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SCIENTIFIC INVESTIGATIONS ON THE CLAIMS OF THE MAGNETIC WATER CONDITIONERS

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ABSTRACT: A lot of study has gone into the principles and function of magnetic "Water Softeners" around the world. The results have been mixed, the tests run of the function of these devices by the device manufacturers usually turn out fine, while tests run by anybody else usually don't. Although a variety of claims are made about magnetic water conditioners for softening water, through "Pre-precipitation", changing the hardness in the water from "Sticky" crystals to "Non-sticky", or somehow rendering the hardness ions inert. This article focuses specifically on the claimed benefits of magnetically treated water, by scientific investigation for five commercial water conditioners from different manufacturers and for different purposes, the manufacturer's instructions are considered. The investigation is carried out based on measurable and analyzed parameters (pH, TDS, Hardness). After a lot of serious laboratory measurements and chemical analysis, it is concluded that; the magnetic water conditioners have no effect on the water pH, total dissolved salts, and hardness.
KEYWORDS: Magnetic Water Conditioners Softener pH TDS Hardness

INTRODUCTION

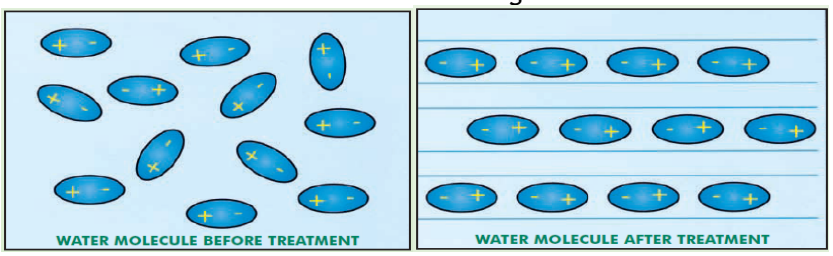
According to the magnet vendors, magnets can be used to improve blood pressure, circulation, cure and prevent diseases, tooth decay and hair damage, increase vehicles mileage, reduce fuel consumption, control pollution, improve plant growth, soften water, prevent scale deposition [8], [13], [1], and even increase the strength of concrete by 23 % [5].

To many people, magnets are a complete mystery. Vendors of magnet-based scams often use this ignorance to their own advantage, so a familiarity with the basics of magnetism can aid in the detection of dubious claims. Magnetic fields are produced by the motion of charged particles. For example, electrons flowing in a wire will produce a magnetic field surrounding the wire. The magnetic fields generated by moving electrons are used in many household appliances, automobiles, and industrial machines. One basic example is the electromagnet, which is constructed from many coils of wire wrapped around a central iron core. The magnetic field is present only when electrical current is passed through the wire coils. Permanent magnets do not use an applied electrical current. Instead, the magnetic field of a permanent magnet results from the mutual alignment of the very small magnetic fields produced by each of the atoms in the magnet. These atomic-level magnetic fields result mostly from the spin and orbital movements of electrons. While many substances undergo alignment of the atomic-level fields in response to an applied magnetic field, only ferromagnetic materials retain the atomic-level alignment when the applied field is removed. Thus, all permanent magnets are composed of ferromagnetic materials. The most commonly used ferromagnetic elements are iron, cobalt, and nickel. The strength of a magnet is given by its magnetic flux density, which is measured in units of Gauss. The earth's magnetic field is on the order of 0.5 Gauss [10]. Typical household refrigerator magnets have field strengths of about 1,000 Gauss.

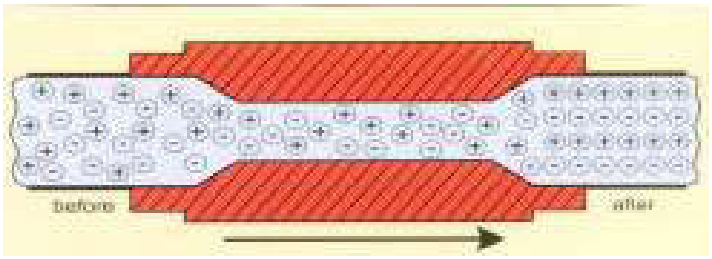
According to the distributors, the magnets sold for water treatment have magnetic flux densities in the 2,000 to 4,000 Gauss range, which is not unusually strong. Permanent magnets with flux densities in the 8,000 Gauss range are readily available. The magnets sold for magnetic water treatment are nothing special; they are just ordinary magnets. Magnetic water treatment is based on magnets are placed inside or to the exterior surface of the incoming water pipe. The water is exposed to the magnetic field as it flows through the pipe between the magnets. An alternative approach is to use electrical current flowing through coils of wire wrapped around the water pipe to generate the magnetic field.

There is apparently no consensus among magnet vendors regarding the mechanisms by which magnetic water treatment occurs. A variety of explanations is offered, most of which involve plenty of jargon but little substance. Few vendors, if any, offer reasonable technical explanations of how magnetic water treatment is supposed to work.

