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Does Magnetic Field Change Water pH?

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Authors' contributions

This work was carried out in collaboration between all authors. Author HBA designed the study, conducted the experiments and analyzed the results, and wrote the first draft of the manuscript. Authors AE and MH managed the analyses of the study. Author AE made the necessary corrections and validated the results. Author MH managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Salt-laden waters pose major problems in the hydraulic field. Scaling problems can be troublesome for sanitary, potable and irrigation water networks. Also, irrigation water salinity is a major concern for agriculture, affecting crop productivity and yield. To alleviate some of these problems, various physical processes are put to the test such as magnetic processes. A laboratory experiment was conducted at the Laboratory of Natural Water Treatment of Borj Cedria Tunisia, to study the effect of different magnetic treatments (M_1=3300 Gauss, M_2=2900 Gauss, M_3=5000 Gauss and Electromagnetic Em=900 Gauss) under two flow rate (0.03 and 0.06 letter/second) and two temperature (18 and 24°C) on water characteristics in order to observe the variation in the pH of water. The application of all magnetic field treatment showed slightly an increase in the pH of treated water compared to untreated water.

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Keywords: Magnetic device; pH; water treatment; flow rate.

1. INTRODUCTION

The quality of drinking water or irrigation is a huge problem, so improving the physicochemical character of these is a concern for researchers, industrialists and farmers alike. Several treatment methods have been used. However, these different techniques have anomalies, because chemical techniques are expensive, while membrane techniques are the seat of the clogging problem that requires maintenance and cleaning membranes. In this context appears the magnetic treatment as a water treatment process in different fields namely industries, households, agriculture, etc. Magnetic devices are environmentally friendly, with low installation costs and no energy requirements [1], given the expected global water shortage, and can also improve water productivity [2]. Crops promote seed germination and improve human health and even animals. Many researchers have shown that magnetic treatment has no effect on the chemical properties of water, such that its composition remains the same after treatment on the other hand, it influences the physical parameters, including pH, electrical conductivity, etc., and it would slightly change the configuration of ionic particles in water [3], in fact, an arrangement of ions occurs during the passage of water through the magnetic field.

The hydrogen potential noted pH is a measure of the chemical activity of hydrogen ions H^+ also commonly called protons. More commonly, pH measures the acidity or basicity of a solution. Thus, in an aqueous medium, at 25°C: A solution of pH = 7 is called neutral; A solution of pH <7 is called acid; A solution of pH> 7 is called basic. Natural waters usually have pH values ranging from 4 to 9 however, most are slightly alkaline due to the presence of bicarbonates and carbonates, alkali and alkaline earth metals [4].

2. MATERIALS AND METHODS

The experimental study of this work was conducted in the Laboratory of Natural Water Treatment, Water Researches and Technologies Center, Borj-Cedria.

2.1 Magnetic Devices Used

In this work, the magnetic devices (M_1 = 3300 Gauss, M_2 = 2900 Gauss, M_3 = 5000 Gauss and Electromagnetic Em = 900 Gauss) are mounted on the experimental system to obtain magnetized water.

2.2 An Experimental Device of the Laboratory

To follow the effects of the magnetic devices on the water, a laboratory pilot was realized. It consists of magnetic devices, pump, probes linked to a recorder connected to a computer for the instantaneous monitoring of physicochemical parameters of water such as pH. The experimental tests consist of heating the water to the desired temperature then the sample is pumped to the other beaker by passing through the magnetic apparatus. The second beaker was put in another thermostatic bath to keep the water at the same temperature, the pH measurement before and after treatments were conducted using the probes connected to a recorder and the reading is on the computer using the D230 software.

