pH: Is it an appropriate indicator of product safety?

ABSTRACT

There is much confusion among cleaning and disinfectant users regarding pH and what it means with respect to a product's cleaning or killing properties, its materials compatibility as well as its rating with regards to its toxicity / hazard profile. The intent is to dispel these misunderstandings and provide the facts to help increase your confidence in your choice of cleaning or disinfectant chemistry.

BACKGROUND

pH (or the power of hydrogen) is the unit of measure used to express the degree of acidity or alkalinity of a water-based substance. It is expressed as a number ranging from 0 to 14 (0 pH and 14 pH would be the highest acidic and alkaline media respectively and pH of 6-8 is considered to be neutral).

The pH is relevant, because it shows us if the solution is acidic, neutral or alkaline but a pH value alone is not the sole indicator in determining the strength of different types of acids. The following table provides a listing of various substances and their associated pH value:

Substance	pH Value
Stomach acid	1.0
Vinegar	2.0
Lemon Juice	2.4
Cola	2.4
Orange Juice	3.0
Tomato Juice	4.0
Black Coffee	5.0
Detergents	3-10
Milk	6.8
Blood	7.4
Seawater	8.0
Milk of Magnesia	10.7
Domestic Bleach	8.0-11.0
Quaternary Ammonia Compounds	8-11.0
Caustic Soda	14.0

ACIDS AND TOXICITY

Vitamin C, or ascorbic acid, is found in many fruits and vegetables we commonly eat. Vinegar, or acetic acid, is a common acid that can be used as a condiment, a pickling solution or a cleaning solution. Citric acid is present in citrus fruits such as lemons, limes, oranges, and grapefruit as well as pineapple. Many foods use citric acid as preservative to control the acidity. Phosphoric acid is used widely in cola as a flavouring agent to give a product its tartness. Sorbic acid is a preservative that is also widely used found in food production. The usage of these acids in food either naturally or as additives illustrates that such acids are not toxic and at the appropriate concentrations they do not pose an occupations health safety concern.

FOOD ACIDS VERSUS NON-FOOD ACIDS

Acids can further be divided into different categories; food acids and non-food acids. For the purpose of this discussion we will focus on food acids.

Food acids are those that are not toxic and are found naturally in food including acetic acid, phosphoric acid, citric acid, ascorbic acid, carbonic acid, sorbic acid, etc. These acids are also referred to as weak acids. This means unlike strong acids, they are not completely ionized in the solution. If these weak acids are carefully formulated in products such as cleaning or disinfecting formulations, they do not cause any irritation. Moreover, due to their non-toxic nature, they will not attribute to any concerns with respect to the product's toxicity. In summary, acids in concentrate (undiluted) form can be toxic, however, many acids are used in food products at low levels just as they are in AHP, so to say "acids are bad or toxic" is an inaccurate and/or unqualified statement.

IS A LOW PH PRODUCT TOXIC OR IRRITATING

You might be surprised to hear that the vinegar (5% acetic acid solution) we commonly use has pH of about 2, and the cola we drink has pH of 2.4. Furthermore, the pH of a stomach might go as low as 1.0. So how is it that we can drink cola, or eat vinegar and have a highly acidic environment in our stomachs and still survive?

Technical Bulletin

Consider cola, one of the world's most enjoyed beverages, although it contains phosphoric acid and has a pH of 2.4 we do not worry about any harmful side effects from consuming and certainly do not panic if we spill it on our skin or clothes. Why is this? We know that coke is not toxic, and the amount of phosphoric acid used in it is low. If on the other hand, you came in contact with the concentrated acid used in cola before it was diluted into the recipe you might injure yourself or experience chemical burns.

When it comes to cleaning and disinfectant products, some people may be sensitive to some products or ingredients used in the formulations. This does not mean that the product is considered a skin irritant. It simply implies that like food allergies or food intolerances, people will exhibit differing levels of reactions depending on their sensitivities. To further illustrate consider those who cannot tolerate milk or other dairy products due to allergic reactions or digestive intolerances. We do not conclude that milk itself is bad as most of us can eat dairy products without having any problems. In summary, pH alone is not a good measure of irritancy; several other factors must be considered. There are standard tests to measure skin and eye irritancy; these tests results are the true measure

ARE ALL NEUTRAL PH CHEMICALS NON-TOXIC AND NON-IRRITATING

Not necessarily. Toxicity and irritancy depends on the nature of a chemical and not only the pH. Here are some examples:

- Chlorine is an irritant. If you neutralize the chlorine solution, you might reduce the irritancy a little, but you cannot make it non-irritating. This irritancy is due to the reaction that each chemical has by its nature, and since chlorine is a very reactive chemical, even in neutral pH, it will be a skin and eye irritant.
- Aldehydes, such as formaldehyde or glutaraldehyde, are toxic and are considered to be irritants. It doesn't matter that the pH of the formaldehyde or glutaraldehyde solution that you are using is acidic, neutral or alkaline. In all cases, it is still toxic and an irritant.
- Phenols are toxic and are irritants. Again, in all pH ranges (acidic, neutral, and alkaline) they will be toxic and considered an irritant and the irritation/toxicity will vary with the concentration of the phenol.
- Enzymatic-based cleaners. Although such solutions typically have neutral pH, most enzymes, by their nature react with skin and can cause allergic reactions. Therefore, if the product contains an effective amount of enzymes in order to have good cleaning efficacy, this product will most likely be a skin irritant. However, the formulators sometimes use very low levels of enzymes in their product to make their product mild to skin, in case of contact, but this leads to poor cleaning performance.
- Alcohol as the main ingredient in a product can dry the skin, and might be an irritant. It again doesn't matter if the solution is acidic, neutral or alkaline. Alcohol will still dry the skin in all cases and can still be irritating.

IMPLICATIONS FOR AHP®

AHP® Disinfectants provide the perfect balance between safety and efficacy

- AHP® has low levels of Hydrogen Peroxide at the in use dilution, lower even than some products used every day by consumers to whiten teeth, clean contact lenses or even disinfect a wound, and therefore is designed to be easier on employees and occupants resulting in protocol compliance
- AHP® provides a HMIS rating of "0", meaning it has been proven to be non-toxic, non-irritating to eyes and skin and non-skin sensitizing and does not require the use of personal protective equipment to handle
- The lower pH for AHP® (1.8-3.0) is due to the usage of these food acids in its formula. Hydrogen peroxide is also a food additive and is found in many foods as a preservative such as milk or honey

AHP® Disinfectants are One-Step Disinfectant-Cleaners

- AHP® has powerful surfactants, which means it cleans while it disinfects surfaces and equipment, resulting in lower cost and faster results

AHP® Disinfectants have realistic contact times

- Short contact times ensure surfaces remain wet for the required contact time, providing comfort and confidence that disinfection has occurred

AHP® Disinfectants are compatible

- AHP® formulations are tested to ensure compatibility that preserve your investments in equipment, furniture, and building surfaces

AHP® Disinfectants are environmentally sustainable

- AHP's® active ingredient, hydrogen peroxide, breaks down into water and oxygen leaving no active residues
- AHP® is formulated to ensure that it will not negatively impact indoor air quality

REFERENCE

Schneider, P., Holtkamp, D., Ramirez, A., & Zhang, J., (2013). An evaluation of the effectiveness of sanitation procedures using an accelerated hydrogen peroxide (Accel) disinfectant to reduce virus transmission via livestock transport vehicles. Twenty-first Annual Swine Disease Conference for Swine Practitioners, November 14-15, 2013.