

# WATER AND AIR ENRICHED WITH PURE H<sub>2</sub> GENERATED BY PEM WATER ELECTROLYSIS



Perinova Ilona, Horackova Zuzana

Lazena, Ecom s.r.o., Ceske Mezirici, Czech Republic

LAZENA

## INTRODUCTION

H<sub>2</sub> gas produced by the water electrolysis has the potential to expand medical applications, so there have been developed technologies to safely deliver pure H<sub>2</sub> to the living organism by H<sub>2</sub> inhalation or drinking hydrogen-riched water. LAZENA company promotes clean technologies that support healthy life and at the same time do not burden the environment or the human organism. Applying the latest scientific experience to concrete products used in everyday life is an effective and meaningful way to achieve this goal. Here we present LAZENA generators based on the proven proton exchange membrane (PEM) water electrolysis, which produce therapeutically effective H<sub>2</sub>.

## PEM WATER ELECTROLYSIS

Electrolysis of water is one of the most capable methods for the H<sub>2</sub> production because it uses renewable H<sub>2</sub>O and produces only pure O<sub>2</sub> as a by-product. More recently PEM water electrolysis has also been used in generators producing therapeutic H<sub>2</sub>. PEM water electrolysis (Fig. 1) powered by direct current (DC) uses membrane between electrodes (cathode and anode), which allows only water and positive ions pass through. Protons (H<sup>+</sup>) on the cathode side are reduced to H<sub>2</sub> gas.

## HYDROGEN GAS GENERATOR

H<sub>2</sub> inhalation has positive effects in respiratory and cardiovascular systems, it is effective way of providing H<sub>2</sub> systemically and can be used for treating acute and chronic conditions [2]. Inhalation of 100% H<sub>2</sub> even at low flow rates (2-4% H<sub>2</sub> mixture is below the flammability level), can increase blood H<sub>2</sub> concentrations to therapeutically effective levels [3]. LAZENA HB-H12 generator (Fig. 2) produces H<sub>2</sub> at 99.99% purity and enables inhalation at a flow rate of 300 ml/min via a nasal cannula. The generator is based on PEM water electrolysis using only purified distilled water (Fig. 1). This generator was used in a randomized, single-blind, placebo-controlled study in acute "post COVID19" patients, that confirm beneficial health effects [4].