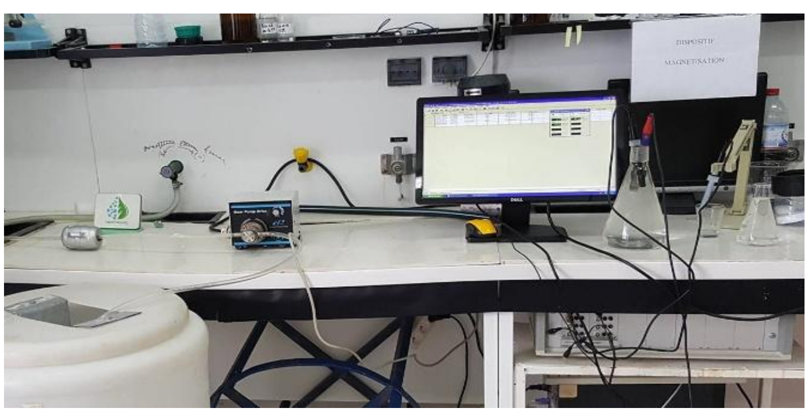
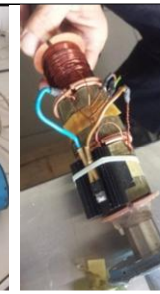


Fig. 1. Experimental device at the laboratory scale

Tabel 1. Characteristics of magnets

Devices	M_1	M_2	M_3	Em
Pics				 
Intensity	0.33 Tesla / 3300 Gauss	0.29 Tesla / 2900 Gauss	0.5 Tesla / 5000 Gauss	0.09 Tesla / 900 Gauss
Languor	8.5 cm	33 cm	15 cm	20 cm
Diameter	60 mm	33 mm	46 mm	30 mm
Arrangement of the magnets	Bipolar	Monopolar	Monopolar	-
Weight	0.5 Kg	13 Kg	1.5 Kg	-

3. RESULTS AND DISCUSSION

3.1 Effect of Magnetic Treatment on pH

The results of the pH measurements recorded during laboratory tests are presented. For a temperature of 18 ° C and a flow rate of 0.03 l/s, the variation of the pH is not very high presented in Fig. 2.

For a flow rate of 0.06 l/s, the pH remains almost unchanged compared to the first figure, but it is noted that the time of return of the pH to its initial value for M_1 increased 4 min more, compared to the treatment with a flow rate of 0.03 l/s (Fig. 3).

While Fig. 4 shows that by multiplying the flow rate by 10 (0.6 l / s) and keeping the same temperature, the pH of the water is virtually invariable for all magnetic devices.

Also, Fig. 5 illustrates the pH changes for a temperature of 24° C. At this level; we note that M_2 affects the pH by increasing its value by 0.09 while it returns to its initial value 13 hours later.

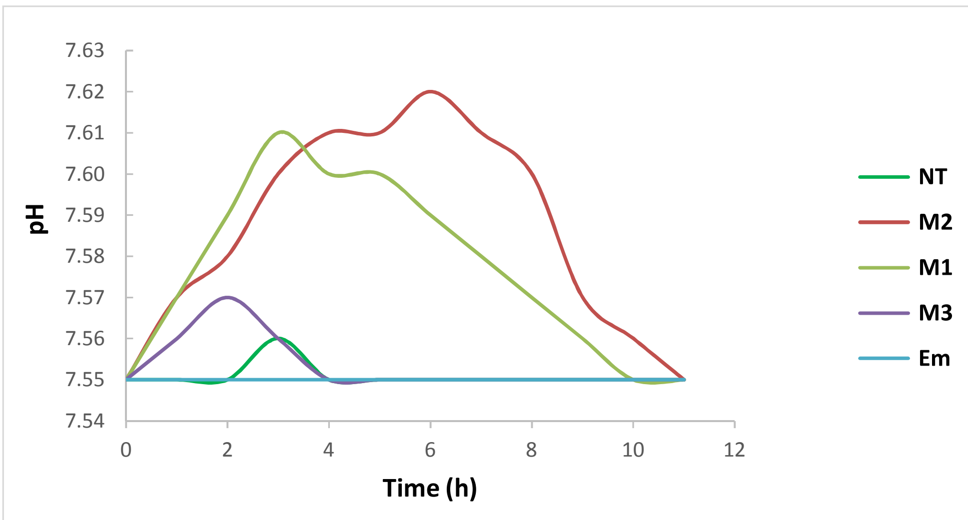


Fig. 2. pH monitoring with magnetic devices M_1, M_2, M_3 and Em at T = 18 degrees, flow rate 0.03 l/s (NT: untreated)

