TESTING COMMERCIAL WATER MAGNETIZERS: A STUDY OF TDS AND pH

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ABSTRACT

It is well known that a considerable portion of the world population is being supplied with hard water which has different negative domestic, industrial and agricultural effects. Recently, various research efforts have been directed towards the treatment of hard water using magnetic techniques. The main purpose of this paper is to report the effect of some commercial magnetic water conditioners on the total dissolved salts and pH on different solutions. In order to measure TDS and pH a traditional EC calibrated portable pH/EC/TDS/Temperature Meter (Hanna with probe HI 991300) which measures pH, electro-conductivity and total dissolved solids and temperature in a single instrument is used. TDS and pH were observed in all the magnetically treated solutions every twenty minutes.The paper includes laboratory evidence of water quality modifications which supplies different purposes using magnetic means.

Keywords: Magnetizer, Water, TDS, pH

1. INTRODUCTION

Magnetically treated water (MTW) is water which has been passed through a magnetic field prior to use. There are a lot of benefits to using such treated water, although there is still considerable debate as to its efficacy. Biological benefits claimed include: increased commercial earliness of crops; increased yield; increased vitamin C, sugar and total acid content, Pavlov et al. [1] and increased flowering and fruit set, Pavlov et al. [2]. Applications of MTW are abundant in industry where it is used to prevent scaling on the inner walls of pipes conveying fluids, especially water, Noran and Shani [3]. The oil industry has recently had success in preventing calcium carbonate scaling in the Auk field, indicating the potential benefit of magnetic treatment of fluids in offshore rigs, Donaldson [4]. There are other well documented cases of the use of applied field to prevent hydrocarbon deposits in pipes.

Various studies have shown that anti-scale magnetic treatment (AMT) appears to be enhanced by prolonged or repeated magnetic exposure, and is more effective above a threshold magnetic field contact time and in flowing systems, Baker and Judd [5]. Theories and mechanisms to explain the ability of weak magnetic fields to influence water and other fluids to reduce scale formation abound.

Kochmarsky [6] reviews the fundamental properties of water's fine "structure", the hydration of ions and nature of the hydrocarbon bond. He outlines a model of possible mechanisms which describe how relatively weak fields can influence the statistical mean number of hydrogen bonds between water molecules as a result of forbidden triplet-singlet transitions in the Zeeman electron-proton multiplets of the water molecule and its near surroundings. Other mechanisms include intramolecular / intraionic interaction, Lorentz force effects, dissolution of contaminants and interfacial effects, Baker and Judd [5].

Increasing the magnetic field density leads to increase the salt removal percentage due to the following: water molecules are electrically charged, having a small dipole and thus a small dielectric constant. This dipole may be susceptible to the effects of exogenous electric and magnetic fields. It is well-known that the subjection of water to a small magnetic field can change its dielectric constant. The change in the electric dipole of water can result in change of the physical properties. Among those physical properties, are conductivity and thus TDS and pH. The objective of this study was to investigate the effect of commercial magnetisers on the TDS and pH of various types of water each with the magnetizer specialized for it. These commercial magnetizers are permanent magnets each with a magnetic field density according to the type of water it should be used with.

2. METHOD

Four different water samples were used: drainage water, suction sumb water, normal tap water and salt water each with the magnetizer specialized for it. The commercial magnetizers are placed on about the middle of a one inch PVC pipe of length 1.5m as shown in Figure 1; different kinds of water are pumped from a 25 Litre tank using a CALPEDA pump. The pump is made in Italy with the following specifications:

Hmax=41 m, Hmin=21 m, Qmax=4 m^3/hr, Qmin=0.25m^3/hr, Weight=19 Kgram, Horse Power=0.75 KWatt, cosΦ=0.98 and frequency=50 Hz.

