Effect of Magnetization on Some Physical Properties of Almasab Alam Salty Water

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Abstract. In this paper, the effect of magnetic field (MF) on some physical properties of water is investigated. Salty water (SW) and five types of magnetized water (MW) were measured under the same conditions. Each case is repeated three times, and the average of the three cases is taken. It was found that the properties of SW were changed following the intensity of MF treatment, showing a decrease in the duration of the evaporation, boiling point, density, and increase solubility after magnetization. The changes depend on the magnetization effect. The optimal magnetizing condition was determined as the MF strength of 3000 Gauss. The findings of this study offered a facile approach to improve irrigation water and agriculture soils, cooling, and power generation efficiency in industrial.

Keywords: Irrigation water; magnetization; physical properties; Almasab Alam; salty water.

1. Introduction

Irrigated agriculture is dependent on an adequate water supply of usable quality. Water quality concerns have often been neglected because good quality water supplies have been plentiful and readily available. This situation is now changing in many areas. Intensive use of nearly all good quality supplies means that new irrigation projects and old projects seeking new or supplemental supplies must rely on lower quality and less desirable sources. Sound planning must ensure that the quality of water available is put to the best use [1].

Numerous papers reported that the magnetic field (MF) could change the physicochemical properties of water for several decades [2,3,4]. When water passing through an MF, it becomes magnetized water (MW). Study the optical properties of water between two strong magnets; they found that the infrared absorption property of MW changed [5]. Some studies concluded MF could enhance the conductivity and decrease the surface tension of water [6,7]. Other studies have tested the effect of a static MF on liquid water using frictional experiments; the results suggested the friction coefficient was small [8]. Other researchers studied the effect of MF on the hydrogen bonds of water and discussed the mechanism of magnetization based on molecular dynamics simulation, experimental and theoretical models [9–10].

Although many properties of water that MF influences have been reported from lots of studies, few works focus on specific heat, evaporation amount, and boiling point of MW. These properties are essential in various applications, including condensed systems, thermal power, and other fields. This work aims to investigate the effect of MF on some physical properties of Almasab Alam salty water, such as boiling point, density, duration of evaporation, and solubility of MW and SW. Moreover, the influence of MFS on the magnetization effect was discussed. Five different magnetic field intensities (1000, 2000, 30000, 5000, and 7000) Gauss are used in this study.
2- Materials and method

The project Almasab Alam is of significant development projects in Iraq since it is essential in the transfer of saltwater extracted from land reclamation in the central and southern Iraq through the interconnected network of drainages start from a total of drainages field covered to collected drainages, and then the secondary and the main is in the end. The course of Almasab Alam is responsible for paying saline water to the Arab Gulf through the Home of its sections. The idea of setting up Almasab Alam is in the fifties of the last century when one of charged U.S. companies to prepare a map of networks drainages restricted between the rivers Tigris and Euphrates.

The project was directed in 1973 (first phase) and carried out the work in phases. The project was running on 12/12/2008 after completing the final implementation of the main pumping station south of Nasiriyah. Its coordinates are (30°58'09" N, 46°20'38" E) the discharge capacity is 220 m³/sec. The study area between the station 360+000 with coordinates (519159, 3563531) and the station 441+000 with coordinates (461006, 36300087) represents the site of Almasab Alam in the governorate of Babylon, shown in Figure 1.

![Figure 1. Study area.](image-url)

This research is to study the effect of magnetization on boiling point, density, duration of evaporation, and solubility of Almasab Alam water for five different intensities (1000, 2000, 30000, 5000, and 7000) Gauss selected for MW (Magnetic Water) preparation. The samples are identified as MW-1 (1000 G), MW-2 (2000 G), MW-3 (30000 G), MW-4 (5000 G), MW-5 (7000 G), and NMW (No Magnetic Water) for Almasab Alam water. Each case is repeated three times, and the average of the three cases was taken. Table 1 shows the studied saltwater properties from Almasab Alam drainage before and after the magnetization.
Table 1. The properties of study saltwater.

| Water type | Ec (mmhos) | TDS (ppm) | pH  |
|------------|------------|-----------|-----|
| NMW        | 5.30       | 3400      | 8.20|
| MW-1       | 5.31       | 3410      | 8.20|
| MW-2       | 5.87       | 3512      | 8.22|
| MW-3       | 6.11       | 3912      | 8.30|
| MW-4       | 6.20       | 3935      | 8.30|
| MW-5       | 6.31       | 4040      | 8.32|

2.1 Magnetize water device
Al-Nahrain University developed magnetized water equipment with five different intensities (1000, 2000, 30000, 5000, and 7000) Gauss. These devices are constructed from a 16 mm diameter plastic tube and surrounded by a constant magnetic strength required for each device, and the flowrate is (0.20 l/s). The volume of the upper and lower tank is 20 letters. Figure 2 shows the magnetized water unit, which was packed from the outside by another plastic tube.

