On site electrochemical production of water disinfection agents by Hlorogen® electrolyzers: Design, materials and reaction products

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Clean drinkable water, globally available, is one of the major challenges of the modern society, recognized by the United Nations as one of the Sustainable Development goals [1]. Contaminated water, containing pathogenic bacteria or viruses is a constant threat to public health, as waterborne diseases can easily grow into pandemics due to the prevalence and survival of these microorganisms [2]. Water disinfection is thus a crucial step in water treatment. Although there are many water disinfection strategies using physical (UV irradiation, membrane filtration) or chemical methods (chlorination, monochloramination, chlorine-dioxide, ozonation) and other emerging technologies, chlorination is the most widely used procedure for over a century [2,3]. However, not all chlorine sources are the same, as the traditional chlorination is based on the use of gaseous chlorine or sodium-hypochlorite. Even though their addition to water will result in formation of active chlorine (mixture of HClO and ClO^-), their use is regarded unsuitable as they are toxic and corrosive, so their storage and transportation is utterly unsafe.

Another way of producing active chlorine is by electrolysis of sodium chloride solution [4]. This way, the use of hazardous chemicals is avoided, while the water disinfection is achieved by an affordable and efficient technology, producing the active chlorine in a form of a 1 % solution. Sigma doo Crvenka has developed HLOROGEN® electrolyzers for this use, and by electrolysis of 3 % NaCl, 1 % active chlorine is produced and dosed directly into the drinking water system, as this equipment is installed on-site in a water processing plant. The optimization of the process, regarding the complicated electrochemical reactions occurring at the anode, has been a major challenge over the past two decades. In this regard, different electrode materials have been investigated, as well as the electroylzer design, with adjustment of the reaction products customized according to the local water composition. Today, over 110 HLOROGEN® plants have been installed in Serbia, providing drinking water for 1.500.000 citizens, including the city of Novi Sad, also expanding to neighbouring countries. As an extension of HLOROGEN® technology, OksiHLOROGEN® devices were developed, with ClO_2 as additional disinfecting component, produced simultaneously in the electrolytic process, to address more demanding water supplies.

During the COVID-19 pandemic, the company has expanded its portfolio to production of AqualorH disinfectants by HLOROGEN® technology [5], for the use in hand disinfection, and other disinfection domains such as healthcare, household, veterinary, agriculture, HoReCa, *etc*.

This research delves into the innovations of the electrolyzer design, used electrodes materials, as well as the electrode manufacturing procedures used by Sigma doo Crvenka in HLOROGEN® technology.

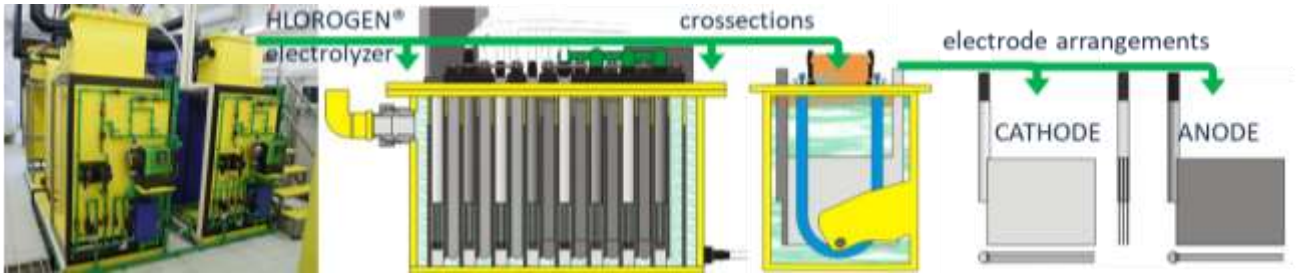

Figure 1. HLOROGEN® electrolyzers: a) complete plant – Novi Sad water supply, b) crossections – side views with electrode compartments and cooling system, c) electrode arrangement with 3 cathodes and 2 anodes per electrode compartment

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