Olla H. Kareem
Department of Civil Engineering,
University of Technology, Baghdad, Iraq.
ulla_alobaidy94@yahoo.com

Abdul Hameed M.J. Al-Obaidy
Environmental Research Center,
University of Technology, Baghdad, Iraq.
10929@uotechnology.edu.iq

Riyad H. Al-Anbari
Dijlah University,
Baghdad, Iraq.
dr.alanbari@duc.edu.iq

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Improving the Properties of Main Drainage Water by Using of Magnetic Field Technique

Abstract- *In this research, main drainage channel treated by using a magnetic field with a density of (6000 Guesses). The general drain water samples flowed through the magnetic field with three levels of treatment (5 minutes, 15 minutes and 30 minutes) depending on the contact time. After treatment, it was found that the magnetic field works to improve more than ten physical and chemical properties of water. Essentially, Magnetic treatment has had a significant effect on the high salt content found in general drain water samples as it has been reduced and converted into simpler compounds. In addition, the magnetic field has an important role in increase the percentage of dissolved oxygen in water.*

Keywords- *Magnetic water, Physical properties, Salinity, Water treatment*

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1. Introduction

Iraq suffers from a scarcity of water resources, it is necessary to think seriously about finding scientific methods that make poor quality water with improved properties to compensate the decrease of water [1].

Among the techniques that are used to improve, the quality of water (drainage water) is the magnetic treatment technique (MTT), modern and sophisticated methods of water treatment, such as the use of MTT [2] , should be used. This technique was used in Europe in 1890, Australia in 1990 and its aim was to eliminate calcification in water transport pipelines [3]. These methods are unique in that they are safe, environmentally friendly, simple and low-cost [4]. In this technique, some water properties can be changed and the treated water can be used in some applications related to industry, agriculture, health and the environment [5]. The process of water treatment magnetically reinvigorates and strengthens the properties lost in the water obtained by desalination or environmental pollution, and the magnetic treatment (MT) reorganizes water shipments properly [6]. Many positive effects can be induced if water is exposed to a magnetic field of a certain intensity and thus affect its physical properties and its water is magnetically treated [7,8].The influence of the magnetic field (MF) on the structure of water and aqueous solutions are similar and can alter the physical and chemical properties of water-dispersed systems [9]. With the use of the magnetic field, hydration of salt ions and other impurities slides down and improve the possible technological characteristics of the water [10]. The main objective of this study is to determine whether magnetic water treatment (MWT) could improve the general drain water properties. Moreover, influence of magnetic field strength (MFS) on magnetization effect was discussed.

2. Materials and Methods

The practical side of the research consists of three basic stages:-

The first stage was designed of the magnetic system for water treatment, while the second stage was the collection of water samples and analysis their physical and chemical properties. Then the third stage was to treat the water by the magnetic field with three degree of treatment (5 minutes, 15 minutes and 30 minutes) depending on contact time. The practical side of this study explains in the flow chart as shown in (Figure 1).

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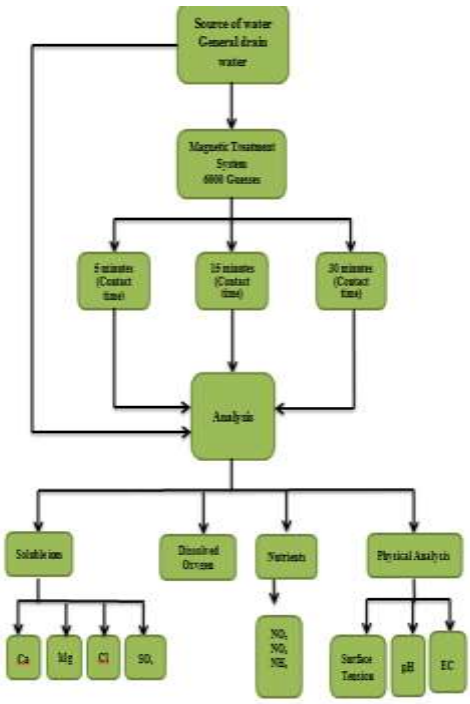

Figure 1: Flow chart of practical side of study

I. Design of magnetic treatment system (MTS)

The magnetic treatment device used in this study was the magnetic liquid modifier (Bipolar), manufactured in the Ministry of Science and Technology as shown in (Figure 2). Its diameter is 3/8 inch (0.952 cm) and its effective length (the length of the magnet) is 17.5 cm with a magnetic flux intensity of 6000 gauss (0.6 Tesla). It was connected to the system by the direction specified on the product itself, and connected to a container, in which the water was stored before passing through the magnetic treatment device for treatment as shown in (Figure 3). The average flow rate of water through the magnetic treatment device in this study was 500 ml/min (3.3*10-6 m3/sec), it was adjusted by a control and remained constant for all experiments.

