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Review Article

Treatment Method of Water based on the Magnetic Devices

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Abstract

Magneto - Electric Machine, a device based on the principle of electromagnetic radiation in water is used to separate the bonds of compounds in water. Since magnetic treatment has a variety of selective influences on different substances and processes, its application has wide potentials in the practice. This paper presents a research result on the influence of the magnetic field on the water's Total Dissolved Solids (TDS) and Potential of Hydrogen (PH). Then, the experimental results are conducted to show that the fluctuation of the magnetic field affects the concentration of PH and TDS in water.
Keywords: Water Magnetic Devices.

INTRODUCTION

Mineral fouling is a frequent technological problem during water processing. Encrustation in pipelines reduces the flow capacity, thus requiring more pumping power. When to precipitate on heated surfaces, it also reduces heat transfer due to the insulation effect of minerals. The predominant scale from ground and terrestrial waters is calcium carbonate owing to its decreasing solubility with CO_2 gas released from the solution when the temperature is increased or the pressure is reduced. Its solubility also depends on the pH; for instance, when NaOH is added CO_2 forms additional carbonate ions and the precipitation of $CaCO_3$ occurs. Depending on water processing conditions, $CaCO_3$ commonly precipitates in amorphous and various crystalline modifications: rhombus-shaped calcite that may adhere into highly- compact scale; needle- like aragonite that tends to form a brittle scale, but in rigorous thermal and hydrodynamic conditions grows into a hard scale, and spherical vaterite that usually form a powder- like scale.

Economic and environmental concerns have led to the development of alternative physical means for hard- scale prevention: by the usages of permanent magnets [1- 3], electromagnetic coils [4-5], electrodes [6], and ultrasonic pretreatment [7]. The common principle of these treatments is the pre- precipitation of calcium carbonate (a homogenous nucleation/coagulation in bulk water) into fine suspended particles that later in critical regions (e.g. under the hot conditions of the heat- exchanger) offer preferable surfaces for crystallisation, depositing as a loosely adhered sludge or being carried further by the water- flow.

The anti- scale magnetic treatment of hard water has been employed for more than half a century, but the application has sometimes proved to be ineffective due to insufficient data about efficiency requirements [8] and still some influencing factors are unrecognized [9].

Here, a modelling of electromagnetic radiation for water source with concentration of PH and TDS source exceeds Vietnam standard for boilers.

DEVICE CONSTRUCTION

Principle of creating magnetic field

Magnetic water treatment technology is a device based on frequency modulation using a coil wound around a pipe section of the water system. This coil is triggered by a constantly changing power supply of polarity, frequency and amplitude. When water goes through the pipe section, which is rolled by this coil, they are inhibited, losing their ability to adhere to the wall of the device, and melting of older deposits, so that the surface of the device is free of scale, increasing heat transfer efficiency, saving energy, and extending the life of the heat transfer. The principle of creating a magnetic field is shown in Figure 1.