2.2 The boiling point of water
The boiling point of water was determined, which required two tubes blocked at one end. The first was a regular capillary tube used to determine the melting point of solids 100 mm in length and 1 mm in diameter, and the second was 90 mm in length and 5 mm in diameter. A small amount of liquid 0.25-0.5 ml is placed in the wide tube, and the capillary tube is inserted into the liquid (well water is magnetized or not magnetized) so that the sealed end is upward and the wide tube is connected to the leg of the thermometer with a rubber ring. As shown in Figure 3, the thermometer is covered with its accessories. The water bath is used to measure the melting point of solids. When the bath is heated gradually, air bubbles will slowly release from the end of the capillary tube submerged in the liquid, and when the liquid reaches its boiling point, we notice the air bubbles quickly and continuously, and the thermometer reading gives the liquid boiling point in degrees.
2.3 Solubility
To estimate the solubility of SW and MW, a small amount of water is taken and dissolved 1 gram of table salt in (100 ml) of the water sample before its magnetization, as well as dissolving 1 g of table salt in (100 ml) of the water sample after it was magnetized and then we left it for an hour and put the two samples in a device. EXAO calculates the transparency ratio [8].

2.4 The density of water
The density of magnetized and non-magnetized water is estimated using a density flask and at a laboratory temperature of 25 °C, as it is weighed empty and then weighed with water. The difference is the mass of water, and by dividing this mass by its volume, the density is obtained in (gm/cm³) [11].

2.5 Evaporation
To determine the duration of evaporation for SW and MW or before and after magnetizing, provided the same conditions for all samples of temperature, the vessel used for heating, and the amount of water estimated at 10 ml in each sample.

3- Results of tests
The effects of magnetizing saline irrigation water on some of the water's physical properties are as follows:

3.1 Boiling point:
Table 2 and Figure 4 show the effect of magnetization of saline irrigation water for the site under study on the average degree of the boiling point of irrigation water. As the results showed, in general, a highly significant effect in the decrease of the rate of the boiling point of magnetized water compared to the boiling point of ordinary non-magnetized water. The highest decrease of the rate was achieved when the water was magnetized with 3000 Gauss and in proportion to its amount of 1.52%. The basis of the idea of magnetized water is to make the water pass through a magnetic field inside the magnetizing device so that the water is affected by the magnetic flux, making it the arrangement of the internal particles as electrical charges. It works on the magnetization of water, or as a result of the movement of electrons and the completion of the electronic shell with the covalent bond, the water has acquired the magnetic property, which is why it has a zero electromagnetic moment. When it is subjected to an external magnetic field, it reaches a magnetic moment related to the nature of the magnetic property, which is the decrease in its internal magnetic induction, resulting in inductor magnetization. When saltwater is magnetized, it acquires energy due to the magnetic moment [3,4].
Thus, it increases the movement of water molecules and salt ions present with it, and that this energy can disengage the bound water molecules and salt ions. Therefore, it needs little energy for evaporation by placing it at a level boiling is less than regular water, as the latter needs energy to disengage and energy for evaporation. Therefore, normal water needs a higher boiling point than magnetized water. The lower boiling point of the water after its magnetization because the magnetization gives higher energy to the water ions and thus helped to disentangle the ions from each other and increased the value of evaporation. Therefore, the escape of water molecules from the surface and evaporation will be faster and with a shorter period than the salty water, and as a result, it needs a degree of boiling less than saltwater.

**Table 2. Effect of magnetic field on the boiling point of saltwater.**

| Water type | Boiling point (°C) | The difference with NMW (%) |
|------------|--------------------|-----------------------------|
| NMW        | 98.5               | ----                        |
| MW-1       | 98.2               | -0.03                       |
| MW-2       | 97.6               | -0.09                       |
| MW-3       | 97.0               | -1.52                       |
| MW-4       | 98.0               | -0.05                       |
| MW-5       | 97.5               | -1.01                       |

**Figure 4. Effect of magnetic field on the boiling point of saltwater.**

### 3.2 Degree of solubility

The results obtained in Table 3 and Figure 5 showed the percentage of transparency in water before magnetization and after magnetization. By observing the results, it was found that the percentage of transparency in magnetized water is higher than that of non-magnetized water, which indicates that the solubility of magnetized water is higher than the solubility of non-magnetized water. The highest transparency rate was achieved when the water was magnetized with 3000 Gauss, and it outperformed non-magnetized water by 14%.

**Table 3. Effect of magnetic field on transparency percentage of saltwater.**

| Water type | Transparency percentage (%) | The difference with NMW (%) |
|------------|----------------------------|----------------------------|
| NMW        | 66                         | ***                        |
| MW-1       | 68                         | +2                         |
| MW-2       | 74                         | +8                         |
| MW-3       | 80                         | +14                        |
| MW-4       | 72                         | +6                         |
| MW-5       | 75                         | +9                         |
The high solubility of magnetized water compared to normal non-magnetized water is because water is a polar liquid. One part of the water molecule has a positive electric charge, and the other has a negative electric charge, but the resultant electric charge is negative. In other words, water is a dipole, and its magnetic or electric field is subject to change by rotating the molecule in one direction or the other direction to take a high voltage, negative or positive, depending on the external magnetic field used on the south (positive) or North Pole (negative). Thus, the positive influence field extending to the South Pole makes the water more soluble and less surface tension [12].