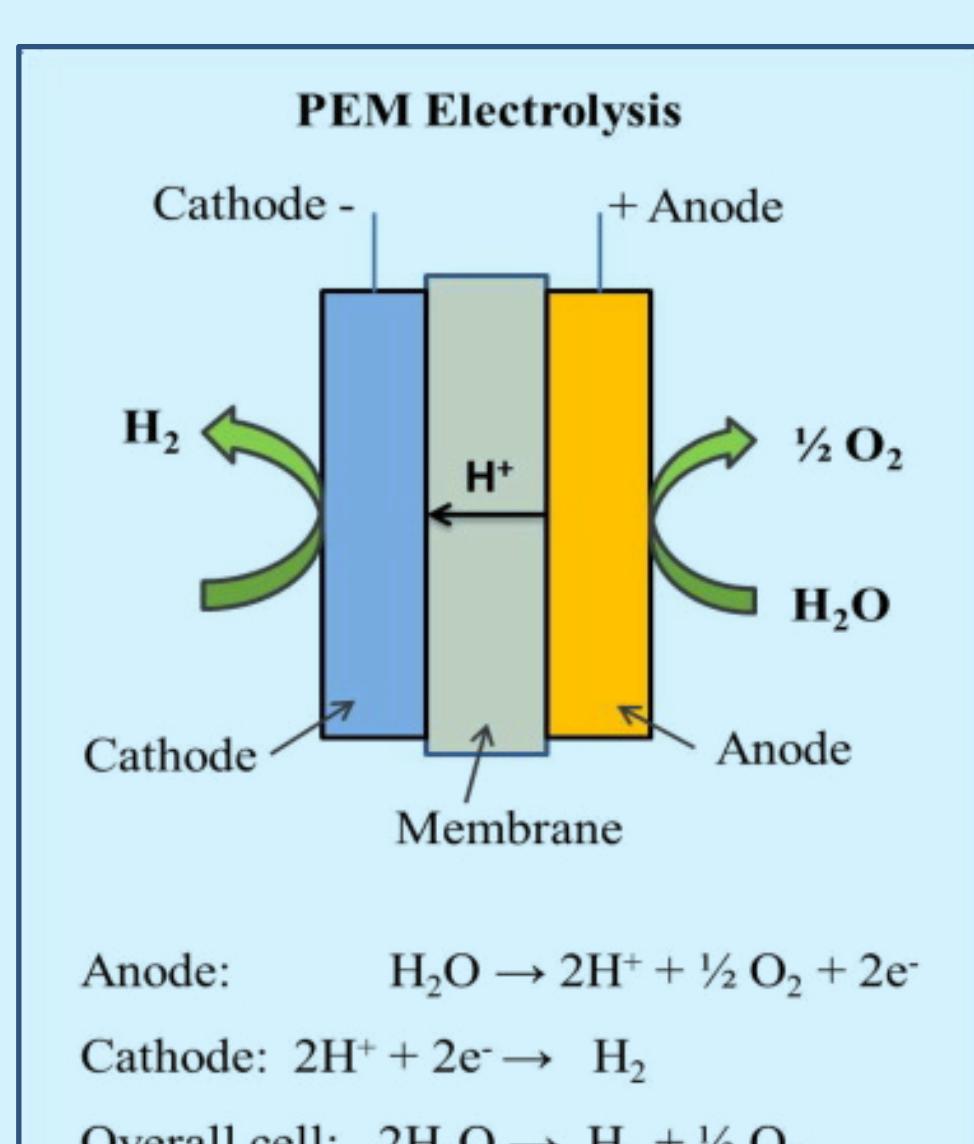


Fig. 1 PEM water electrolysis schema [1]



Fig. 2 Hydrogen gas generator LAZENA HB-H12

## PORABLE HYDROGEN WATER GENERATOR

The most pronounced effects of hydrogen-riched water (HRW) have been described in conditions that affect the gastrointestinal tract and supporting organs. Numerous studies have analyzed the post-exercise effects of drinking HRW when it is consumed before physical activity [2]. Research studies indicate that it is possible to supply H<sub>2</sub> on daily basis via HRW within safety standards under hydrogen-rich conditions [5]. The most suitable conditions for H<sub>2</sub> production were found for temperatures from 1.5°C to 30°C and water hardness of 83 mg/L. The best method to preserve H<sub>2</sub> within hydrogen-water after the production is using the aluminum or stainless steel-made container [6]. LAZENA HB-H04M portable hydrogen water generator (Fig.3) saturates drinking water with H<sub>2</sub> in concentrations from 0.6 to 1.6 ppm. Oxygen, chlorine and ozone are separated (Fig. 4) and the generator uses self-cleaning, reversing-polarity technology. It is possible to use high-quality drinking water or filtered water.