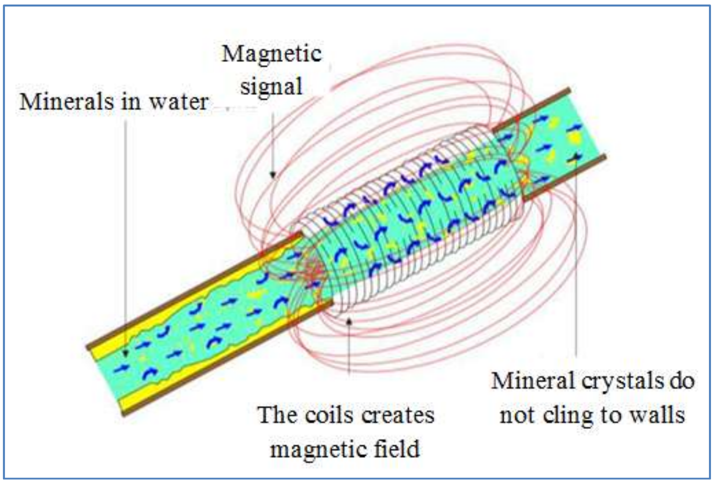

Fig-1: Principle of creating magnetic field

Experimental model design

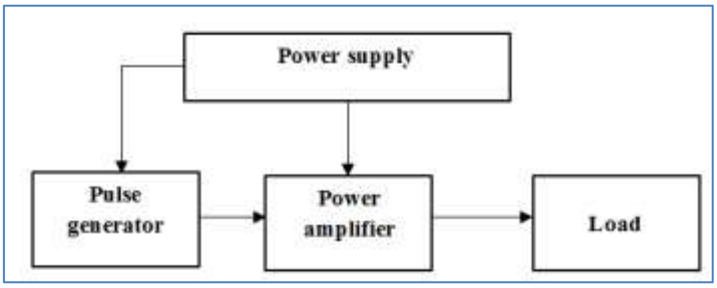

Fig-2: Block diagram of magnetic field generation system

The power supply is designed ±35V_{DC} to provide power amplifier and 12V_{DC} to supply for pulse generator.

Pulse generator uses the Arduino due to generate square pulses with different frequencies.

The power amplifier is designed 350 W with a frequency response from 20 Hz to 20 KHz, the amplification factor is 35 dB and load is 4 Ω.

The magnetic field tube is used cylindrical tube with iron material, diameter 150 mm, length 650 mm, and thickness 3.5 mm.

The coil generates a magnetic field using copper core wire with a diameter of 1.5 mm, a length of 200 m, and the total resistance 3.2 Ω.

Experimental approach

We use a tank with filled water; the dimensions of the tank are 850 mm in length, 450 mm for width and 600 mm in height. The TDS concentration in water was measured as 1182 ppm and PH concentration in water was measured as 11.2. The magnetic field tube as Figure 3 is placed inside the water tank. We also adjusted the average voltage on coils to generate magnetic fields of 50 V at all frequencies. After every hour, we measure the concentration of TDS and PH water. The measurement results are presented in experimental section.

