IONIZED OR ELECTROLYZED WATER

Water has always been the cleaning agent par excellence as it is safe for human beings and the environment. However, it does not have the necessary properties to properly clean and degrease surfaces. Indeed, its high surface tension and its inability to dissolve fatty substances make it difficult to obtain an effective washing performance. This is the reason why it is often necessary to add chemical compounds called surfactants. They are used to increase the washing power of water by reducing its surface tension (Figures 1 and 2) and allowing the solubility of oils and fats (Figure 3).

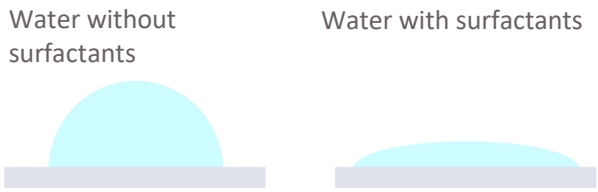

Figure 1 : Effect of surfactants on water wetting

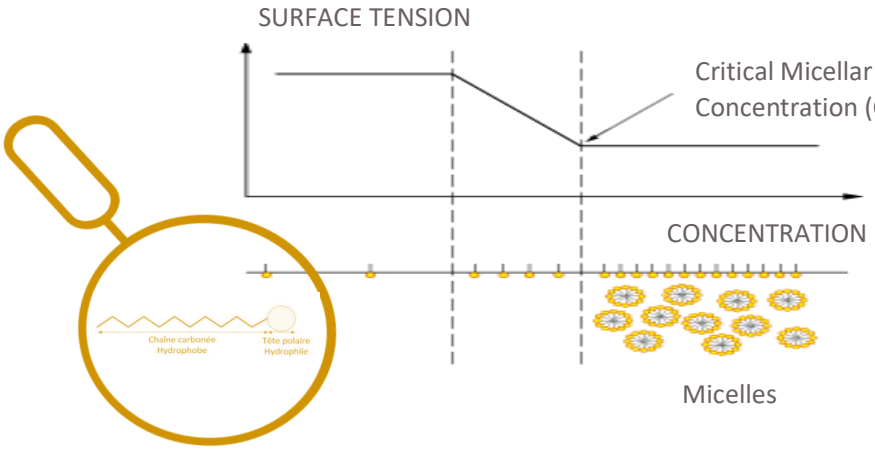

Figure 2: Decrease in surface tension of water as a function of surfactant concentration

Figure 3: Soil detachment and suspension by the micelles

What interest for electrolyzed water ?

The addition of surfactants can have harmful effects on the environment even though surfactants provide a number of important properties in water.

With the technique of water electrolysis, it is possible to create a powerful cleaning and disinfecting agent without the addition of surfactants.

The process by which the electro-activation of water is triggered has been known since the beginning of the 19th century. Specifically, scientist Michael Faraday first discovered it in 1859. However, it wasn't until the 1950s that the very first machine to electrolyze water was made. This makes it possible to chemically decompose certain compound bodies by the passage of electric current. Initially, it was designed for agriculture with the aim of curbing the use of fungicides. But over the decades, the use of this technology has been extended to other fields such as medicine.

Principle of operation

The role of the electrolytic process is to ionize, under the effect of an electric charge, the water in the network to which a minimal quantity of salt is added.

This generates two types of water: alkaline and acidic. They should be kept apart so that they cannot combine again in ordinary mains water.

Alkaline water will have cleansing properties while acidic water will have disinfectant properties .

The electrolysis process requires mains water in which a minute amount of sodium chloride (NaCl) or hydrochloric acid (HCl) is dissolved.
The electrolysis unit is made up of a generator able to release a direct current to the electrodes. In this compartment, there are the anode (+) and cathode (-) electrodes which come into direct contact with the saline solution. The anodic and cathodic chambers are separated by a semi-permeable microporous membrane or diaphragm wall. Thanks to this wall which makes it possible to divide the two electrodes, two different but complementary waters can be obtained: an oxidizing acid electrolyzed water and a reducing alkaline electrolyzed water.

