The importance of pH value and conductivity as relevant values for offset printing

3.10.12

What is "pH" ?

The term pH value is daily used:

- pH value of skin

- pH neutral

- pH value of water in aquarium, etc.

Deriving the term pH from different interpretations, for example in Latin: Potentia hydrogenii or pondus hydrogeni. All have in common reference to hydrogen (ions).

The exact scientific definition - negative decade logarithm of the hydrogen ion concentration (activity) is very abstract.

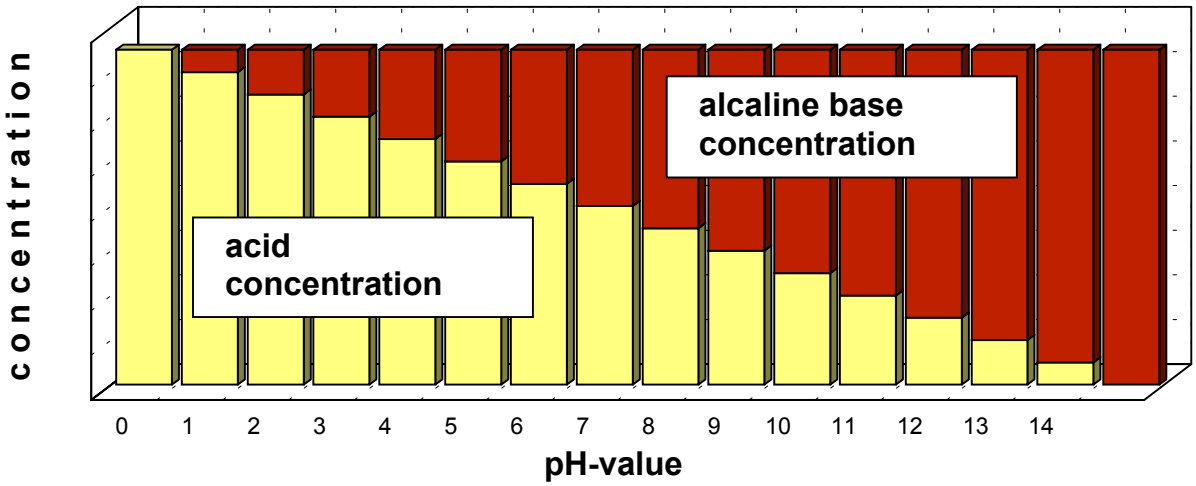


Illustration 1 tries to explain relations

pH value is a unit of measurement for acid concentration, the pH value of pure water amounts to 7.0, here acid and alkaline base are being balanced; pH values smaller than 7.0 acid concentration is increasing (and base concentration is decreasing), pH values higher than 7.0 indicate higher base concentration (lower acid concentration):

Because of the definition decade logarithm one has to take into consideration that changing the pH value by one value, for example from pH = 5 to pH = 4, means decupling of the acid concentration, Small changes of the pH value can have a great influence. Table 1 shows some typical pH values.

Table 1: Typical pH values of solutions

Solution	pH value	Solution	pH value
gastric juice	0.9 -2.3	water (pure)	7.0
lemon juice	2.2. - 2.3	blood	7.38
vinegar	3.0 - 3.1	sea water	7.8 - 8.2
damping solution	4.8 - 5.3	soap	8.2 - 8.7
milk	6.4 - 6.7	lime water	12.3

Importance of pH value for offset printing

Acid concentration (pH value) in damping solutions influences a number of characteristics in printing procedure (compare also illustration 2):

- Clean non image area of printing plate
- Water absorption/emulsification of printing ink
- Oxidative drying of printing ink
- Durability of press material (corrosion)
- Reaction of damping solution with paper coating.

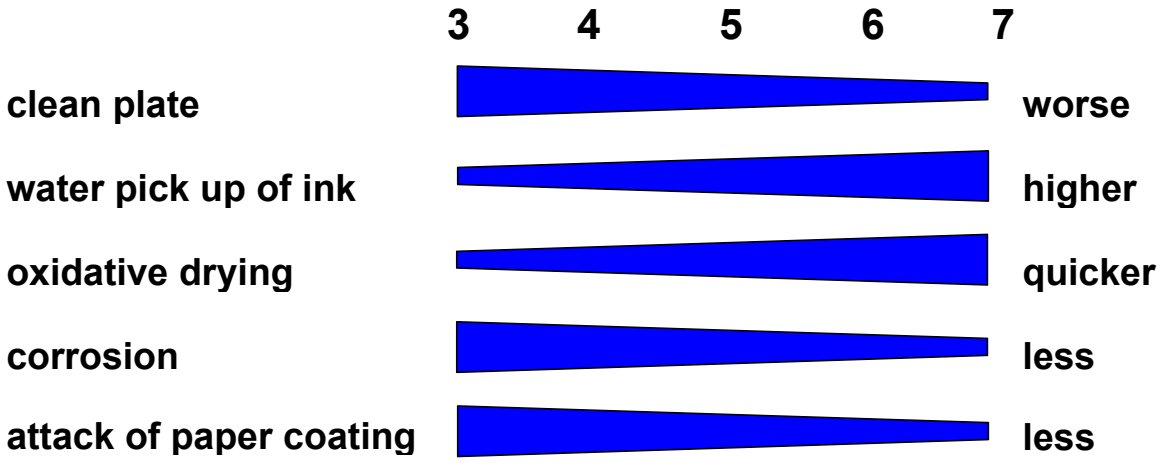


Illustration 2: Influence of pH value to print characteristics.