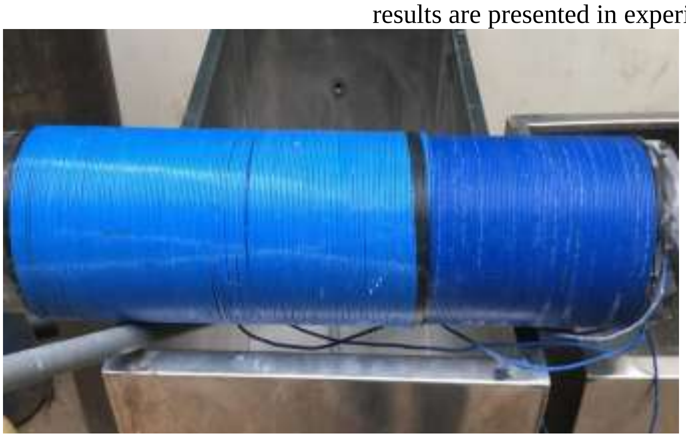

Fig-3: Magnetic field devices

EXPERIMENTAL RESULTS

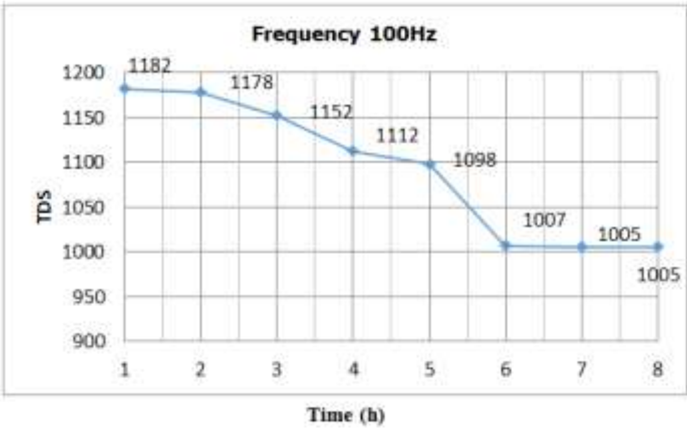

Fig-4: TDS concentration measurement results at frequency 100Hz

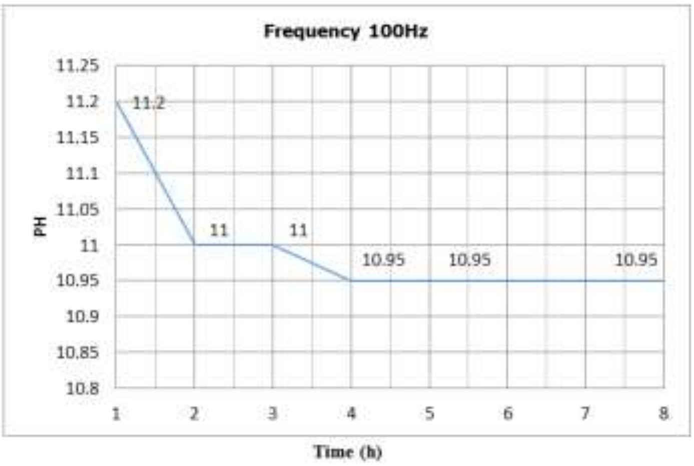

Fig-5: PH concentration measurement results at frequency 100Hz

Figure 4 and Figure 5 show measurable results of TDS and PH concentration at frequency 100Hz. From Figure 4 and Figure 5, we observe that the method in this research can offer improved performance power water.

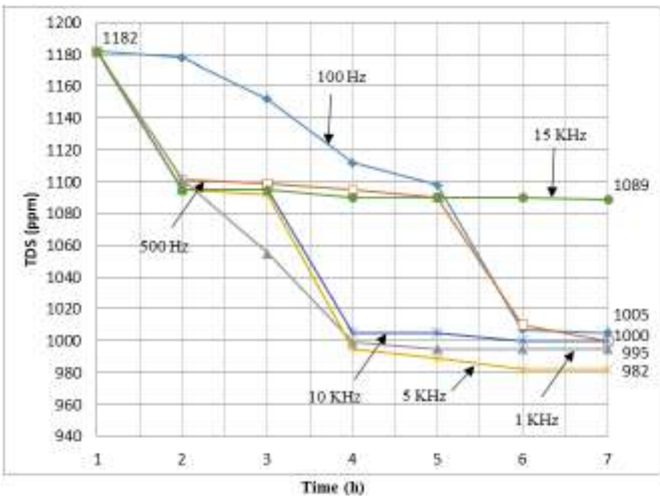

Fig-6: TDS concentration measurement results at frequency 100Hz, 500Hz, 1KHz, 5KHz, 10KHz and 15KHz

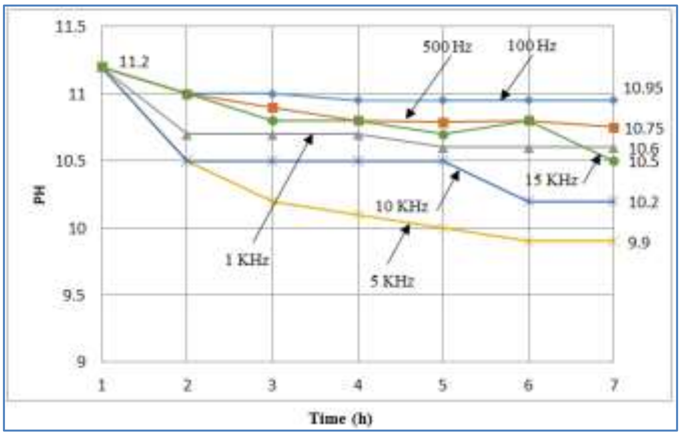

Fig-7: PH concentration measurement results at 100Hz, 500Hz, 1KHz, 5KHz, 10KHz and 15KHz

Figure 6 displays the result of TDS concentration measurement frequency 100Hz, 500Hz, 1KHz, 5KHz, 10KHz, and 15KHz. Figure 6 illustrates that the magnetic field of frequency 5KHz for best processing efficiency and the magnetic field at 5KHz frequency is not good effective.

Figure 7 displays the result of PH concentration measurement frequency 100Hz, 500Hz, 1KHz, 5KHz, 10KHz, and 15KHz. Moreover, Figure 7 also illustrates that the magnetic field of frequency 5KHz for best processing efficiency and the magnetic field at 5KHz frequency is not good effective.

From Figure 6 and Figure 7, we observe that the magnetic field at 5 KHz gives the best effective both in TDS concentration and PH concentrations.

CONCLUSION

This research presented as a result of treatment method of water based on the magnetic devices. The major contribution of this research was designed a magnetic generating system to reduce TDS and PH concentrations in water, which could be applied in boilers. Experimental results showed that concentration of PH and TDS in water was satisfactory to supply for boilers according to Vietnamese standards.

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