Fig. 4 LAZENA portable hydrogen generator principle schema

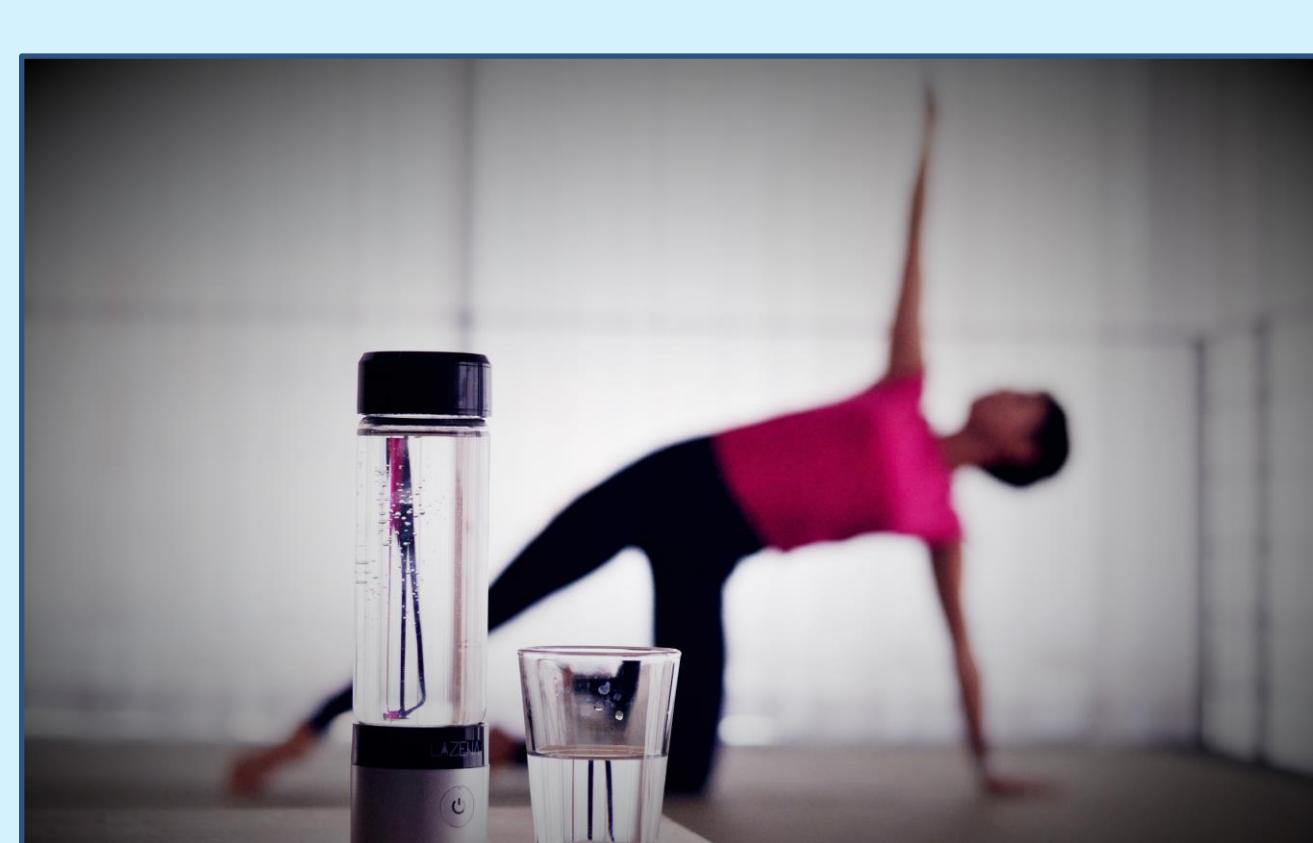


Fig. 3 Portable hydrogen water generator LAZENA HB-H04M

## IONIZATION HYDROGEN WATER GENERATOR

Ionizers generate three basic types of electrolyzed water (EW): acidic (AEW), neutral (NEW) and basic (BEW, so-called alkaline, containing dissolved H<sub>2</sub>) (Fig. 5). Mildly alkaline water (ERW, electrolyzed reduced water) with pH 8-10 and ORP -100 to -700 mV is marketed as healthy drinking water. The Japanese JMHLW and the Korean FDA approved water ionizers as a "medical substance generator", which could help with gastrointestinal symptoms [7]. Water ionizers are marketed for commercial and home use. However, the concentration of dissolved H<sub>2</sub> and the level of maintenance required can vary significantly [8]. EW is a powerful multifunctional agent with a wide range of applications in the medicine, agriculture, and food industries (Fig. 6). It is low cost and harmless to the human body and it is also friendly to the environment. LAZENA SM-S230TL water ionizer (Fig. 7) produces all levels of EW and removes unwanted substances from the tap water using two filters at the same time while leaving beneficial minerals as is. The device uses self-cleaning, reversing-polarity technology, which significantly prevents scale build up and ensures a long service life of the electrodes.