Figure 2: Experimental Magnetic Treatment Device

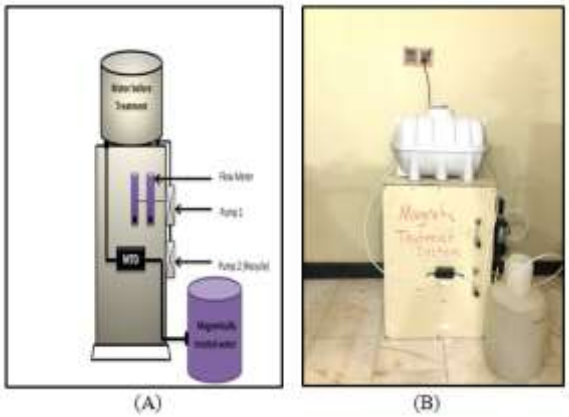

Figure 3: demonstrate (A) Schematic and the experimental setup used for magnetic water treatment (B) Magnetic treatment system

II. Collection of water samples and analysis their physical and chemical properties

A. Water samples

The sources of water samples used in this study were taken from general drain water in Al-Yosifeya southeast of Baghdad (N 33°7'69", 44°21'84" E) as shown in Figure 4. The phenotypic of water samples were characterized by a high percentage of impurities, dark color and undesirable odor. The irrigation water quality characteristics are shown in Table 1.

Figure 4: water source in general drain water and the filled up tanks

Table 1: General drain water characteristics

CATIONS (mg/L)					ANIONS (mg/L)			
Ca^{++}			Mg^{++}		CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}
165.7			221.48		0	190.3	1720.3	3300
NUTRIENTS (mg/L)					pH	DO (mg/L)	SANILITY	
NH_4	NO_3	NO_2	PO_4	TP	8.6	2.27	EC (µs/cm)	TDS (mg/L)
2	1.74	1.38	4.4	3.16			6250	2550
TURBIDITY (NTU)			O_2%		SALT (mg/L)		Temperature	
4.42			29.4%		1.85		24.9 c	

B. Analysis the properties of magnetically treated water

Water characteristics were analyzed before and after treatment by using the methods as listed in Table 2. Procedures followed for analysis have been in accordance with the "Standard Methods for Examination of Water and wastewater [11].

The samples of water was divided into four groups depending on the degree of treatment, each of them contain three samples. The first group was not treated (control), the second group was treated with 5 minutes contact time, the third group was treated with 15 minutes contact time and the fourth group was treated with 30 minutes contact time. After 5 minutes of treatment, the analysis of water began for each group before and after treatment. More than ten properties of water were analyzed to investigate the effect of magnetic field on them and show the ability of magnetic field to improve them.

Surface tension was be studied to show the effect of magnetic field on it, the change of it could be calculated by the following equation [12]:

Percentage of reduction =1-($cos\ \theta_0/cos\ \theta_1$) (1)

Where; 1: Ratio of change in angle of contact and surface tension

θ_0: it's the contact angle of control water

θ_1: it's the contact angle of water after treatment

Table 2: Analytical methods of selected water quality constituents

Constituents	Methods
pH	Method 4500 H^+ "pH Value"
EC	Method 2510 B, "Electrical Conductivity"
Ca^{2+}	Method 3500-Ca B, "EDTA Titrimetric Method"
Mg^{2+}	Method 3500-Mg B, "Calculation Method"
Cl^-	Method 4500-Cl B, "Argentometric Method"
NO_3-N	Method 4500- NO_3 D, "Nitrate Electrode Method"

3. Results and Discussion

I. Physical properties of general drain water

A. Surface tension

After magnetic treatment it was found that the magnetic field has an effect on the angle of surface tension as it works on decrease it.

The percentage of reduction in surface tension for (5 min.) contact time is: 1- ($cos64^\circ/cos61^\circ$) = 9.5%.Thus for all degrees of treatment as shown in Table 3. From the surface tension results, it is clear that the more contact time within magnetic field the more of reduction in general water surface tension. Pang and Deng [13] concluded that the decrease in surface tension of water is decreasing the hydrophobicity of water, which will reflect on the flow characteristics of the fluids in the pipeline systems. Adding to that the movement of water in soil become more easiness, and its uptake by the plant become better.