Vendors explain the principle of magnetic water treatment using the magnetic resonance that is the physical effect applied to the atoms of water as it passes from one magnetic field into the reverse magnetic field of the opposite polarity. This produces a resonating, polarizing effect on the atoms of hydrogen, oxygen and mineral in water as illustrated in Figure 1.



a)



b)

Figure 1. (a) Water Molecules Before and After Magnetic Treatment
(b) Configuration of Ionic Particles in Magnetic Field

According to some vendors, magnetically softened water is healthier than water softened by ion exchange. Ion-exchange softeners increase the water's sodium concentration, and this, they claim, is unhealthy for people with high blood pressure. While it is true that ion-exchange softening increases the sodium concentration, the amount of sodium typically found even in softened water is too low to be of significance for the majority of people with high blood pressure. Only those who are on a severely sodium-restricted diet should be concerned about the amount of sodium in water, regardless of whether it is softened [14]. Such individuals are often advised to consume demineralized water along with low-salt foods.

Purveyors of magnetic water treatment devices claim that exposing water to a magnetic field will decrease the water's "effective" hardness. Typical claims include the elimination of scale deposits, lower water-heating bills, extended life of water heaters and household appliances, and more efficient use of soaps and detergents. Thus, it is claimed, magnetic water treatment gives all the benefits of water softened by ion-exchange without the expense and hassle of rock-salt additions. Note that only the "effective" or "subjective" hardness is claimed to be reduced through magnetic treatment. No magnesium or calcium is removed from the water by magnetic treatment. Instead, the claim is that the magnetic field decreases the tendency of the dissolved minerals to form scale. Even though the dissolved mineral concentration indicates the water is still hard, magnetically treated water supposedly behaves like soft water.

The important question here, though, is whether magnetic water treatment works. In an effort to find the answer, we conducted a search for relevant scientific and engineering journal articles. I describe the results of this search below.

More than one hundred relevant articles and reports are available in the open literature, so clearly magnetic water treatment has received attention from the scientific community (e.g., see reference list in [3]), in nearly all cases researchers report finding no significant magnetic treatment effect. On the other hand, many researchers have evaluated Magnetic Water Treatment Devices (MWTD) worldwide for scale control in various industrial processes, including desalination, and also for desorption of scales and corrosion products [4]. Rameen et. al. [12] reported the effect of commercial magnetic water conditioners on the total dissolved salts and pH on different solutions, the work includes laboratory evidence of water quality modifications which supplies different purposes using magnetic means. PANG et. al. [11] investigated the properties of water and their changes under the action of a magnetic field were gathered by the spectrum techniques. It was found that some properties of water were changed, and a lot of new and strange phenomena were discovered after magnetization. Magnetized water really has magnetism. These results show that the molecular structure of water is very complicated, which needs studying deeply. Dave[2] found in the personal test runs, the magnetic "water softener" did exactly nothing. H. Banejad et. al. [6] found that changing magnetic field intensity, amounts of water influent, and also together influence there factors, have significant effects at level of 99 percent on reducing of water hardness. In the other way, for finding their mechanisms, analyzes done by X ray. Calcium carbonate exists in two forms, calcite and aragonite. But the main form of sediment is calcite. Results showed that amount of

aragonite in compare with calcite, by attention to situation, increased 70 percent to 99.99 percent and ratio between calcite/aragonite had a main reducing. Amiriet. al. [9] found that surface tension of water is too sensitive to experimental conditions to be considered as a safe and reliable indicator for studying the effects of magnetic field on water. It was found that meaningful changes in surface tension of a liquid sample after a day can be a good indicator for presence of physical or chemical changes in the sample.

The most important question for consumers is whether the magnetic water treatment devices perform as advertised. Some commercial devices have been subjected to tests under controlled conditions. Duffy [3] tested a commercial device with an internal magnet and found that it had no significant effect on the precipitation of calcium carbonate scale in a heat exchanger. A study of a commercial magnetic water treatment device was conducted by [7]. Under the technical supervision of the device supplier, very hard water (300 to 340 ppm) was pumped through a cast-iron pipe, and the rate of scale accumulation inside the pipe was determined by periodically inspecting the pipe's interior. Magnetic exposure was found to have no effect on either the rate of scale accumulation or on the adhesive nature of the scale deposits. Consumer Reports magazine (December 1996) tested a $535 magnetic water treatment device from Descal-A-Matic Corporation. Two electric water heaters were installed in the home of one of the Consumer Reports staffers. The hard water (200 ppm) entering one of the heaters was first passed through the magnetic treatment device. The second water heater received untreated water. The water heaters were cut open after more than two years and after more than 10,000 gallons of water were heated by each heater. The tanks were found to contain the same quantity and texture of scale. Consumer Reports concluded that the Descal-A-Matic unit was ineffective.

A lot of study has gone into the principles and function of magnetic "Water Softeners" around the world. The results have been mixed. The tests run of the function of these devices by the device manufacturers usually turn out fine, while tests run by anybody else usually don't. Although a variety of claims are made about electronic/magnetic devices softening water, through "Pre-precipitation", changing the hardness in the water from "Sticky" crystals to "Non-sticky", or somehow rendering the hardness ions inert; the applications of these devices are at best limited to very specific feed water chemistry.