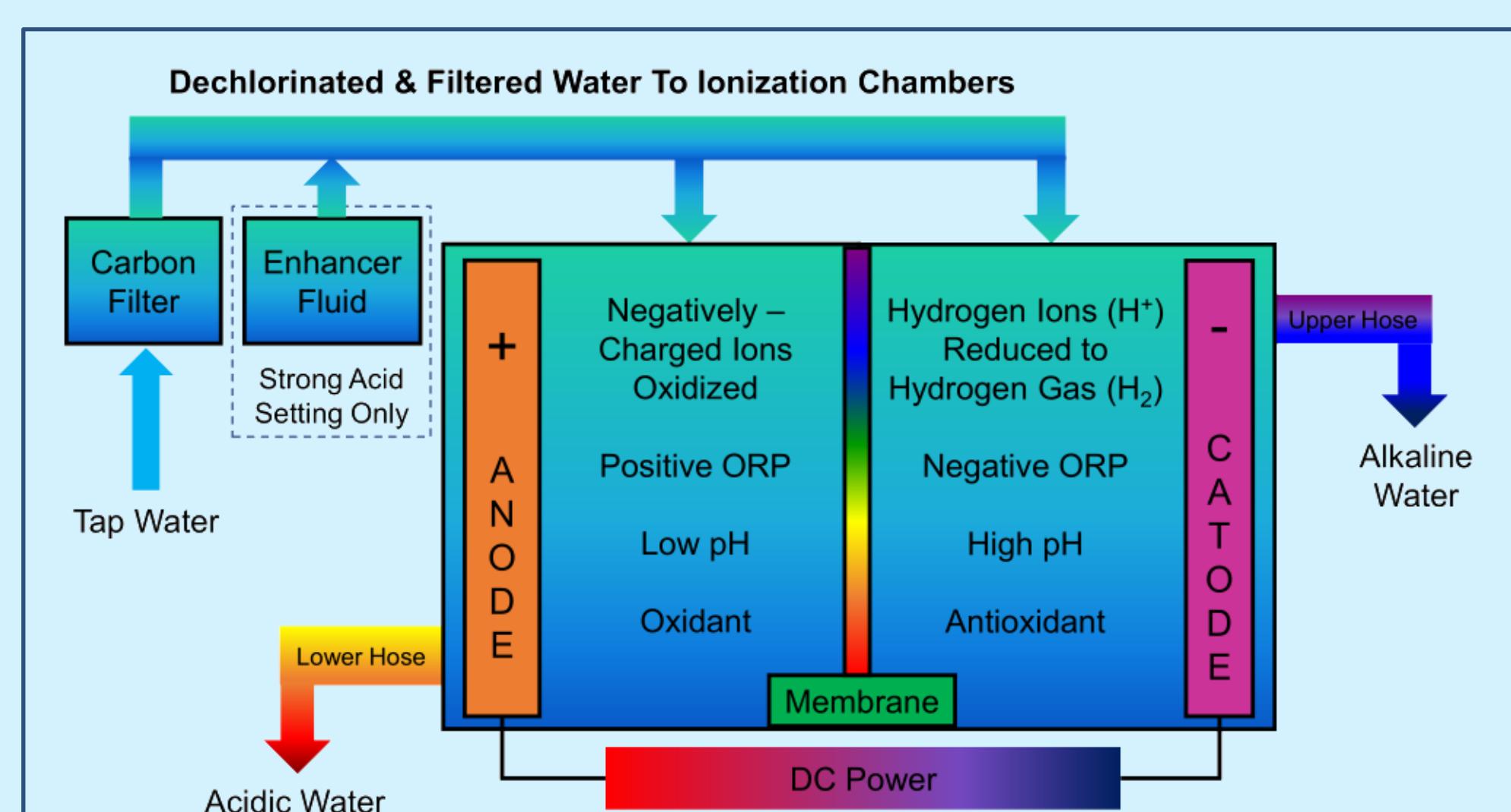


Fig. 5 Ionizer principle schema [7]