Table 3: Surface tension reduction of different levels of magnetically treatment

Degree of treatment	Angle of surface tension	Percentage of reduction
Control (no treatment)	64°	-
5 min.	61°	9.5 %
15 min.	56°	21.6%
30min.	49°	33.1 %

B. pH value change after magnetic field

This test was conducted to show the effect of magnetically treatment of general drain water after passing through the magnetic field until 12 hours. Figure 5 illustrates the pH values change of the 3 groups of water with different levels of treatment.

The results of this study showed that when the water was subjected to a magnetic field with three different levels of treatment (5, 15 and 30 min.), the pH values of the water were magnetically treated were increased by increasing the contact time of the treatment [7]. This is because magnetically treated water tends to alkaline rather than acidic because of the increase of hydroxyl ions at the expense of hydrogen ions in water

[14].The results showed also, that there is no significant change in the general drain water pH values for 12 hours after magnetic treatment.

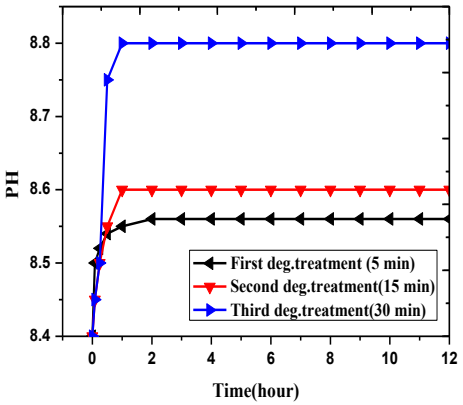

Figure 5: The relationship between pH value and degree of magnetically treatment

C. EC changes after magnetic field

After the flows of water within the magnetic field and for different contact time, it was found that the value of the EC varies depending on the period of treatment as shown in the Figure 6 (A, B, C). The results proved that the value of the EC decreased after magnetic treatment and this was consistent with [15], which showed that the magnetization of water affects the change in EC values. That the magnetization of water will try to redistribute molecules of soluble salts and make them less common in the solution of colloid, which in turn leads to a slight decrease in the value of salinity after magnetization of water [7].

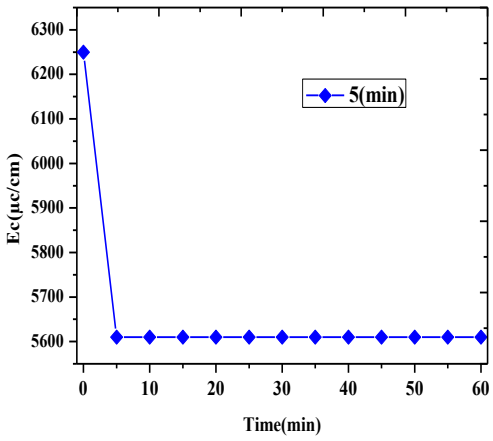

Figure 6 (A): The change in the value of EC with a treatment period of 5 minutes

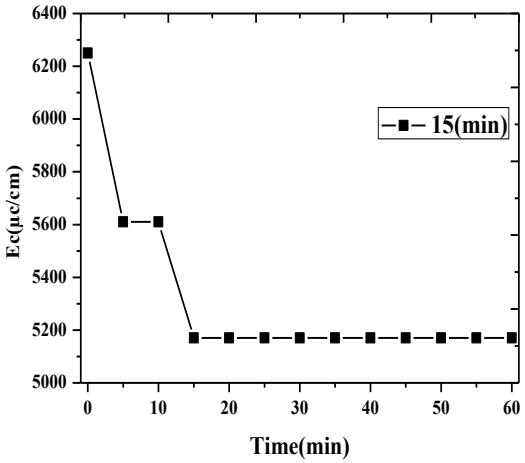

Figure 6 (B): The change in the value of EC with a treatment period of 15 minutes

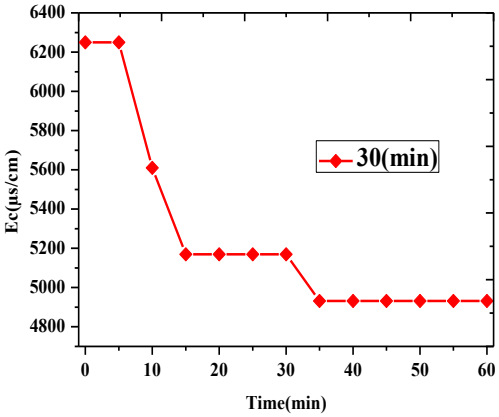

Figure 6 (C): The change in the value of EC with a treatment period of 30 minutes

II. Investigation of the effect of magnetic field on nutrients concentration of water

This test was conducted to show the change in the level of nutrients present in irrigation general drain water under the effect of magnetic field with four levels of treatment (0, 5, 15, and 30) minutes and parameters are considered in this analysis were: NH4, NO2, and NO3.