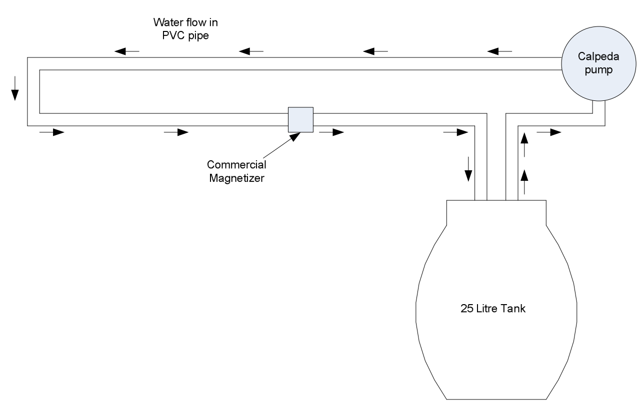

Fig. 1 System schematic design

3. RESULTS & DISSCUSSIONS

The following sections show the effect of the different water magnetizers on the four water samples.

3.1 Effect of commercial magnetizer (MAG3) on drainage water

MAG3 is a magnetic water conditioner (shown in Photo 1) which is suitable for conditioning water used for agricultural/industrial needs it is put on a one inch pipe with water with maximum flow of 25 GPM i.e. 94.635 l/min, the conditioner's magnetic density is 1.12 Tesla. The water used in this experiment is drainage water from Omar Bey Drain with TDS approximately equal 1226 ppm and pH equal 7.42. MAG3 is placed on the middle of the one inch PVC pipe.

Photo 1 Magnetic water conditioner (MAG3)

The effect of MAG3 on TDS and pH of drainage water after pumping it and recycling it to pass through the conditioner and taking readings every twenty minutes is shown in Table 1 and Figures 2 and 3.

Table 1 TDS and pH of water after exposure to MAG3 every twenty minutes

Time	TDS in ppm	pH
12:00 pm	1226	7.42
12:20 pm	1222	7.56
12:40 pm	1207	8.07
1:00 pm	1203	8.08
1:20 pm	1200	8.37
1:40 pm	1100	8.4
2:00 pm	1050	8.42

As seen in Table 1 and Figures 2 and 3 the exposure of water to magnetic field results in decreasing the TDS of water i.e. softening the water and increasing the pH as when water is subjected to a magnetic field, the water molecules will arrange in one direction. This mode of arrangement is caused by relaxation bonds, then the bond angle decreases to less than 105º, Stafford Lowe [7], leading to a decrease in the consolidation degree between water molecules, and increase in size of molecules. For these reasons, the viscosity of magnetic water is less than viscosity of normal water. This change in water molecules composite causes a change in permeability pressure, surface tension, pH and TDS.

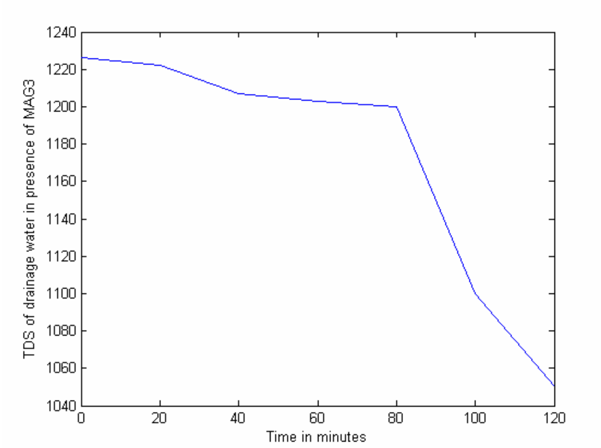

Fig. 2 TDS of water in presence of MAG3

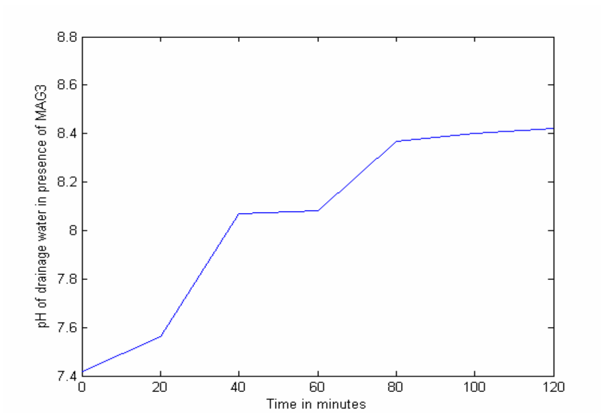

Fig. 3 pH of water in presence of MAG3

3.2 Effect of commercial magnetizer (MAG-SOL200) on suction sumb water

MAG-SOL 200 is a magnetic water conditioner (shown in Photo 2) which is suitable for conditioningfor residences having water hardness levels exceeding 257 ppm.