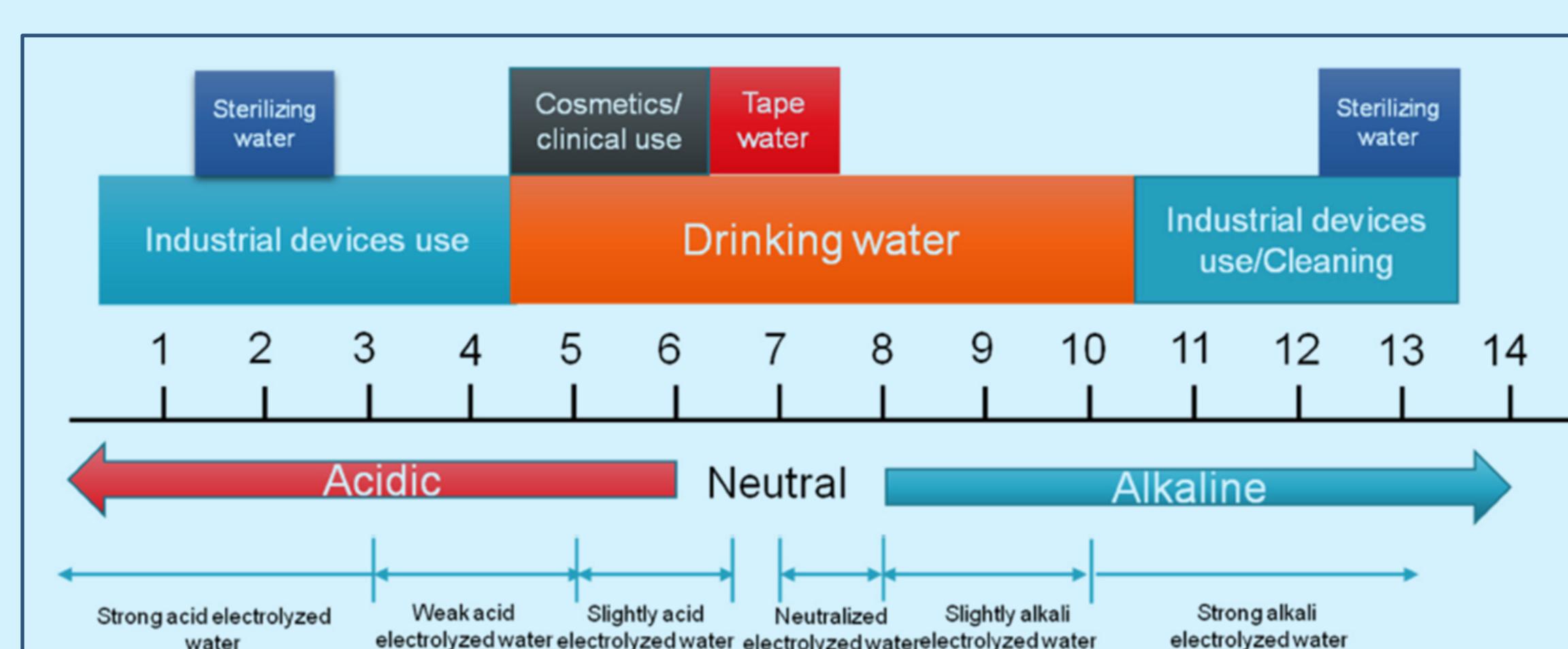


Fig. 6 EW application at different pH values in various fields [9]



Fig. 7 LAZENA water ionizer SM-S230TL

## CONCLUSION

H<sub>2</sub> has almost universal pluripotent therapeutic potential that can be explained by its pleiotropic effects on various proteins, molecules and signaling pathways [10]. In the future H<sub>2</sub> may be used to solve various problems either as a support of modern treatment or as a standalone procedure. Thanks to its enormous efficacy, no adverse effects and excellent safety profile, H<sub>2</sub> has potential to become the next generation therapy for medical applications [11]. LAZENA devices, using the most advanced technologies for the H<sub>2</sub> production, represent a very effective way of consuming pure H<sub>2</sub> and therefore health promotion for everyone in everyday life.

## References

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