3.3 Evaporation
Table 4 and Figure 6 show the results of the duration of evaporation. From Table 4, the duration of evaporation of the water sample is decreased after magnetization. The highest decrease rate in duration time of evaporation was achieved when the water was magnetized with 3000 Guass, and the proportion to its amount was 26%. From the results, we conclude that the relation between boiling point and the duration of evaporation is an inverse relationship.

3.4 Water density
The results of Table 5 and Figure 7 show the magnetization of saline irrigation water for the site on the average water density. The results showed that there is a decrease in the density value than it was before magnetization. The highest decrease rate in duration time of evaporation was achieved when the water was magnetized with 3000 Guass, and the proportion to its amount was 0.13%. This result is consistent with what Gallon [12] indicated that the magnetization of water leads to improvement and reduction of water's physical and kinetic properties.
Table 4. Effect of magnetic field on the duration of evaporation of saltwater.

| Water type | Duration of evaporation | The difference with NMW (%) |
|------------|-------------------------|-----------------------------|
| NMW        | 4.853                   | ---                         |
| MW-1       | 4.822                   | - 1.56                      |
| MW-2       | 4.809                   | - 3.07                      |
| MW-3       | 4.617                   | - 26                        |
| MW-4       | 4.821                   | - 1.70                      |
| MW-5       | 4.800                   | - 4.20                      |

![Density of water (gm/cm³)](chart.png)

Figure 7. Effect of magnetic field on water density of saltwater.

Table 5. Effect of magnetic field on the density of salt water.

| Water type | Water density (g/cm³) | The difference with NMW (%) |
|------------|-----------------------|-----------------------------|
| NMW        | 1.03000               | -----                       |
| MW-1       | 1.0298                | - 0.019                     |
| MW-2       | 1.0291                | - 0.087                     |
| MW-3       | 1.0287                | - 0.130                     |
| MW-4       | 1.0293                | - 0.068                     |
| MW-5       | 1.0289                | - 0.011                     |

The water molecules are linked to each other by hydrogen bonds, and these bonds may be double or multiple, up to tens of bonds. When water molecules are placed inside a magnetic field, these hydrogen bonds between molecules either change or break down. This disintegration works on energy absorption reduce the union of water parts and increases electrolysis susceptibility [11].

4- Discussion of results

Our experimental results suggest that Magnetic fields (MF) have changed some physical properties of saltwater, including boiling point, density, duration of evaporation (evaporation amount), and degree of solubility. The evaporation amount results are consistent with reports in the literature that the evaporation amount of salty water increases after MF treatment [6,8,13]. It is worth pointing out that the test conditions are room research different at the same time as in our study is from room temperature to boiling point temperature, and the degree of increase is more obvious in our study. This can be explained by the evaporation become faster during the heating process.

Moreover, this study explores the effect of MF on the duration of evaporation and boiling point of salt water, and the decrease of specific heat and boiling point has been observed. This is an important result that can provide a new way to change the two properties of water and then apply them to the relevant industries to save energy. In this study, the degree of solubility increases, and the density...
decreases when saltwater passes through MF. When the solubility degree of irrigation water increases, it improves the soil's properties due to the water's ability to dissolve the salts in the soil. In addition, the optimal result in all experiment is achieved in MW3, which indicate that the magnetization effect reaches a maximum when the MF strength is 30000 Gauss, it must be pointed out that the magnetization effect does not enhance with increasing MF and the result was also reported by other researchers [3,5,14,15]. At the same time, some studies have been carried out to investigate the effect of MF on the properties of pure water or high-level purified water [2,5,3].

The changes are generally similar to that of saltwater, such as more evaporation amount, lower surface tension, and higher conductivity [10,11,16]. Therefore, it can be inferred that dissolved solids and ions have a very limited influence on the magnetization effect, and the influence extent should be studied in the future. But still, the principle of MF treatment is obscure, several authors have been done in the attempt to understand it, and the hypothesis was proposed that the hydrogen bonds among water molecules were probably affected by MF [8,11]. However, no clear mechanisms of this effect have been reported in the literature.

5. Conclusions
This article has examined the effect of magnetic field treatment on some physical properties of Almasab Alam saltwater. The study reached the following conclusions:

- The magnetic field treatment changed the degree of solubility, density, evaporation amount, and boiling point of water. The results in this study are helpful in the application of MW to improve soil properties, cooling, and power generation efficiency in industries.
- The magnetization of Almasab Alam saltwater decreases the density, evaporation amount, and boiling point and increases the degree of solubility of water.
- The optimal magnetizing condition was determined as the magnetic field strength of 30000 Gauss.
- The relation between boiling point and the duration of evaporation is an inverse relationship.
- Increasing water solubility helps improve agricultural soil properties.

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