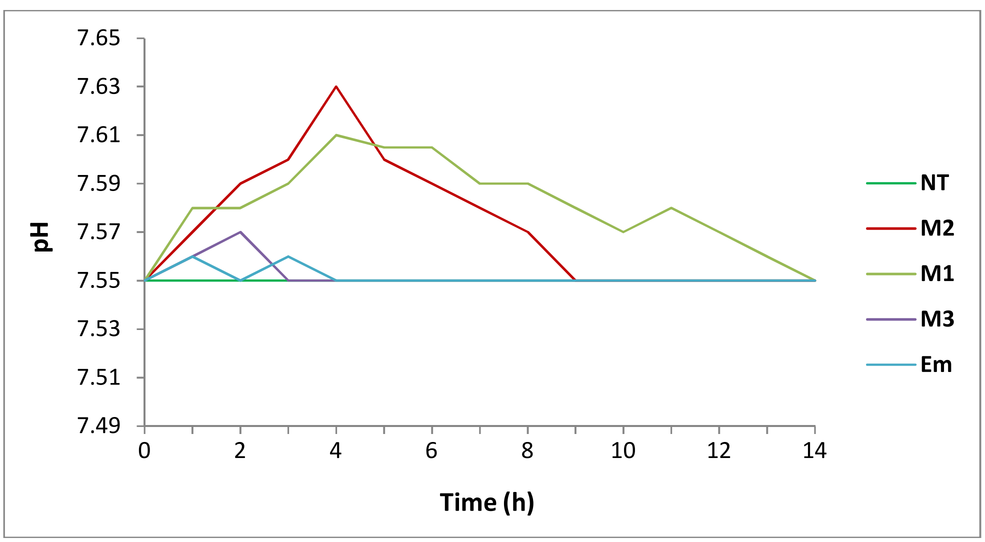


Fig. 3. pH monitoring of water treated with magnetic devices M1, M2, M3 and Em at T = 18 ° C, flow rate = 0.06 l / s (NT: untreated)

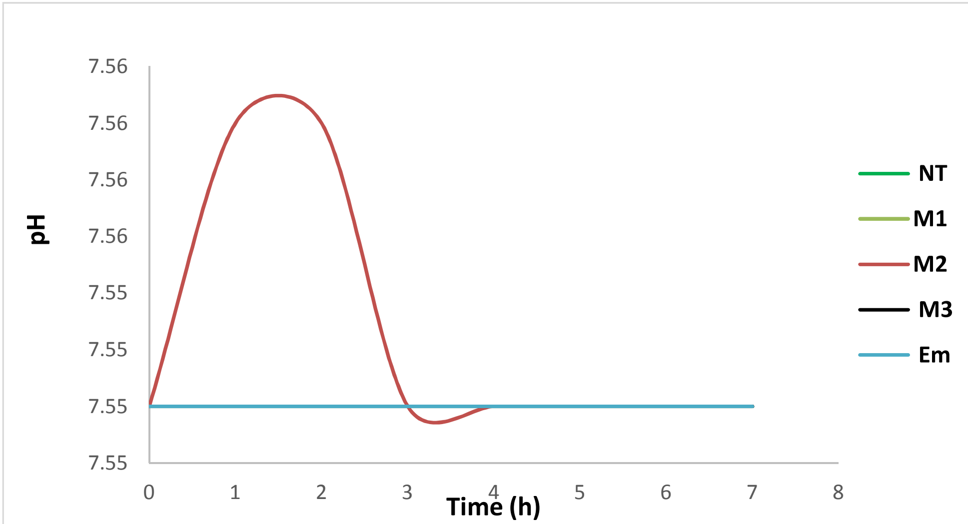


Fig. 4. pH monitoring of water treated with magnetic devices M_1, M_2, M_3 and Em at T = 18 ° C, flow rate = 0.6 l / s (NT: untreated)

