

WATER PURIFICATION USING HIGH VOLTAGE PLASMA

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Abstract - Water treatment is a crucial step in providing secure and hygienic water supplies for a range of uses, including drinking water, business operations, and waste water management. Traditional water treatment techniques have trouble in adequately removing microbes, new contaminants, and persistent pollutants. As a result, there is an increasing need for creative and environmentally friendly methods to enhance the filtration of water. The prototype's goal is to eradicate the leakage of untreated industrial waste, which are primarily produced by the industrial and residential sectors. In this project, a plasma-based water filtration prototype has been developed to treat the water.

Key Words: Plasma generation, non-thermal Plasma, waste water management, plasma-based water filtration.

1. INTRODUCTION

Only 2.5% of the water on Earth is fresh water, and only a small portion of this is easily measurable which is available as ground as well as surface water sources. Fresh water is therefore a limited resource. (Fig. 1)[1]. Today there is a much greater need for better environmental circumstances. Water is thoroughly examined and a crucial topic because it is thought to be safe for humans and the rest of nature. Hazardous chemicals are typically present in wastewater from houses and the chemical industry. These compounds have the potential to be dangerous or even detrimental to both the human species and the planet's ecology. Therefore, it's imperative to just keep an eye on these substances in water and remove them from that environment. The greatest method to prevent water pollution is to inform individuals of the risks associated with utilizing hazardous items in their homes and places of employment. Understanding how to treat water to make it harmless is essential because this is not at all achievable [2].

Currently, population increase and excessive development are putting stress on this resource that sustains life and have also caused aquifer depletion [3- 5]. Humans and industrial and agricultural water needs compete in numerous ways. Indeed, agriculture accounts for around 70% of global freshwater draws [6-7].

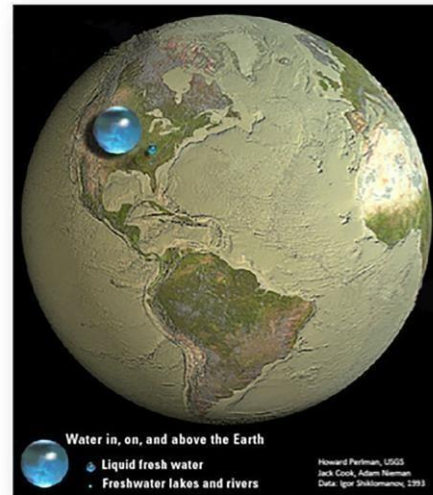


Fig -1: Pictorial representation of freshwater availability[1].

Pollution lowers water quality, which has the consequence of lowering the amount of water that is available for use in agricultural or drinkable purposes [8]. Many various techniques for treating water have been tried and developed over the years. Physical, chemical, and biological treatment procedures comprise the four categories.

The range of techniques for treating water is the greatest with biological technologies. The biggest benefit is the low operating cost, which is why municipalities and industries utilize it most frequently. The biggest drawback is that the technique for removing dangerous pollutants is not very effective. Additionally, the biological breakdown of contaminants occurs much more slowly than other processes [9]. Physical methods use a supporting system, such as filter paper and charcoal, to separate waste materials from water in a pure mechanical manner. The absence of chemicals in this method is a benefit. On the other hand, most harmful substances cannot be removed by physical means, especially when it comes to organic basic compounds. Chemical oxidation procedures are more frequently utilized to treat water that has been contaminated by organic chemicals, in contrast to the physical method. Chlorine, chlorine dioxide, ozone, and potassium permanganate are the most prevalent oxidants.

However, this reagent produces the dangerous by-products [10]. The ozonization procedure, which is effective but more expensive in comparison, is used to alleviate this problem.

With the application of the A/C voltage for the discharge ignition to occur, different electrode configurations in the coaxial reactor design can produce plasma in the liquid. This discharge into the liquid will start a variety of chemical and physical processes that are utilized to purify water. The electric discharge will begin a number of physical processes, such as the creation of a strong electric field, UV radiation, and shockwaves. The best chemical reaction, however, makes use of ions, radicals, and molecules with a high oxidation potential. [2]. Based on the previous procedure without using any additional chemicals, this may be used to treat the factory's wastewater. This procedure allows for the treatment of both organic and inorganic pollutants. Plasma can also be used to sterilize and disinfect the surface of hospital waste.

2. PROPOSED SYSTEM

Several components have been used in this project of which High Voltage Generator is the important component where it can produce high voltage electrical supply. The plasma production device and other parts of the purification procedure can be powered by a lithium-ion battery. Conductive materials called electrodes are employed to aid in plasma discharge and interaction with water. Water is supplied or circulated across the plasma-water contact zone using a water pump. It guarantees a steady flow of water, enabling the plasma to be purified by coming into touch with freshly formed water.

The combination of these components enables the plasma water purification process, where the plasma generated by the high voltage system interacts with water, causing chemical and biological reactions that lead to the degradation and removal of contaminants present in the water.

Table -1: Components with specifications

COMPONENTS	SPECIFICATIONS
High Voltage Generator Boost Inverter	DC 3.7V-7.4V to 1000KV
18650 Li-ion Rechargeable Battery	1200mAh
Micro Submersible Mini Water Pump	DC 3-6V
Electrodes	-

2.1 High Voltage Generator

High voltage generators are essential for plasma generation. They produce a high voltage electrical supply that is applied to the electrodes or plasma source. The gas is ionized by the high voltage, generating the plasma required for water filtration. For a variety of uses, it can create a wide range of high voltages. According to the voltage range given, the generator can produce voltages ranging from 3.7V to 1000kV (or 1,000,000 volts). In research and development labs, high voltage generators are frequently used for experiments, testing, and studies involving high voltage phenomena. They can be applied to physics, materials science, and electrical engineering, among other disciplines. High voltage generators are used to simulate high voltage conditions for testing and calibrating power system equipment, such as transformers, circuit breakers, and insulators.

2.2 Lithium-Ion Battery

Lithium-ion batteries ensure the system can operate even in areas without a stable power supply. Lithium-ion batteries are rechargeable energy storage devices that utilize lithium ions moving between positive and negative electrodes to generate electrical power. They are utilized in many different applications and have gained a lot of popularity because of their high energy density, lengthy cycle life, and light weight. Portable electronic devices including smart phones, tablets, laptops, digital cameras, and wearable technology frequently use lithium-ion batteries. These devices can run for long periods of time without needing to be frequently recharged thanks to their high energy density. They serve as the main form of energy storage in electric cars. In comparison to other battery technologies, they offer a greater driving range while providing the necessary power to run the car. Large lithium-ion battery packs are used by EV manufacturers to store energy for propulsion.

BIOGRAPHIES

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