The results showed that the magnetic field had a slight effect on its nutrient concentration in water as shown in Table 4 .

Table 4:- Effected of magnetic field on nutrients concentrations

Parameter	0min.	5min.	15min.	30min.
NO_3 (mg/L)	1.74	1.74	1.764	1.78
NO_2 (mg/L)	1.38	1.38	1.39	1.41
NH_4 (mg/L)	2	2	2.1	2.17

I. Effect of magnetic field on dissolve oxygen concentration (DO)

It is clear that the concentration of DO in water increases with increasing the period of magnetic

field exposed to water as shown in Table 5. The results of this study were agreed with [16] when using a magnetic field with a density of 500 Gauss, there was a significant increase in the dissolved oxygen concentration of water from 5.43 mg /L to 10.62 mg/ L, this is because magnetically treated water is used to solve many different problems and helps improve water quality.

Table 5: Increasing in (DO) concentration according to period of magnetically treatment

Period of treatment (min.)	Dissolve oxygen concentration (mg/L)
0	2.27
5	5.62
15	8.29
30	10.91

V. Effect of magnetic field on soluble ions

All of concentrations of the ions of **(Ca^{+2} , Mg^{+2} ,CL^{-1} and SO_4^{-2})** decrease with increasing the period of magnetically treatment as shown in Table 6. These results proved that the magnetic field works to reduce the concentration of salt ions as it transforms them into simpler compounds [12].

Table 6: The effect of magnetically treatment on soluble ions

Period of treatment (min.)	Ca^{+2} (mg/L)	Mg^{+2} (mg/L)	CL^{-1} (mg/L)	SO_4^{-2} (mg/L)
0	165.7	221.4	1720.3	3300
5	142.3	202.6	1695.5	3140
15	112.4	194.3	1600.4	2854
30	96.4	174.2	1430.3	2410

4-Conclusion

Water treatment has been done using magnetic field technology, which is considered a modern technology and does not require an electrical source because its principle is magnetic induction.

Magnetic treatment is one of the most environmentally friendly, low cost and gives positive results in improving the properties of physical and chemical water. The following conclusions were obtained after analyzing field results:

1-The magnetic field had a positive effect on the surface tension of the water (the contact angle) where it reduced by (23%) and is a good indicator of plant growth, when the contact angle decreases, the absorption rate of the plant increases by the capillary property.

2-pH value increases by increasing the contact time of the water inside the magnetic field, through the results of the research had been showing that the time (30 min.) contact time gave the highest value of pH which is(8.9) and kept the water value for up to 12 hours.

3-Electrical conductivity (EC) was significantly affected by the magnetic field where the field reduced its value during different degrees of treatment (depending on the time of exposure to the magnetic field), which decreased by (10.4 %, 20.3 %, and 45.7) through four contact time (5, 15, and 30 minutes) respectively.

4-Concentration of dissolved oxygen (DO) increased gradually by (59.6%, 72.6%, and 79.1%) for contact time (5, 15, and 30) respectively. This proves that the magnetic field works on the disintegration of hydroxyl compounds and the release of oxygen ion.

5-The concentration of nutrients (NO_2, NO_3, and NH_3) in irrigation water is affected by the magnetization obtained for water. It is true that the effect changes slightly in the results, but this change had a significant impact on plant growth and recorded the highest increase in nutrient concentration at 60 minutes contact time.

6-The concentration of soluble ions was reduced, and the highest value of reduction was recorded with 60 minutes contact time, these ions are:

*Ca^{+2}: reduced by 45.5%.
*Mg^{+2}: reduced by 23%.
*Cl^{-}: reduced by 18%.
*SO_4^{-2}: reduced by 27.4%.

This study shows that this technique works to improve the properties of water in particular salt concentration as it reduces its value, which is considered an indicator of the presence of salts and increases the concentration of dissolved oxygen. This treatment is more efficient by increasing the exposure time of the water to the magnetic field, where the longer period of treatment gets more efficient with stabilized magnetic intensity. This treatment has many applications in the field of agriculture because it works to reduce the surface tension of the water so that the plant easily absorbs water from the soil.

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