Photo 2 Magnetic water conditioner (MAG-SOL 200)

System includes three U-1 cold water units and either two U-1 hot water heater boosters or two U2 hot water booster units placed on PVC pipe of diameter 1-1.5" . The water used in this experiment is drainage water from suction sumb with TDS approximately equal 371 ppm and pH equal 8.04. MAG-SOL 200 is placed on the middle of the one inch PVC pipe.

Table 2 TDS and pH of water after exposure to MAG-SOL 200 every twenty minutes

Time	TDS in ppm	pH
12:00 pm	371	8.04
12:20 pm	344	8.18
12:40 pm	342	8.2
1:00 pm	338	8.23
1:20 pm	329	8.42
1:40 pm	309	8.47
2:00 pm	291	8.52

The effect of MAG-SOL 200 on TDS and pH of suction sumb water after pumping it and recycling it to pass through the conditioner and taking readings every twenty minutes is shown in Table 2 and Figures 4 and 5.

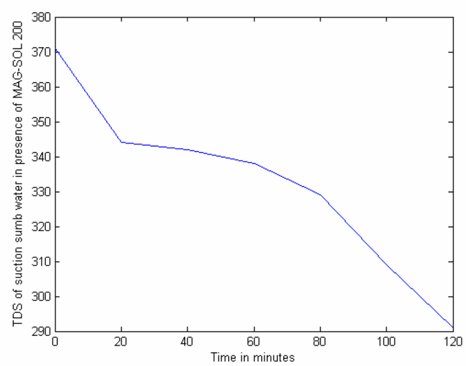

Fig. 4 TDS of water in presence of MAG-SOL 200

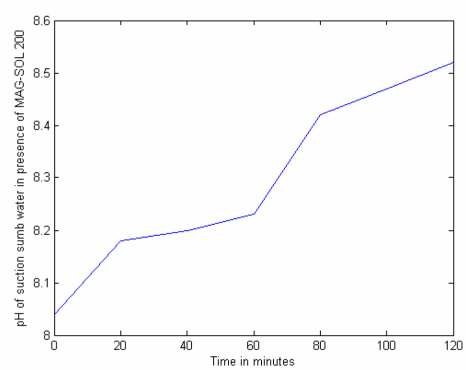

Fig. 5 pH of water in presence of MAG-SOL 200

As seen in Table 2 and Figures 4 and 5 the exposure of water to magnetic field results in decreasing the TDS of water i.e. softening the water and increasing the pH.

3.3 Effect of commercial magnetizer (H_2FLOW) on tap water

H_2FLOW is a magnetic water conditioner (shown in Photo 3) which is suitable for conditioning tap water. It has no moving parts, lifetime guarantee, fuel saving, no power required, easy to fit and no chemicals used. The water used in this experiment is tap water with TDS approximately equal 227 ppm and pH equal 7.73. H_2FLOW is placed on the middle of the one inch PVC pipe.

Photo 3 Magnetic water conditioner (H_2FLOW)

The effect of H_2FLOW on TDS and pH of tap water after pumping it and recycling it to pass through the conditioner and taking readings every twenty minutes is shown in Table 3 and Figures 6 and 7.

Table 3 TDS and pH of water after exposure to H_2FLOW every twenty minutes

Time	TDS in ppm	pH
12:00 pm	227	7.73
12:20 pm	217	7.74
12:40 pm	213	8.26
1:00 pm	213	8.31
1:20 pm	210	8.34
1:40 pm	200	8.37
2:00 pm	191	8.4

As seen in Table 3 and Figures 6 and 7 the exposure of water to magnetic field results in decreasing the TDS of water i.e. softening the water and increasing the pH.

