Magna Imperio Systems: Innovating Solutions Through Technology

Grant R. Page

Houston, TX, USA, gpage@m-i-systems.com
MAGNAIMPERIOSYSTEMS.COM

ABSTRACT

The patented END® electro-desalination water treatment process focuses on the highest recovery and performance capabilities with the lowest energy consumption to make far-reaching impacts around the world. By implementing this technology, Magna Imperio Systems Corp. (MIS) will be a key enabler to solving the world’s water crisis. MIS is determined to reinvent and modernize water treatment worldwide with its advanced, state-of-the-art technology, saving millions who are unable to access clean, safe water.

Keywords: desalination, nanotechnology, nanofiltration, electrochemistry

1 INTRODUCTION

Fresh, potable water is a sacred, yet scarce, resource that brings life to the world. The successful foundation of every community is reliant on the crucial interconnected relationship between water, food, and energy known as the water-food-energy nexus. Increasingly high stress on the water-food-energy nexus due to the demands of exponentially growing populations has drastically deteriorated not only the quantity of water resources available but also the quality of those available resources. Gaining and maintaining access to a reliable source of fresh water has become increasingly difficult.

As of June 2017, nearly eight-hundred-million people worldwide lacked access to clean, safe drinking water -- a necessity many take for granted on a daily basis [1]. Furthermore, the absence of clean water encourages the spread of water-borne diseases, resulting in the death of millions annually. Worldwide, the people who are most susceptible to becoming victims of contaminated water are children.

In an effort to unify, promote, motivate, and accelerate global social, economic, and environmental developments, the United Nations (UN) General Assembly instituted seventeen goals known as the Sustainable Development Goals (SDGs), the sixth of which addresses the need for clean, accessible water for all [2]. Although the establishment of this momentous goal was of vital importance bringing attention to the water crisis, it is the responsibility of individual companies, authorities, municipalities, organizations, etc. around the world to take initiative to achieve it.

Water desalination techniques have been widely accepted as a sustainable solution for water shortages in many regions of the world; however, high facility construction costs, wastewater treatment costs, equipment maintenance costs, as well as intense energy demands among traditional desalination technology are all factors preventing countless communities from using this option and driving the need for high performance, cost-effective desalination solutions. Magna Imperio Systems Corp. is dedicated to designing, developing, and implementing technology that maximizes recovery, minimizes energy consumption and capitalizes on this increasing demand for high performance desalination technology in the interest of millions of people who struggle without access to clean drinking water, while simultaneously alleviating unnecessary pressure to the water-food-energy nexus.

2 MAGNA IMPERIO SYSTEMS CORP.

Magna Imperio Systems Corp. (MIS), founded by Grant Page on June 3rd, 2014, was established for the purpose of solving the world’s water crisis through innovative technology that can treat any type of water anywhere, anytime in a socially acceptable and economically feasible manner. Solving this crisis is critical to the sustainable future of humanity and has become MIS Systems’ mission through environmentally responsible operations, a dedicated workforce, and extraordinarily high ethical standards.

3 ELECTROCHEMICAL NANO DIFFUSION (END®)

The Electrochemical Nano Diffusion (END®) process is designed to remove total-dissolved salts (TDS), heavy metals, as well as certain bacteria and viruses, thus purifying water while saving energy through a unique combination of electrochemical reactions and nanofiltration. Page was able to perfect END®, the world’s most efficient, patented water treatment process, through years of experimentation and development at the U.S. Naval Academy and the Navy Research Labs. Based on proven electrodialysis reversal (EDR) technology, this groundbreaking system utilizes extensive electrolytic cell research to redefine how the world obtains fresh, safe drinking water. Page revolutionized the traditional EDR...
process through improvements to its two key components, the electrodes and spacers, which allows direct electrochemical separation of salts and water in order to achieve the highest performance capabilities via maximum recovery with minimum energy consumption. In recognition of these astonishing advancements in energy conservation and sustainability efforts, Page and his technology were awarded the 2014 U.S. Department of Energy “Excellence in Energy Award”.

3.1 Key Features of END®

Traditional EDR processes require high energy inputs in order to facilitate the separation of water by electrodes in the electrolyte at the electrode surface. When this process is being administered, the pH of the electrolyte is altered and the reaction results in a formation of gases that must be controlled and monitored. END® electrodes are designed to promote the capture, reallocation, and exploitation of energy when ions react within the electrolyte instead of splitting the water; thus, requiring significantly less energy, minimizing pH fluctuations, and eliminating the formation of gaseous products.