Taking into consideration all influence values in offset printing in Europe pH range from 4.8 to 5.3 has established. Ink, damping solutions and plate are adapted to this area; a fundamental change of the pH area needs a new adaptation of all participating. Experiences in other countries, for example US, show that adaptations in other pH areas are possible. But each pH area can only be a compromise between all parameters.

Stabilisation of the pH value

The preceding explanations show the importance of a correct and stable pH value in the damping solution. Damping additives contain buffer systems for adapting and stabilising of the pH value. Buffer systems are mixtures of acids and bases. They change their pH value in case of the addition of small quantities of acid or basic pollution only insignificantly and guarantee a constant pH value within a stable range also in case of external influence like paper and ink components in water.

Quality of a buffer system is characterised by the so called buffer capacity (compare illustration 3). Buffer capacity indicates how many external substances, for example calcium carbonate of paper coating, can be added without changing the pH value significantly.

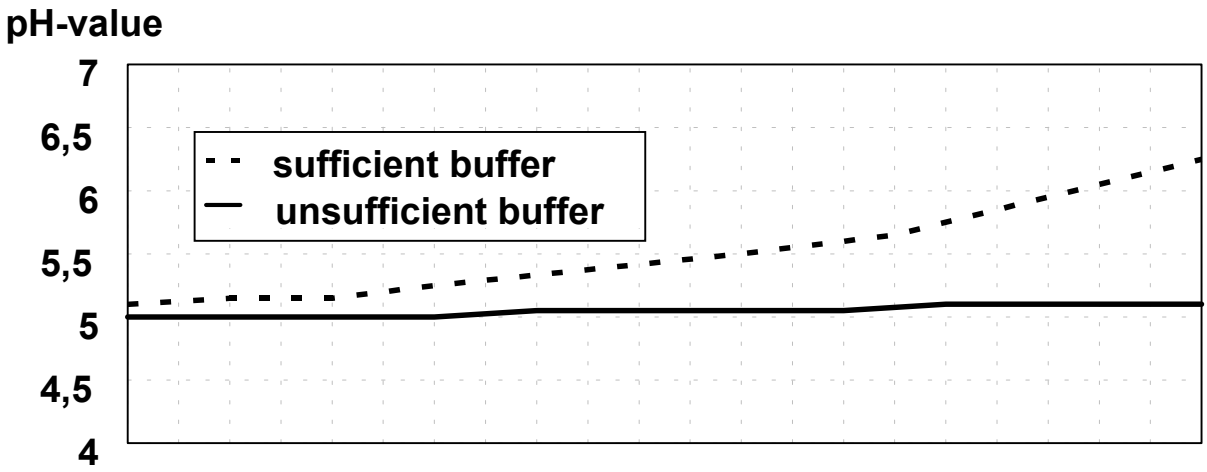


Illustration 3: Stabilisation of pH value by good buffer capacity.

Buffer systems show a special behaviour (compare illustration 4). Concentration of buffer (damping additive) and pH value are not in a direct (linear) connection.

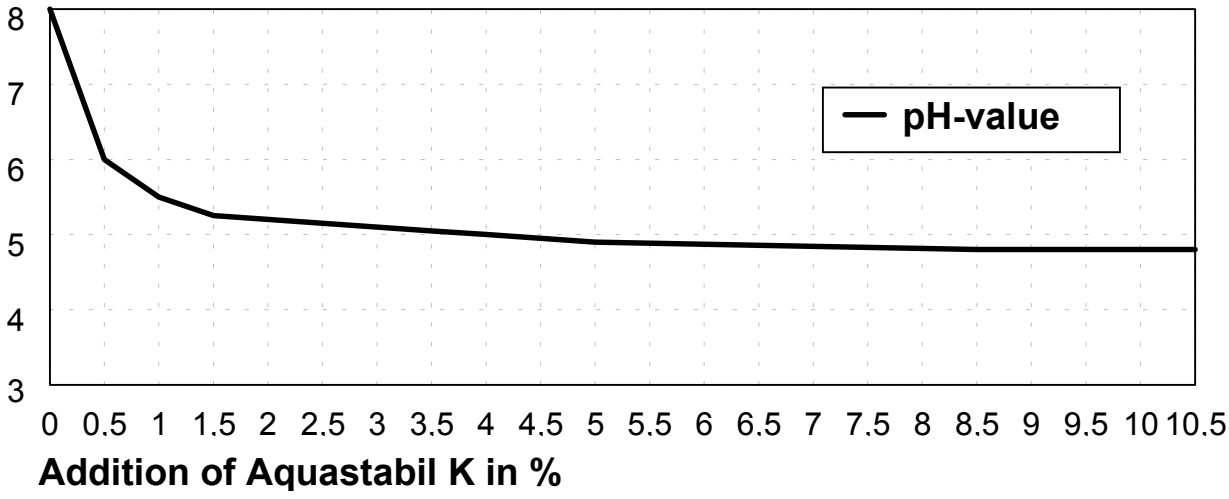


Illustration 4 shows pH value dependent on additive quantities.