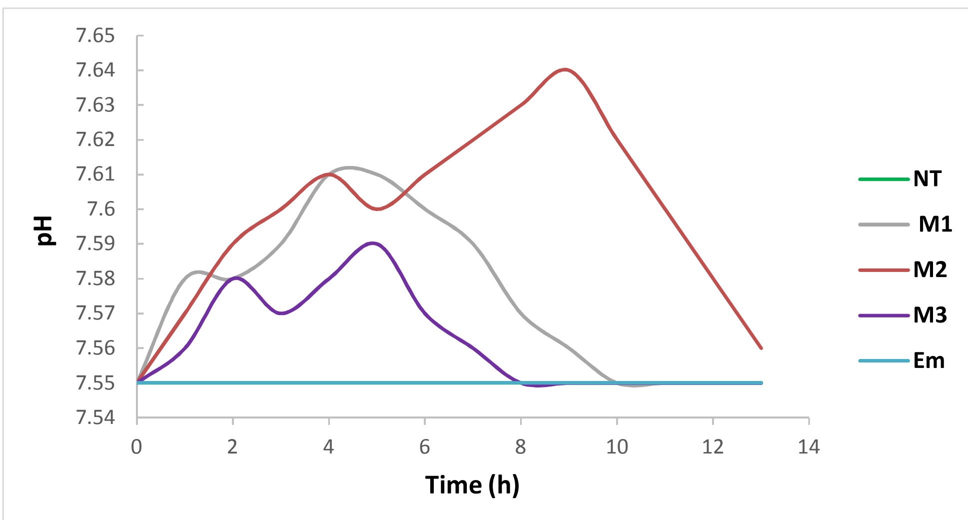


Fig. 5. pH monitoring of water treated with magnetic devices M_1, M_2, M_3 and Em at T = 24 ° C, flow 0.03 l / s (NT: untreated)

The same test with a double flow 0.06 l / s. Fig. 6 shows that the increase of the latter reduces the impact of magnetic fields on the pH of the water.

With even higher flow rates 0.6 l / s confirms the stability of the pH of the water after passing through the various magnetic devices (Fig. 7).

Water becomes more volatile as a result of magnetic processing. This result is confirmed by some scientists such as [5], who explain these variations by the weakening of the hydrogen bonds between water molecules. According to [6], magnetic processing can increase or decrease the pH of water samples. They suggested that many of the pH values recorded were close to their true values with an accuracy of + or - 0.20 pH. It should be noted that impurities in the treatment device could also affect pH readings. pH has slightly increased in some cases, a finding confirmed by [7]. Water is a solvent for almost all ions, and pH compares the most water-soluble ions. The result of a pH measurement is defined by the amounts of H^+ ions and OH^- ions present in the water. When the amounts of these two ions are equal,

