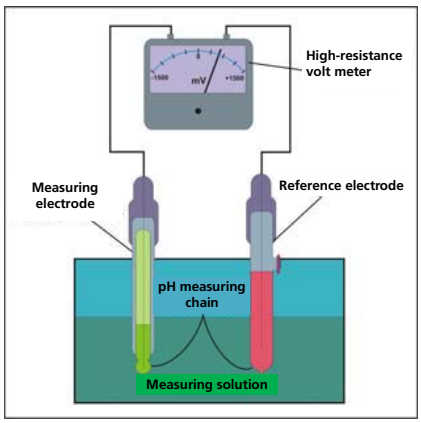

Picture 2: pH papers

Glass electrodes provide exact values and are used in laboratories and increasingly in processes.


Picture 3: Various pH glass sensors

Function of a glass electrode

Two electrodes are immersed in the liquid to be measured (in our case water), a reference and a measuring electrode.



Picture 4: pH measuring principle

The reference electrode is electrically connected with the water via a diaphragm. The measuring electrode is “electrically” connected with the water via a pH sensitive glass membrane. Depending on the pH value of said water, a difference in potential is created between the two electrodes, which is directly converted into the pH value. This conversion applies: 59.16 mV = 1 pH at 25 °C.
Under working conditions, it is impractical to handle two electrodes. Thus, sensors have been developed in which the two electrodes are combined.

When measuring the pH value, various factors of disturbance can occur. They are:

- Change of temperature of the water
- Change of the chemical substances contained in the water
- Ageing / damage of the glass electrode

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The pH value is highly temperature sensitive. It is therefore important that there is always equilibrium between the temperature of the water and the temperature of the sensor itself. The same applies to the calibration of the sensors. Intelligent sensors, as the Hamilton ones, recognize these situations and a calibration is only possible when temperature equilibrium is achieved.

Benefits of the pH measurement

In water, the pH value is measured and possibly adjusted in order to fulfil legal requirements and to protect the infrastructure from damaging influences.
A pH value that is too low can cause corrosion at metallic and cement-bonded materials.
A pH value that is too high can reduce the effectiveness of disinfection.

The sensor POLILYTE Plus ARC 120

The sensor used in the AquaMaster is part of Hamilton's ARC programme. In the upper portion of the sensor, the data is digitalized. All necessary operating activities can be carried out via the AquaScat.

Picture 5: Hamilton POLILYTE Plus ARC 120

The sensor provides the pH value and the temperature.
It is necessary to exercise the utmost caution as soon as the sensor is taken from the measurement holder. The glass tip is the most sensitive part and should only be rinsed with water and never cleaned with a rag.

Product

SIGRIST product and configuration:
- Hamilton POLILYTE Plus ARC 120

Parameter settings
- The sensor is calibrated and ready to use upon delivery

Advantages of the Hamilton sensor
» Customer benefits
- The ARC concept allows permanent quality monitoring of the sensor
  - » A warning is given if the sensor needs to be replaced
  - » Hamilton calibration standards are recognized automatically
- The sensor has only little drift
  - » Measurement is permanently precise
- The sensors are preconfigured
  - » Replacement is very simple
  - » Retrofitting is very simple
- Various, very precise calibration standards are offered
  - » The customer can choose between pH 4, 7 and 10
  - » The calibration solutions rate as industrial standards as regards their exactness and shelf life