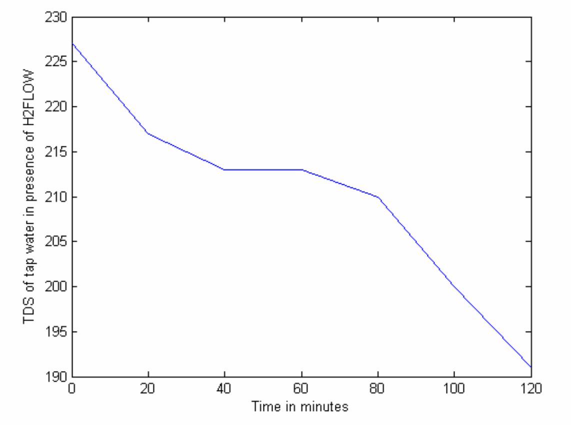

Fig. 6 TDS of water in presence of H_2FLOW

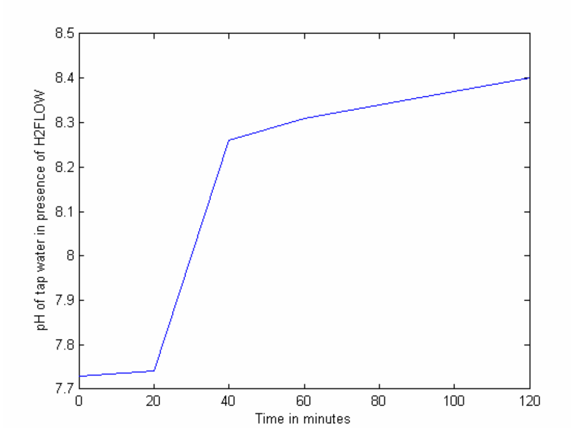

Fig. 7 pH of water in presence of H_2FLOW

3.4 Effect of commercial magnetizer (A100s) on sea water

A100s is a magnetic water conditioner (shown in Photo 4) which is suitable for conditioning salty water without filtration to be used for irrigation. Maximum flow of water through the pipe it is clanged on is 10 m3/hr i.e. 167 Litre/sec, the pipe is PVC body. It can be fixed on pipeline 1" and 1.5". Used without preliminary filtration to soften salty water can be used for irrigation. The water used in this experiment is water prepared in the laboratory using NaCl with TDS approximately equal 1890 ppm and pH equal 7.56. A100s is placed on the middle of the one inch PVC pipe.

Photo 4 Magnetic water conditioner (A100s)

The effect of A100s on TDS and pH of sea water after pumping it and recycling it to pass through the conditioner and taking readings every twenty minutes is shown in Table 4 and Figures 8 and 9. As shown the TDS reached 1270 and the range of salinity of water used for irrigation is 486.4-1280 ppm and the pH reached 7.99 and the range of the pH of water used for irrigation is 6.5-8.4.

Table 4 TDS and pH of water after exposure to A100s every twenty minutes

Time	TDS in ppm	pH
12:00 pm	1890	7.56
12:20 pm	1770	7.87
12:40 pm	1635	7.94
1:00 pm	1522	7.98
1:20 pm	1400	7.98
1:40 pm	1388	7.98
2:00 pm	1270	7.99