Within traditional water treatment systems, spacers are generally non-conductive elements that vary geometrically to ease flow in between membranes. This nonconductive attribute increases cell resistance and creates blockages among the membrane surface area, resulting in yet another site of wasted energy. This constraint on energy flow has been alleviated with the use of END® spacers. Energy that would normally be wasted in the membrane gap is reallocated in the END® cell to achieve higher recovery with minimum energy consumption due to the spatial and geometric positioning of the spacers which encourages conductivity between the membranes and along the membrane surface area.

Additionally, with consideration to the close proximity of many industrial operations to the surrounding environment and communities, MI Systems has also implemented real-time monitoring of the health and efficiency of the process, known as MiTRAX™, to further its long-standing pledge to be a responsible citizen of the world. This is an essential element in END® operational system due to its role in remotely monitoring, analyzing, and controlling the conditions within each unique operation to optimize treatment.

3.2 The END® Process

The treatment and purification process implemented by the patented END® system starts with the separation of the product and brine streams into the electrodessalination cell through porous membranes, which have pores in the range of several nanometers. These membranes selectively allow either cations or anions to pass through them. This process is driven by electrochemical separation of dissolved salts rather than traditional desalination process which utilize pressure driven processes. Nano-dispersion of salts occurs across each layer in the membrane stack based on the electrical potential applied to the process.

When power is applied across the electrodes, the environment becomes conducive to allow the appropriate chemical reactions to take place. These reactions result in the consumption or production of negative charges. The alternating cation and anion exchange membranes only allow ions of the correct charge to pass through them. Positive ions and negative ions in the feed water stream move towards the cathode and anode respectively to maintain charge neutrality within the electrolyte streams. The END® result is an increase of ions in the concentrate stream and a decrease of ions in the feed water stream to produce clean water.

![Figure 1: The patented END® electro-desalination water treatment process.](Image)

3.3 Key Benefits of END®

Through the advancements applied by the END® electrodes, spacers, and concentration gradient, this process is able to deliver product water at low energy by minimizing the internal resistance. Fully optimized END® systems are capable of delivering over 40% energy savings at recoveries as high as 98%. Comparatively, the END® process is up to three times more efficient than traditional reverse osmosis (RO) systems. Traditional EDR technology requires tradeoffs between electrical power and pumping power to optimize the total energy consumption. END® eliminates this tradeoff with its profound improvements to the electrodes and spacers. END® also requires a significantly lower amount of energy due to the reduction in internal resistance, as well as the lower activation energy needed for the process. The use of electrochemical separation of dissolved salts rather than pressure gradients driving the water purification process is the key concept that results in astoundingly efficient recovery. Additionally, because this process operates at low pressures, does not require a pressure gradient, and no high-pressure components are incorporated, both unit cost and weight remain low. These attributes translate into the most
remarkably high-performance capabilities seen among desalination technology.

The END® unit is also designed to incorporate its own self-cleaning routine and equipment; therefore, it requires minimal maintenance and intervention during its targeted 20-year lifespan. This ensures optimal performance and reduces mechanical stress on the system, which leads to longer system life compared to other leading desalination operations. Overall, these advantages offer significant capital and long-term operating cost advantages at each facility.

4 MARKETABILITY

The versatile design and advanced controls incorporated into END® systems make them ideal for application within a wide range of industries requiring municipal, industrial, and/or mobile water treatment worldwide. Units are modular and scalable containers comprised of stackable cells, meaning this technology can be scaled to fit any size operation. This key logistical attribute allows MI Systems to cater to a wide variety of applications within diverse markets. Target markets include industrial waters, such as chemical plants, aerospace manufacturers, power plants, mining operations; oil and gas organizations; agricultural waters such as irrigation, livestock, and stressed aquifers; the food and beverage industry; RO brine management; brackish water desalination; and sea water desalination.

Depending on the client’s specific needs, most systems are provided as a complete treatment process including feed pumping, brine and product tanks, chemical cleaning equipment, a full complement of process instrumentation, and fully integrated PLC based controls. The goal that many of these target markets share consistently ties back to increasing availability of safe drinking water in regions where fresh water supplies are insufficient.

![Diagram](image)

Figure 2: The illustration above depicts the general setup of a 40-foot, easily portable cargo container which accommodates a unit suitable for large-scale operations.

5 CONCLUSION

Fresh water supplies must support exponentially growing populations and their demands in order to promote survival and sustainability across the globe. MI Systems’ remarkable technology design promotes an affinity to recapture energy while purifying water. MI Systems strives for exceptionally high process recovery.

MI Systems is committed to reinventing water treatment worldwide as a global leader in water treatment and restoration to save millions by providing life-sustaining fresh, potable water. Through revolutionary technological advancements, END® will be the answer to the global water crisis while simultaneously alleviating unnecessary pressure to the water-food-energy nexus. The END® process is the future of water desalination. Our Planet is in dire need for reliable, sustainable solutions, and MI Systems is ready.

6 REFERENCES


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