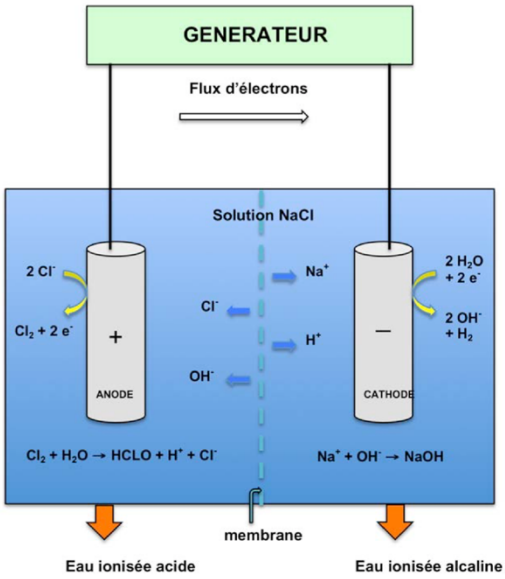

Figure 4: Diagram of an electrolyser with diaphragm

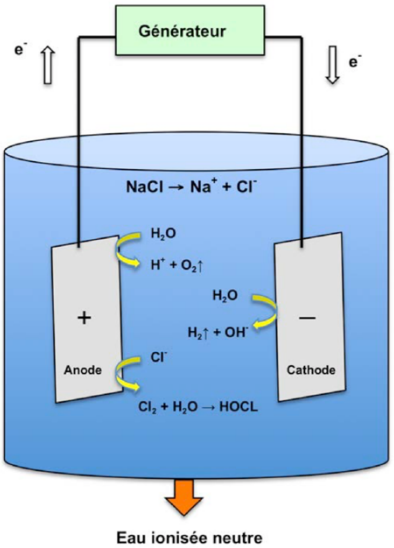

Figure 5: Diagram of an electrolyser without a diaphragm

There is also an innovative technique that optimizes the water electrolysis process while allowing the two types of water to mix to become a neutral disinfection agent.

The existing machines are not all identical, the setting of these can vary and the concentration of sodium chloride (NaCl) of the substrate also. It is therefore possible to produce many ionized waters with different characteristics and properties.

The different ionized waters

- Alkaline Water

Alkaline water is reducing with a pH between 7 and 12. It has a Redox Potential of -80 to -900 mV. It is a water rich in hydrogen, which gives it antioxidant properties.
It behaves largely as a surfactant. That's according to reproducible testing by Aspen Research Corporation (an independent contract research and development company based in St. Paul, Minnesota). In fact, alkaline water has the power to hydrate the soil faster, disperse dirt and remove stains more effectively than ordinary tap water.

- Acid Water

Acid ionized water is oxidized water, its pH is between 2 and 9, so it can have a neutral or even basic pH, but it is usually very acidic. Its Redox Potential is between +400 and +1200 mV. This water is used as a disinfectant because of its broad antibacterial spectrum.

- neutral water

Later appeared, ionized water called weakly acidic or neutral. It has a pH between 5 and 7, and a Redox Potential around +800 mV. This water mainly has advantages in terms of conservation and effectiveness against microorganisms.

Place of acid and neutral ionized water in the range of disinfectant products

The main disinfectant products are listed in different classes (see table 1):

- The category of oxidants which includes:
  - Peracetic acid, which is made up of hydrogen peroxide and acetic acid. It is currently the solution of choice for cold disinfection. Handling this product requires protective equipment and an adequate ventilation system.
  - Chlorine dioxide which has the same properties as peracetic acid, but it is a very irritating product.

- The category of aldehydes with:
  - Glutaraldehyde _
  - Orthophthalaldehyde (OPA) 0.55% has excellent antibacterial activity and requires less time than glutaraldehyde to eliminate microorganisms. This solution stains proteins gray, including the skin, so its handling is done with care.

- Alcohols which are flammable, and therefore cannot be used in large quantities. Additionally, they are not effective on spores.

- Phenols, particularly irritating to the skin.

- Quaternary ammoniums which are surfactants with detergent and antibacterial properties, whose spectrum of activity is less important than glutaraldehyde. They are also molecules that irritate the skin and mucous membranes at a concentration greater than 0.1 % and they can cause damage to the treated material.

Class	Example	Toxicity
Alcohols	70% ethyl alcohol	Any
Aldehydes	Glutaraldehyde	Very irritating, allergenic
Biguanides	Chlorhexidine	Slightly irritating
Chlorine Compounds	Sodium hypochlorite	Irritant, Corrosive
Iodophors	Povidone iodine	Hypersensitivity reaction
Phenolic derivatives	Phenic Acid	Very irritating
Quaternary ammoniums	Benzalkonium chloride	Hypersensitivity reaction
Oxidizing agents	Peracetic acid	Corrosive, explosive
Amines	Alkylamine	Any

Table 1: The different classes of disinfectants and their main disadvantages

In this range of disinfectant products, acid and neutral electrolyzed waters are solutions with a broad spectrum of activity and have the main advantages of being non-irritating, non-toxic and requiring no special equipment. Table 2 illustrates these conclusions well with a study conducted on endoscopes (Babb and Bradley, 2001).

	Disinfectant Action					
	Spores	Mycobacteria	bacteria	Virus	Stability	Inhibition by organic matter
Glutaraldehyde	+/-	+/-	+	+	+/-	no
Takeover bid	-	+	+	+	Yes	no
Peracetic acid	+	+	+	+	no	no
Alcohol	-	+	+	+	no	no
Quaternary ammoniums	-	≈	+/-	+/-	Yes	Yes
Phenols	0	-	+	+	+/-	Yes
Chlorine Dioxide	-	+	+	+	no	Yes
Ionized water	+	+	+	+	no	Yes

Table 2: Properties of disinfectants used for disinfection of endoscopes

+: strong action; -: weak action; +/-: moderate action; 0: no action; ≈: variable action.