This article focuses specifically on the claimed benefits of magnetically treated water, by scientific investigation for five commercial water conditioners from different manufacturers and for different purposes, the manufacturer's instructions are considered. The investigation is carried out based on measurable and analyzed parameters (pH, TDS, Hardness).

MATERIAL AND METHODS

During the preparation of test rig and pre-runs, it was noticed that; any metallic piping, fittings, and the pump itself cause the turbidity of flowing water to be increased, for this reason all metallic passages were replaced by non-metallic material. The test rig (Figure 2) contains 30 liter constant level water tank filled by tap water, fitted with temperature digital readout, while a PVC pump draws water from the tank via a plastic hose and discharges through a plastic hose followed by polypropylene PP-R pipe, the pipe is fitted with gate valve. The test rig is constructed in the laboratory of fuels and oils - Department of Mechanical Power Engineering - Faculty of Engineering - Ain Shams University - Cairo - Egypt.

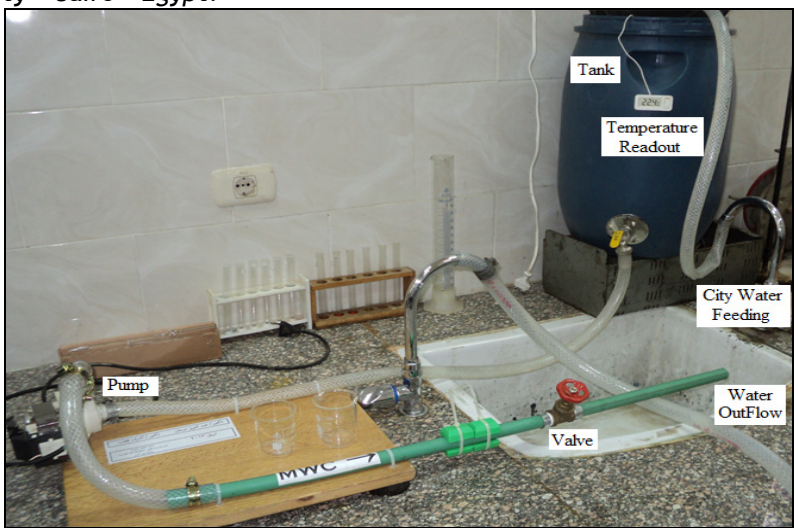


Figure 2. Components and Construction of Test Rig

Instrumentation system is chosen to measure the pH, total dissolved solids, hardness values, and magnetic field intensity, Table 1 illustrates the specifications for each measuring device.

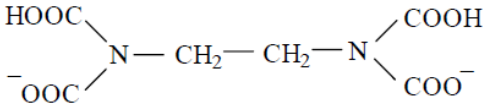
Table 1. Specifications for Measuring Devices

Brand	Description per Manufacturer	Manufacturer
HANNA instruments	Hardness Test Kit Hl 3812 Expired 11/2017 High Range: 0.0 to 300.0 mg/L CaCO3 Sample Size: 50 mL Low Range: 0.0 to 30.0 mg/L CaCO3 Sample Size: 5 mL Analysis Method: EDTA titration 	Romania
ROHS CE	TDS Meter Range: 0 to 1999 ppm Accuracy: ±2 % f.s. Temperature Compensation: 0 to 50 °C 	China
ROHS CE	pH Meter PH-009 (III) High Accuracy Pen Type (with Temperature Display) Range: 0.00 to 14.00 Accuracy: ±0.1 pH, ±1 °C Resolution: 0.01 pH, 0.1 °C Automatic Temperature Compensation: 5 °C ~ 50 °C 	China
Magnetic Field Intensity	GAUSS/TESLA METER F.W. BELL Model 5080 Division of Bell Technologies, a Sypris Company 	U.S.A

Regarding to the chemical analysis to determine the hardness of samples, titration procedures provide relatively inexpensive means for the analysis of different substances. These titrations are based on chemical reactions with completion points that can be monitored by some visible change in the reaction systems.

The most common system involves acids and bases with the use of an indicator that changes color as the system moves from an acidic to basic composition. Calcium and magnesium ions can be measured through reaction with a chelating agent EDTA (ethylenediaminetetraacetic acid). This molecule has four carboxylic acid (~COOH) group sites and two nitrogens, all of which have lone pairs of electrons. The EDTA molecule can form a complex with as many as six sites on a particular cation like Ca^{2+}. These EDTA complexes are generally very stable are always in 1:1(metal:EDTA) molar ratios:

$$Ca^{2+}(aq) + H_2Y^{2-}(aq) \longrightarrow CaY^{2-}(aq) + 2H^{+}(aq)$$



EDTA (anionic form)

In this activity we will be titrating Ca^{2+} in water samples withEDTA. Both Ca^{2+} solutions and EDTA are colorless so an indicator is needed to signal thereaction completion. The indicator of choice is EriochromeBlack T which forms a wine-redcomplex with Mg^{2+}. A very small amount Mg^{2+} will be bound to the indicator through most ofthe titration. When all of the Ca^{2+} has reacted with EDTA, the Mg^{2+} in the indicator will reactwith the EDTA. The indicator then returns to its acidic form which is a sky-blue and signals theend of the process.