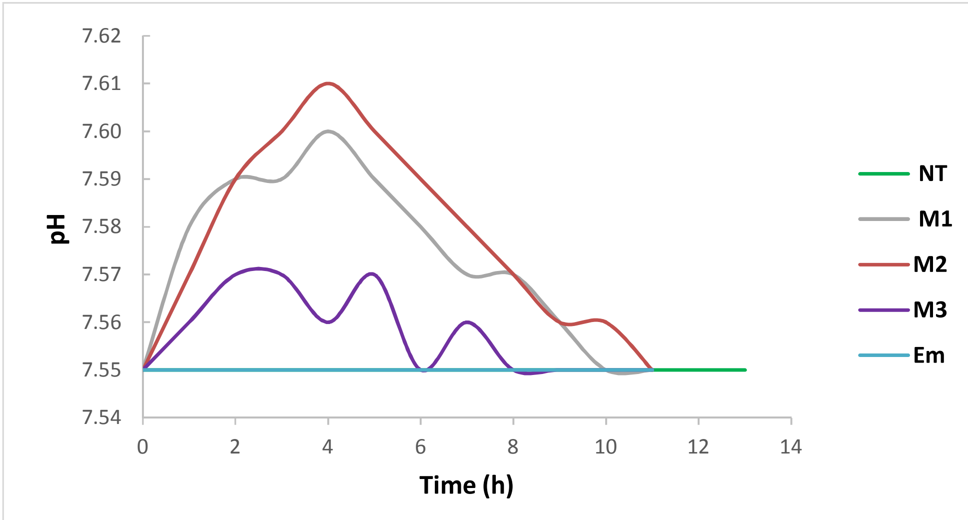


Fig. 6. pH monitoring of water treated with magnetic devices M_1, M_2, M_3 and Em at T = 24 ° C, flow rate = 0.06 l / s (NT: untreated)

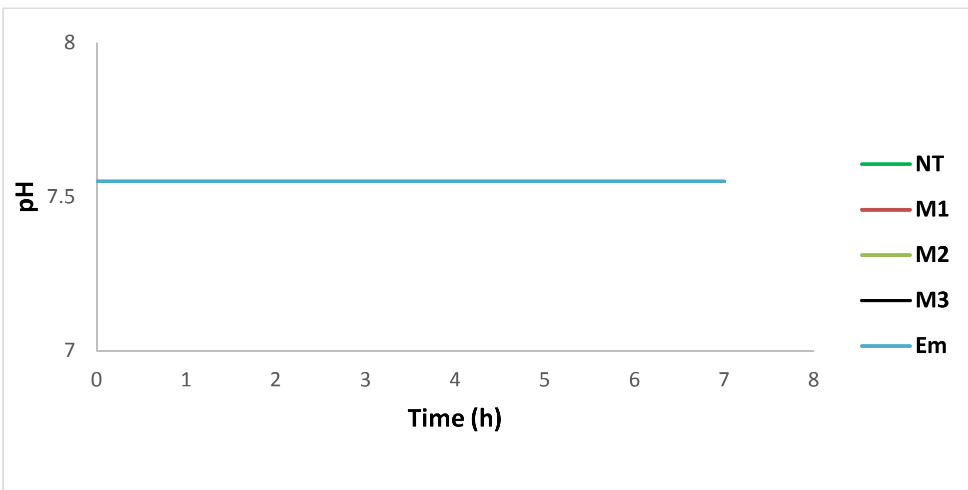


Fig. 7. pH monitoring of water treated with magnetic devices M_1, M_2, M_3 and Em at T = 24 ° C, flow rate = 0.6 l/s (NT: untreated)

the water is considered neutral. According to our results the pH slightly increases, it means the absorption of H^+ ions and the increase of the number of OH^- ions in the water. The pH increases by 5.6% and this increase show that the magnetic treatment of water has a memory effect such that this treatment lasts about three days [8] and this percentage change in the pH of the water is higher than the one we found 1.17%. This difference is mainly due to the quality of the water used and these physicochemical parameters. However, according to the work of [9], for tap water, the pH varies from 0.53% to 1.06%.

The influence of magnetic treatment to really increase the pH of water by a small percentage and this corresponds with our results. The pH return time to the initial value after treatment is explained according to [10] by the memory of water.

Our results also show that this parameter varies according to the intensity of the magnetic field and the flow rate.

Finally, the results showed that M_2 was significantly more efficient, while the intensity of the field is lower than for M_1. This shows that the performance of the magnetic field depends on three parameters which are the intensity, the polarization of the field (agitation of the water molecules), and the length of the apparatus (time of passage of the water inside the field).

4. CONCLUSION

Following the use of four magnets of different size and intensity. First, we noticed that the pH increased slightly over time, then return to its original value, confirming the memory of water effect. It is also noted that the flow rate and the temperature of the water have a great influence on the magnetic treatment, notably the pH variation after passing through magnetic devices.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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