That means pH value cannot be used for checking the additional quantity of damping additives !!

Checking of the additional quantity can only (keeping different conditions) be done by measuring the conductivity.

Measuring of pH value

pH value can be measured by

- electronically measuring device or

- test stripes.

The usual test stripes show an accuracy of about ± 0.5 pH values, that means a measuring value of 4.8 can also be achieved by a damping solution with pH value of 4.3. Because of this inaccuracy electronically measuring device is preferable. This devices show, dependent on their prime costs, an accuracy of ± 0.1 to ± 0.01 pH values.

The device used should show a possibility for "calibration".

What is conductivity ?

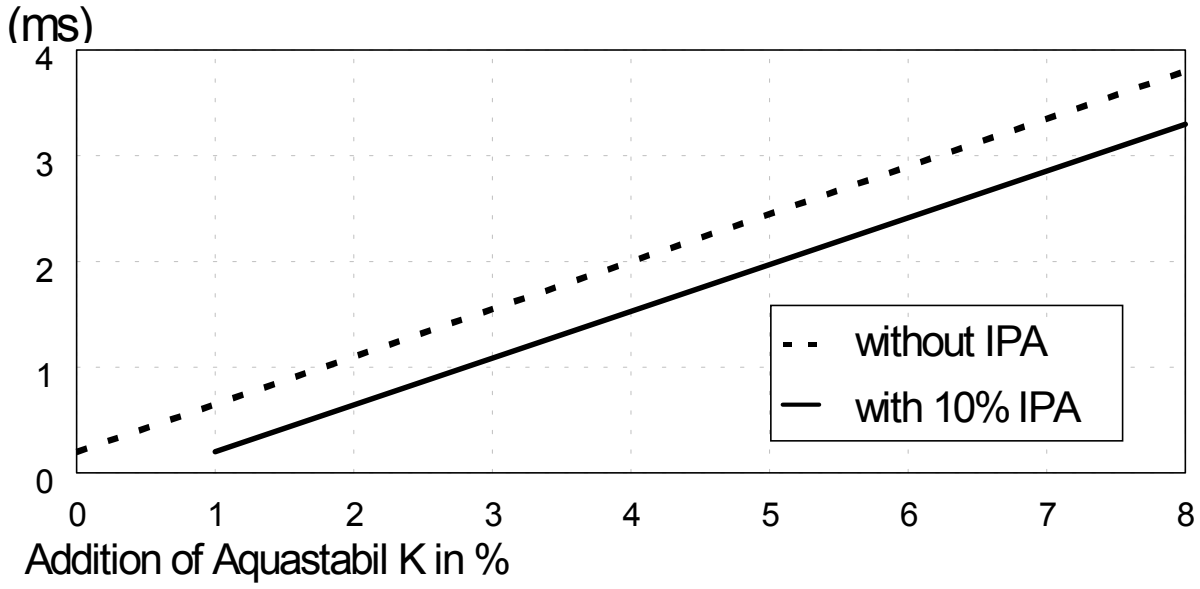
Conductivity is a method to measure the ability to conduct (electric) current. It is caused in solutions by splitting-up of salt into electrically charged parts, the so called ions. The higher salt concentration the higher conductivity. Conductivity is determined by water quality and damping additives.

Conductivity is no printing relevant value, that means (in contrary to the pH value) there is no printing technically favourable section above or below of which printing technically problems occur.

In spite of this fact we recommend for damping solutions especially used in newspaper printing not to exceed 1,500 µS. This recommendation is based on the connection between conductivity and salt concentration; higher conductivity means higher salt concentration and can cause corrosion on printing presses.

Conductivity and damping additives

Conductivity is a direct (and linear) measure of the concentration of damping additives and can be used under restrictions for fixing the exact dosage (compare illustration 5). Hereto it has to take into consideration that already tap water shows conductivity which influences the measuring results. Only completely desalinated water has (nearly) no conductivity.



Picture 5: Conductivity dependent on the additives

Conductivity is strongly influenced by alcohol concentration (compare illustration 5) as well as by contamination with ink and paper components. Determination of concentration is only possible with freshly mixed damping solutions and in case of constant alcohol concentration.

On the other hand regularly measurements of conductivity can inform about the degree of contamination of the damping solution, conductivity increases in case of rising contamination.

Detailed measures of the conductivity and the pH value as well as the drawing up of comparison curves corresponding to illustration 4 and 5 will be done within the Hartmann damping solution service.