Below are the reactions that occur during the titration where H_3In is the general formula for the Eriochrome Black T.

During titration:

$$H_2Y^{2-}(aq) + Ca^{2+}(aq) \rightarrow CaY^{2-}(aq) + 2\,H^{+}(aq)$$
$$H_2Y^{2-}(aq) + Mg^{2+}(aq) \rightarrow MgY^{2-}(aq) + 2\,H^{+}(aq)$$

At end point

$$H_2Y^{2-}(aq) + \underset{\text{Wine-red}}{MgIn^{-}(aq)} \rightarrow MgY^{2-}(aq) + \underset{\text{sky-blue}}{HIn^{2-}(aq)} + H^{+}$$

In the first part of the present work, 4 magnetic water conditioners are investigated; Tables 2, 3, 4, and 5 illustrate the specifications and installation for each magnetic water conditioner (MWC):

Table 2. Specifications and Installation of MWC-01

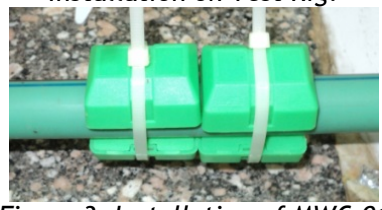
Brand	Specifications and Installation	Manufacturer
Powermag	Ultra Power Magnetic Water SoftenerUP-2 2 pairs in one set Description per Manufacturer: Assembled with strong NdFeB magnet part forces +/- hydronium temporarily into cathode to exchange water molecule and mineral hydronium, makes Ca2+/Mg2+ to unite electro, and has no cation function temporarily. Hence, even heating, it doesn't unite hydronium---for example So42-. The part makes water not to scale any more. Magnetic filter makes water soft, and scale will be never produced in water pipe. Installation on Test Rig:  Figure 3. Installation of MWC-01	China

Table 3. Specifications and Installation of MWC-02

Brand	Specifications and Installation	Manufacturer
Powermag	Way Power Magnetic Water SoftenerWP-1SUPER - NG 3500 1 pair in one set Description per Manufacturer: As mentioned for MWC-01 Installation on Test Rig:  Figure 4. Installation of MWC-02	China

Table 4. Specifications and Installation of MWC-03

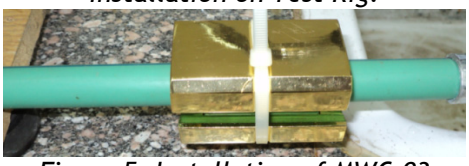
Brand	Specifications and Installation	Manufacturer
Powermag	King Power Magnetic Water SoftenerKP-1 1 pair in one set Description per Manufacturer: As mentioned for MWC-01 Installation on Test Rig:  Figure 5. Installation of MWC-03	China

Table 5. Specifications and Installation of MWC-04

Brand	Specifications and Installation	Manufacturer
Magnetic Technologies	Magnetic Liquid Modifier - Yuri Tkachenko ¾ " x ½ " BS 4346 Description per Manufacturer: The magnetic shower adapter can be attached to any standard shower between the shower pipe and shower head. Magnetic shower has proved to be very efficient and effective for magnetizing liquids in larger quantity. Liquid passed through the shower adapter acquire a finer and more homogeneous structure that significantly enhances the fluidity and dissolving ability as well as biological activity. Such characteristic of magnetized water promote hair growth, reduce hair loss and aid healing skin related diseases. The shower has an inside thread of G1/2, upon tightening the shower is sealed against leak. The plastic body of the shower makes it rust proof and anti-fungal. Installation on Test Rig:  Figure 6. Installation of MWC-04	Russian Technology U.A.E.

RESULTS AND DISCUSSION

Each manufacturer wrote the technical specifications and benefits of its own magnetic water conditioner, but there are no scientific data about the construction, material, and the magnetic flux density is mentioned. For this reason and before investigating the effect of magnetic water conditioners, Table 6 illustrates an attempt to measure the magnetic flux density for the used magnetic water conditioners.

Table 6. Measurements of Magnetic Flux Density for Each MWC

MWC	Description of Measurements
MWC - 01	The magnetic flux density is measured at the contact surface for each piece; it was found that the flux density is not uniformly distributed over the contact surface with the maximum of 330.0 mT. After installation the magnetic flux density inside the pipe is measured, it was found that the flux density is not uniformly distributed over the cross flow area or the covered length with the maximum of 170.0 mT.
MWC-02	The magnetic flux density is measured at the contact surface for each piece; it was found that the intensity is not uniformly distributed over the contact surface with the maximum of 180.0 mT. After installation the magnetic flux density inside the pipe is measured, it was found that the flux density is not uniformly distributed over the cross flow area or the covered length with the maximum of 114.0 mT.
MWC-03	The magnetic flux density is measured at the contact surface for each piece; it was found that the intensity is not uniformly distributed over the contact surface with the maximum of 210.0 mT. After installation the magnetic flux density inside the pipe is measured, it was found that the flux density is not uniformly distributed over the cross flow area or the covered length with the maximum of 110.0 mT.
MWC-04	It is not possible to measure the magnetic flux density at inlet section or exit section, it seems that some type of strainer is fitted at both inlet and exit and prevent the insertion of Tesla meter probe.