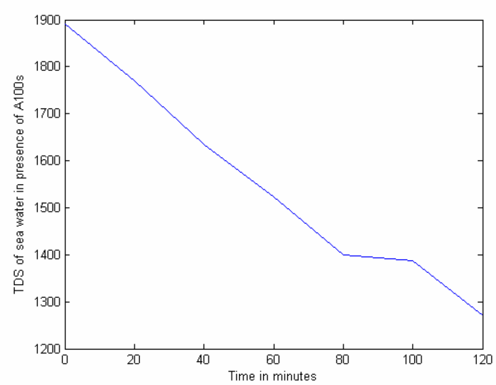

Fig. 8 TDS of water in presence of A100s

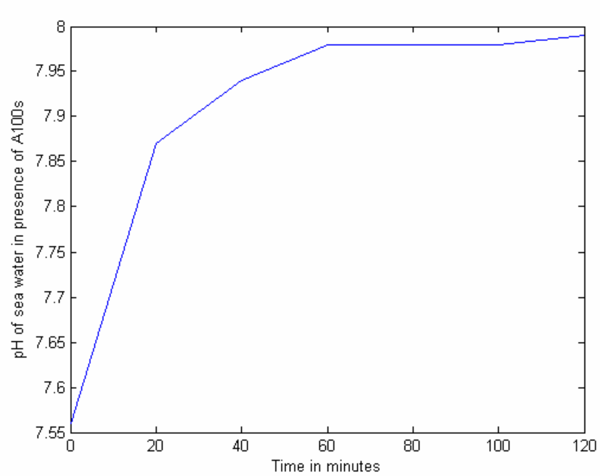

Fig. 9 pH of water in presence of A100s

As seen in table 4 and Figures 8 and 9 the exposure of water to magnetic field results in decreasing the TDS of water i.e. softening the water and increasing the pH.

4. CONCLUSIONS

Hard water is water that has a high mineral content. The main components of these minerals usually are calcium (Ca2+) and magnesium (Mg2+) ions, in addition to dissolved metals, bicarbonates, and sulfates. Calcium usually enters the water as either calcium carbonate (CaCO3) in the form of limestone and chalk, or calcium sulfate (CaSO4) in the form of several other mineral deposits. The main source of magnesium is dolomite (CaMg(CO3)2). The total water 'hardness' (including both Ca2+ and Mg2+ ions) is expressed by parts per million (ppm) or weight/volume (mg/l) of calcium carbonate ($CaCo_3$) in the water i.e. the total dissolved salts (TDS). Due to the hardness of water, scale is formed. The problem of scaling causes loss of production or process time, it causes deterioration of equipment and equipment failure, increased energy consumption and loss of turnover. The methods by which the TDS of water can be reduced and thus scale can be treated can be chemical or physical. The chemical method has been shown to be very effective however can cause environmental pollution through the disposal of treated water, Al Nasser et al. [8].

It was found that the magnetic treatment does affect the TDS and pH of different solutions according to the magnetizer used. The effect of the magnetizer was to decrease the TDS and increase the pH of water. The effect depends on the time of exposure to the magnetic field. As for drainage water MAG3 of magnetic density 1.12 Tesla is used and it decreases the TDS about 14% in two hours. As for suction sumb water MAG-SOL200 of magnetic density 2.5 Tesla is used and it decreases the TDS about 21% in two hours. As for tap water H_2Flow of magnetic density 300 gauss is used and it softens water 15.85% in two hours. As for sea water A100s is used and it softens the water 32.8% in two hours.

REFERENCES

[1] Pavlov P., Gyourov S. and Parmakov D., “Effect of magnetic processed water on the yield of glasshouse tomatoes” , Plant Physiology - Bulgarian Academy of Sciences, vol. 9, pp 65-70, 1983.

[2] Pavlov P., Gyurov S. and Pqakov D., “The effect of magnetic treated water on the growth, flowering and fruiting of glasshouse grown tomatoes”, Plant Physiology - Bulgarian Academy of Sciences, vol. 8, pp. 51-62, 1982

[3] Noran R. and Shani U., “Effect of irrigation with magnetically treated water on the translocation of minerals in the soil,” Magn Electr Sep, vol. 7, pp. 109-122, 1996.

[4] Donaldson J.D., “Magnetic treatment of fluids,” Waterline, April, pp. 75-84, 1995.

[5] Baker J.S and Judd S.J, “Magnetic amelioration of scale formation,” Water Research, vol. 30, pp. 247-260, 1996.

[6] Kochmarsky V., “Magnetic treatment of water: possible mechanisms and conditions for applications,” Magn Electr Sep, vol. 7, pp. 7, 1982.

[7] Stafford Lowe, “The Mechanism of the Vortex Water Energy System”, Helping Agriculture & the Environment through the 21st Century, Fluid Energy Australia, 1996.

[8] Al Nasser W.N, Shaikh A.A, Al-Ruwai A.H, Hounslow M.J., Salman A.D. Determining the Effect of Electronic Anti Fouling System on the Scaling behaviour by Inline Technique. Online Monitoring Effect of EAF on Calcium Carbonate Precipitation & Deposition. Particulate Systems Analysis, pp. 112, 2008.