pH of aqueous coatings

Philip Green, Paint Technology Consultant, comments on the definition and practical usage of physical attributes that are commonly used for the characterisation of coatings.

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According to most physical chemistry text books the pH of an aqueous solution is mathematically represented as:

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pH = -\log_{10}[H^+]\]

where \([H^+]\) is the hydrogen ion concentration. Thus, when the hydrogen ion concentration is high the pH is low (acidic) and when the hydrogen ion concentration is low the pH is high (alkaline).

Pure or distilled, de-ionised water at approximately room temperature has an equal number of hydroxide (OH\(^{-}\)) and hydrogen (H\(^{+}\)) ions and a pH of 7, this is therefore taken as being neutral.

Practical Usage

There are coatings and coatings raw materials manufactured today at many different pH levels but in general they all fall roughly into one of the following 5 categories:

a) Ultra high (pH 10-14):

Examples are sodium and calcium hydroxide, and ammonia, as well as substrates such as fresh damp lime and cement containing plasters. Although materials with such high pHs are used to adjust pH in a upward direction, normally such high pH materials are considered detrimental to coatings and their performance.

b) Medium-high (pH 8-10):

This is the pH range at which most decorative, some and some industrial water borne finishes are made - details vary from market to market and product to product, but for most markets decorative products are most likely in the range of 8-9. This is the "norm" as most of the dispersing, biocide and thickening systems used in decorative products work best within this pH range and may give problems outside this range.

c) Neutral-slightly acidic (pH 5-7):

Some vinyl acetate acrylic polymers and pigments are within this pH range, but they can be used in slightly higher pH systems (8-9) without problems. However, exposure at higher pH (10+) can give colour changes and saponification.

d) Distinctly acidic (pH 2-3)

A lot of alkali swellable ASE/HASE/HEURASE thickeners are manufactured and supplied at this type of pH, but when they are actually used their pH is adjusted to 8-9, which solubilises/activates them. For some of these thickeners, long term exposure in systems at pH above 9 or below 7.5 can lead to destabilisation and massive increases in viscosity, which are not reversible.

e) Ultra low (pH 1-2):

Coatings raw materials do exist in this range, but are not widely used in decorative paints. Some industrial/heavy duty water borne primers (on Poly- vinylene chloride latices) are made and used at this sort of pH. In fact, exposure of most common decorative paints at this type of pH can lead to coating breakdown.

Measurement

pHs are normally measured using a pH meter, which consists of a glass probe, containing the hydrogen ion conductivity cell and the read out unit. These instruments vary in sophistication and robustness and can vary in price from EUR150 to 5000. They are all calibrated using solutions of known pH.