Preliminary Investigations

Preliminary investigations for the effect of magnetic water conditioners on the Hydrogen power (pH), total dissolved solids (TDS), and hardness of water are carried out. The investigations are performed using tap water, flowingin open loop and passing through a part of the pipe where the magnetic water conditioner is installed. Before passing through the magnetic water conditioner, the tap water inflow is analyzed and after outflow from the magnetic water conditioner is re-analyzed. The results obtained during this stage of preliminary investigations are obtained based on single reading. Table 7 illustrates the results of measurements and analysis for four different magnetic water conditioners, the analysis of inflow water is kept unchanged while the outflow water from each magnetic water conditioner seems to be variable. To assess the quality of measurements and analysis, the percentage variations between outflow and inflow are illustrated in Table 7. The situation will be clear if the uncertainty in measurements and analysis is considered.

Table 7. Results of Preliminary Investigations of Magnetic Water Conditioners*

MWC Code	Magnetic Flux Density** mT	Inflow Water Base Line Data			Outflow Water			Flow ml/s
		pH	TDS ppm	Hardness mg/L	pH	TDS ppm	Hardness mg/L	
					%	%	%	
MWC -01	170	7.53	221	129	7.59	221	132	32.5
					(0.8 %)	(0 %)	(2.33 %)	
MWC-02	114				7.61	220	135	30.7
					(1.06 %)	(-0.45 %)	(4.65 %)	
MWC-03	110				7.57	22	129	30.8
					(0.53 %)	(0 %)	(0 %)	
MWC-04	NA				7.57	213	129	25.0
					(0.53 %)	(-3.62 %)	(0 %)	

* Inflow water temperature is 24.8 °C and kept constant for all runs.

** The maximum measurable inside the pipe

Repeated Investigations

To consider the effect of uncertainty in measurements, same procedure as mentioned in 3.1 is applied with repeated measurements and analysis. The number of measurements for each run is 5.

For MWC-01 with average water flow rate of 103 ml/s with standard deviation of 6.116705 at 26.0°C, Figure 7 illustrates the measured pH, TDS, Hardness values for inflow water which are considered the base line data, where for the repeated measurements the high, low, and average values of measured pH, TDS, Hardness for the outflow water are also illustrated in Figure 7. The standard deviations for the repeated measurements and analysis are as follows:

Value	pH	TDS	Hardness
Standard Deviation	0.007071	8.105554	4.024922

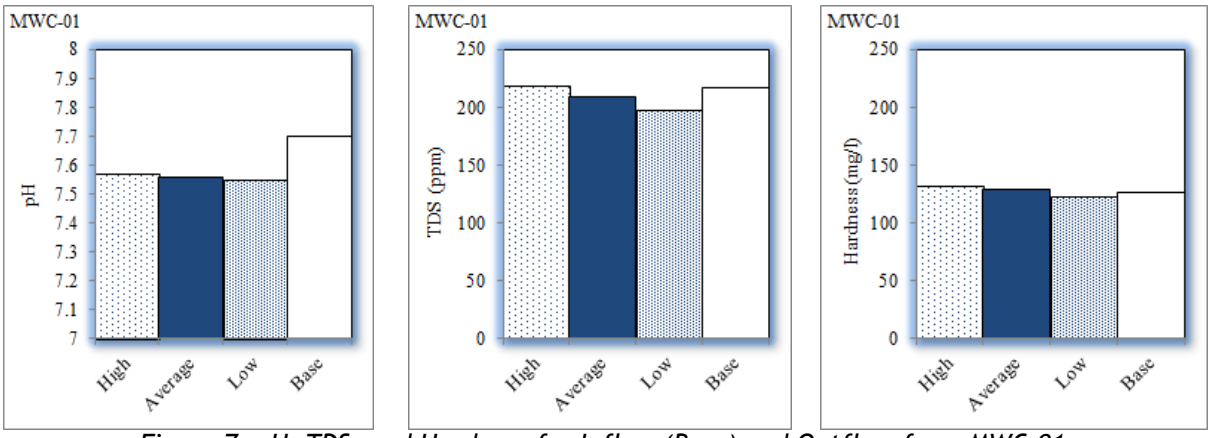


Figure 7. pH, TDS, and Hardness for Inflow (Base) and Outflow from MWC-01

For MWC-02 with average water flow rate of 108 ml/s with standard deviation of 2.587164at 26.0°C, Figure 8 illustrates the measured pH, TDS, Hardness values for inflow water which are considered the base line data, where for the repeated measurements the high, low, and average values of measured pH, TDS, Hardness for the outflow water are also illustrated in Figure 8. The standard deviations for the repeated measurements and analysis are as follows:

Value	pH	TDS	Hardness
Standard Deviation	0.053572	4.949747	10.26158

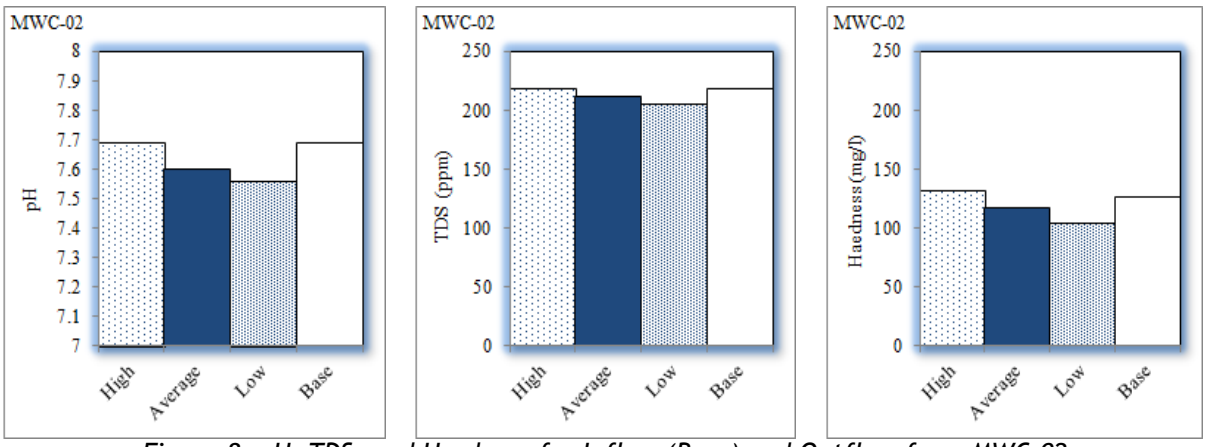


Figure 8. pH, TDS, and Hardness for Inflow (Base) and Outflow from MWC-02

For MWC-03 with average water flow rate of 107.8 ml/s with standard deviation of 1.25219at 26.0°C, Figure 9 illustrates the measured pH, TDS, Hardness values for inflow water which are considered the base line data, where for the repeated measurements the high, low, and average values of measured pH, TDS, Hardness for the outflow water are also illustrated in Figure 9. The standard deviations for the repeated measurements and analysis are as follows:

Value	pH	TDS	Hardness
Standard Deviation	7.52994	7.52994	7.52994

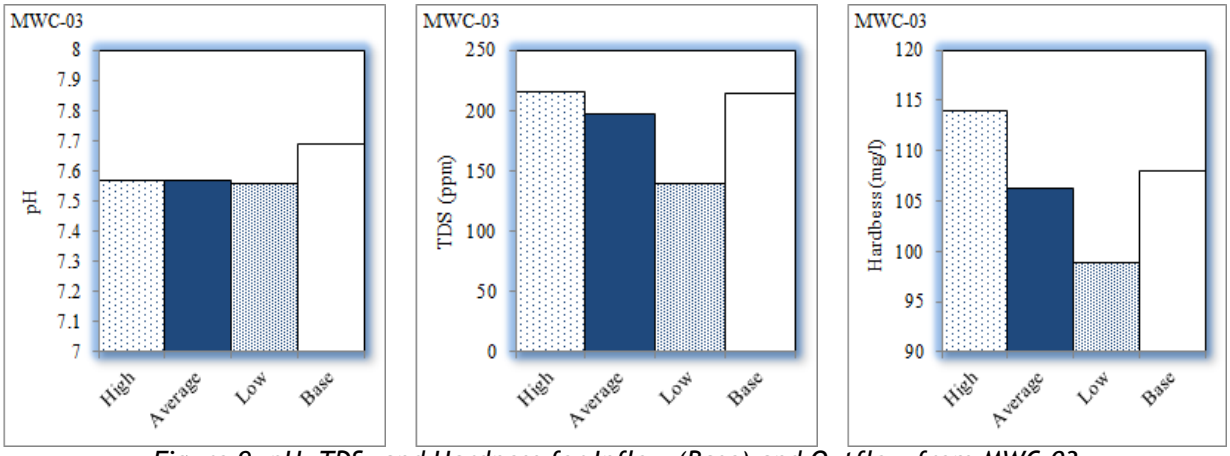


Figure 9. pH, TDS, and Hardness for Inflow (Base) and Outflow from MWC-03

For MWC-04 with average water flow rate of 95.796 ml/s with standard deviation of 6.500971at 26.0°C, Figure 10 illustrates the measured pH, TDS, Hardness values for inflow water which are considered the base line data, where for the repeated measurements the high, low, and average values of measured pH, TDS, Hardness for the outflow water are also illustrated in Fig. 10. The standard deviations for the repeated measurements and analysis are as follows:

Value	pH	TDS	Hardness
Standard Deviation	0.005477	2.167948	8.324662

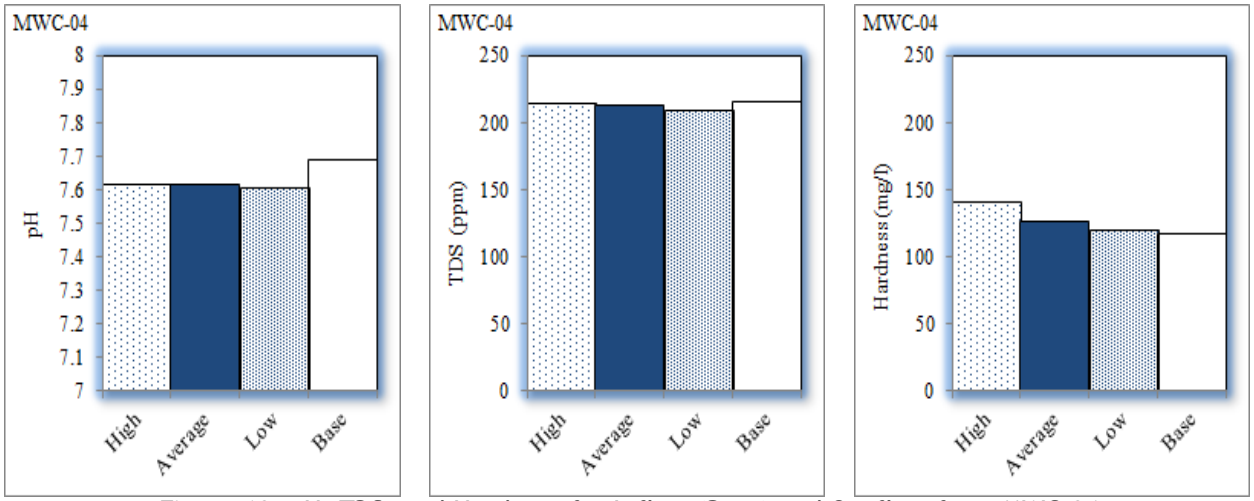


Figure 10. pH, TDS, and Hardness for Inflow (Base) and Outflow from MWC-04

Supplementary Investigations - Magnetic Shower Adaptor

The investigations are extended to different applications and conditions; MWC-04 is used per manufacturer as magnetic shower adapter (Fig. 11), while the inflow and outflow water samples are analyzed. The values of pH, TDS, and Hardnessare illustrated in Table 8.

Figure 11. Installation of MWC-04 as Magnetic Shower Adapter

Table 8. Analysis of Water for MWC-04 as Magnetic Shower Adapter*

Inflow Water			Outflow Water		
pH	TDS ppm	Hardness mg/L	pH	TDS ppm	Hardness mg/L
7.71	220	120	7.72	206	122

* Water temperature is 25.5 °C.

Magnetic Funnel

The investigations are extended to the magnetic funnel that is a patent product with the specifications that are illustrated in Table 9, while the results are illustrated in Table 9. The magnetic flux density inside the lower passage of the funnel is measured and it was found that, it is not uniform with maximum value of 0.073 mT.

The investigations consider two types of fluid flow passing through the magnetic funnel, tap water, and acidic solution (Lemon-water solution).

Table 9. Specifications of MWC-05

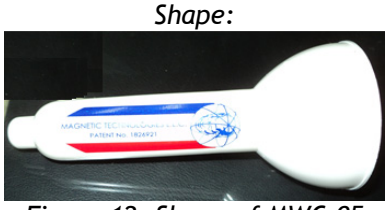
Brand	Specifications and Installation	Manufacturer
Magnetic Technologies	Magnetic Funnel - Yuri Tkachenko Patent No. 1826921 Description per Manufacturer: Magnetic funnel is the most efficient and effective method for magnetizing liquids. Liquid passed through the magnetic funnel acquire a finer and more homogeneous structure that significantly enhances the fluidity and dissolving ability as well as biological activity. Magnetic water has been successful in preventing and curing kidney diseases, kidney and gall stones in particular. Thorough research has proved the curative properties of magnetic water in dealing with many types of diseases: ☐ Consuming 250 ml. of magnetized water daily normalizes disorders of the cardio-vascular, digestive, nervous and urinary systems. ☐ Frequent use of magnetic water, decreases cholesterol content in blood, stimulates brain activity, improves digestion, increase appetite and reduces excess acidity and normalizes the function of bile. ☐ It aids in inducing proper movement of bowels and expels poisons and unwanted salts from the body. Shape:  Figure 12. Shape of MWC-05	Russian Technology U.A.E.

Table 10 illustrates the pH, TDS, and Hardness for inflow and outflow water while the sample collected from the outflow of total 500 ml.

