

Recommended pH Action Level

A pH value of 11 is recommended as an upper do not use/do not drink value. Solutions with pH values at or above this value, lacking other information on the factors noted below, should be considered to present a significant risk of skin and eye irritation and possible exacerbation of skin disorders. In order to avoid potential ocular irritant effects and reversible damage, water with a pH of below 4.5 should not be used.

pH is a measure of the effective concentration of hydrogen ions and is expressed on a scale that ranges from 0-14 units. Because it uses a log scale, a change of one pH unit corresponds to a change in the hydrogen ion concentration of a factor of 10. USEPA recommends that drinking waters be maintained at pH values between 6.5 and 8.5 to avoid adverse aesthetic impacts. Adjustments to somewhat higher pH's (e.g. up to 9) are sometimes used to minimize leaching of metals, in particular lead, into drinking water from pipes within the distribution system.

Strong acids typically cause tissue damage by denaturing proteins. Strong bases can both denature proteins and saponify fats, which facilitates tissue penetration and damage. Effects may range from mild irritation to severe burns. The likelihood and severity of effect depends on the pH; the buffering capacity of the water; the amount or volume of exposure; the duration and frequency of exposure; and individual sensitivity.

High pH

Water with significantly elevated pH values can irritate, and at high enough values, severely damage mucus membranes, the eye, throat and skin if consumed or used for washing. Elevated pH can also cause the water to feel slippery and taste alkali (bitter), make it difficult to get soaps and detergents to lather, and lead to the formation of precipitate deposits in pipes and on clothing and dishes. Elevated pH water could also impact the effectiveness of certain medicines.

According to the World Health Organization eye irritation and exacerbation of skin disorders have been associated with exposures to water with pH values greater than 11 (WHO, 1996). Solutions with pH values of 12.5 or greater have been reported to cause significant tissue damage including esophageal ulceration when consumed. Such effects can be serious and of longer duration and would warrant immediate medical evaluation.

Low pH

Under the Safe Drinking Water Act the lower limit secondary maximum contaminant level for pH was established at 6.5. This value was selected to minimize the corrosivity of drinking water in the distribution system and thus minimize leaching of lead, cadmium, copper, iron, and zinc from metal pipes and the mobilization of asbestos from corrosion of cement asbestos pipes.

Although many foods, including lemon juice and carbonated beverages may have pH values as low as 2.5, Potts (1991) reports that "as the pH of buffered solutions applied to the human eye is decreased from 7.4, the onset of discomfort begins at about pH 4.5. Between pH 4.5 and 3.5, one creates punctate breaks in the corneal epithelium that are stainable with fluorescein but heal in a few hours' time."

Thus, to avoid the potential for ocular irritant effects and reversible damage it is recommended that water with a pH below 4.5 not be used.

REFERENCES

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Potts, A.M. (1991). *Toxic Responses of the Eye*, In, Amdur MO, Doull J, Klaassen CD. (eds.) 1991. Casarett and Doull's Toxicology. The Basic Science of Poisons Volume. 4th. New York: Pergamon Press.

World Health Organization (WHO), Background Document for Development of WHO Guidelines for Drinking-water Quality (1996)

http://www.who.int/water_sanitation_health/dwq/chemicals/en/ph.pdf