Table 10. Analysis of Water for MWC-05

Inflow Water			Outflow Water		
pH	TDS ppm	Hardness mg/L	pH	TDS ppm	Hardness mg/L
7.63	213	120	7.64	214	129

** Water temperature is 15.5 °C.*

For acidic solution flows through the magnetic funnel at 23.0°C, Figure 13 illustrates the measured pH, and TDS, values for inflow solution which are considered the base line data, where for the repeated measurements the high, low, and average values of measured pH, and TDS for the outflow solution are also illustrated in Figure 13. The standard deviations for the repeated measurements and analysis are as follows:

Value	pH	TDS
Standard Deviation	0.01291	7.221001

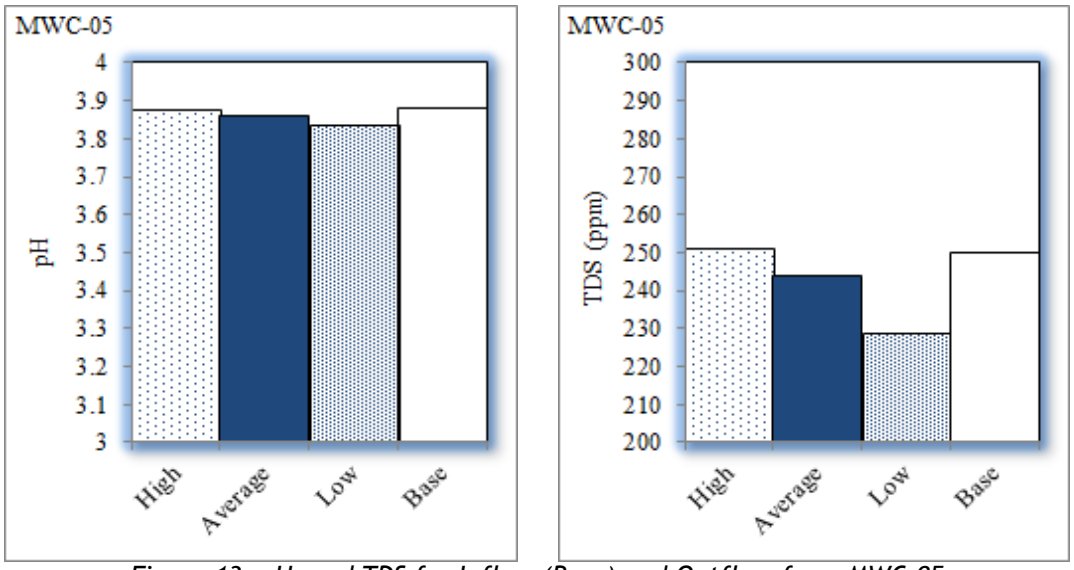


Figure 13. pH, and TDS for Inflow (Base) and Outflow from MWC-05

The present work is an attempt to scientifically investigate the claims of benefits for the magnetic water conditioners; the investigations are based on measuring the pH and TDS values and by EDTA titration to determine the Hardness. Throughout the work five different magnetic water conditioners are investigated, the investigations are divided into three categories. The preliminary investigations are carried out for magnetic water conditioners MWC-01, MWC-02, MWC-03, and MWC-04 and the results showed that; for tap water the pH varies from 0.53 % to 1.06 %, TDS varies from -3.62 % to 0 %, and Hardness varies from 0 % to 4.65 %.

The repeated investigations are carried out for magnetic water conditioners MWC-01, MWC-02, MWC-03, and MWC-04 and the results showed that; for tap water the results showed that; the variations in pH, TDS, and Hardness are in the range of uncertainty of measurements and analysis. The supplementary investigations are carried out for magnetic water conditioner MWC-04 as magnetic water adaptor without sensible change in the pH, TDS, and Hardness. While for MWC-05, for the tap water the results showed no measurable effect on the pH, TDS, and Hardness, and for acidic solution results showed that; the variations in pH and TDS are in the range of uncertainty of measurements.

The questions arise here; do magnetic water conditioners perform well? Is there a beneficial effect of magnetic water conditioners? One can deduce that; for the magnetic water conditioners and conditions in this work, there is no sufficient measurable evidence for the effect of magnetic water conditioners. By other words, is there sufficient scientific evidence of a beneficial effect to warrant spending hundreds of dollars on a residential magnetic water conditioners unit? Unlikely, the understanding of magnetic water conditioners must first be developed to the point where the effects of magnetic conditioners can be reliably predicted and shown to be economically attractive.

We think the previous result is the main reason for the most magnetic water treatment systems are marketed through independent distributors who sell out of their homes. An Internet search using the keywords magnetic water treatment reveals dozens of independent distributor home pages. Very few such devices are offered by national chain stores or advertised in mail-order catalogs. Possibly, the magnetic-device manufacturers sell through independent distributors to insulate themselves from some of the more exotic claimed benefits of magnetic treatment, or perhaps consumer and wholesaler

skepticism has kept magnetic treatment out of mainstream retail. Regardless of the reasons, magnetic water and fuel treatment devices are not usually available at the local hardware or automobile parts supply store. This lack of wide availability has given magnetic water and fuel treatment a sort of fringe-science status in the minds of many consumers.

CONCLUSIONS

Five commercial magnetic water conditioners are tested to investigate their effect on the tap water, unfortunately, after a lot of serious laboratory measurements and chemical analysis, it is concluded that; the magnetic water conditioners have no effect on the water pH, total dissolved salts, and hardness.

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