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The Utilization of Magnetized Water for the Improvement of Crude Oil Quality

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Abstract

The crude oil binds from the oil fields to the refinery with water. This water contains dissolved salts, mostly chloride salts ($CaCl_2$, NaCl, and MgCl2), which is one of the components of the water emulsion in crude oil leading to the contamination of the crude oil. This pollution has a serious negative impact on the refinery units if left untreated, causing many Problems such as (corrosion, sedimentation, blockage of exchanger tubes and furnaces, and other problems). As a result, it is necessary to treat the crude oil salts and remove the effect of the salts by desalinating the oil at different stages during production at the wells and then in the refinery unit. Desalination is the main equipment used in the process of washing crude oil from salts using ordinary freshwater

This work aims to use magnetized water as a substitute for normal water in the stage of washing crude oil salts by installing a water magnetization device with strength of (4500) gauss, at the site of the washing water injection line before the mixing valve at the desalination remover. The results showed that the magnetized water increased the efficiency and energy of the water used, reduced the deposition of salts and corrosion in the tubes of the distillation unit, as well as helped to crack the salt ions and transform its molecules into smaller particles and reduce their concentration in the crude oil.

Keywords: Magnetized water, bioenergy of magnetized water, crude oil processing optimization, crude oil desalination, green technology.

استخدام الماء الممغنط في تحسين معالجة أملاح النفط الخام

الخلاصة:

يرتبط النفط الخام المنتج من حقول النفط إلى المصفاة بالمياه. يحتوي هذا الماء على أملاح مذابة، معظمها أملاح الكلوريدات ($CaCl_2$ ، NaCl، $MgCl_2$)، والتي تعد أحد مكونات مستحلب الماء في النفط الخام، مما يؤدي إلى تلوث النفط الخام .هذا

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التلوث له تأثير سلبي خطير على وحدات المصفاة إذا ترك دون معالجة يسبب العديد من المشاكل مثل (التآكل، الترسيب، انسداد أنابيب المبادلات والأفران ومشاكل اخرى). نتيجة لذلك، لابد من معالجة أملاح النفط الخام و إزالة تأثيرها، وذلك عن طريق تحلية النفط في مراحل مختلفة أثناء الإنتاج عند الأبار ثم في وحداة المصفى. تعد مزيلة الاملاح المعدة الرئيسية المستخدمة في عملية غسل النفط الخام من الأملاح بأستخدام الماء العذب العادي.

تهدف هذه الورقة البحثية إلى استخدام الماء الممغنط بديلا عن الماء العادي في مرحلة غسل أملاح النفط الخام عن طريق تركيب جهازمغنطة الماء بقوة (4500) كاوس، في موقع خط حقن ماء الغسل قبل صمام الخلط عند مزيلة الاملاح. أظهرت النتائج أن الماء الممغنط زاد من كفاءة وطاقة الماء المستخدم ، قلل ترسب الأملاح والتآكل في أنابيب وحدة التقطير، كذلك ساعد على تكسير أيونات الملح وتحويل جزيئاته إلى جزيئات أصغر وتقليل تركيزها في النفط الخام.

1. Introduction:

Magnetic energy is one of the types of energy in the universe, and magnetic water is a new phenomenon with a scientific basis that has started in many countries around the world in various fields and has achieved many benefits. Water is a simple molecule made up of two hydrogen atoms and one oxygen atom bonded together by hydrogen bonds, as we all know. These relationships can be single, double or multiple. When water molecules are exposed to a magnetic field, the hydrogen bonds between them change or disintegrate as a result of their expansion, which weakens the bonds and leads to their disintegration easily [1-3].

This dissociation depends on the absorption of energy, which reduces the level of union of water molecules and increases the electrical conductivity, as well as affects the dissolution of crystals inside a water molecule, rearranging and building them in a different way, unlike ordinary water [4]. Since the salts dissolve in the water in the crude oil molecule, it requires washing the crude oil with water at a specific pressure and temperature, so treating the oil entails removing both the water and the salt [5].

"Salts of chlorides" refer to the vast majority of the salts found in crude oil. Salt is suspended in crude oil in the form of small crystals dissolved in free water, creating a state known as petroleum emulsion, which is difficult to decompose and requires rather complex practical solutions. While free water can be removed easily and quickly from crude oil by stabilization and other processes [8]. In addition, crude oil contains various amounts of inorganic solid plankton, such as iron oxides, sand, crystallized salt, carbon and sulfur, which will be partially removed during the desalination process because many of these components are bound to water droplets that will be removed later [12].

As a result, water is the main material used in removing the dangerous effect of organic

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and inorganic plankton, so the removal depends on the amount of efficiency and effectiveness in addition to the nature of the operational conditions of the water used. As a result of this, the research paper developed a different nature for the water used by the normal user, which is the magnetic effect of water and making it magnetized by passing it through a specific magnetic field or by placing this magnetic field inside or near it for a certain period of time according to the strength of the field used, which will lead in the end To a change in many properties as a result of exposure to the influence of the magnetic field [15].

Note that the process of magnetization of water does not change the composition of the water or purify it in any way (if the water is contaminated with impurities), but the magnetization affects the rearrangement of the dispersed particles and improve their effectiveness, meaning that all these changes in the properties of water are due only to the rearrangement of the molecules The water after applying the magnetic field perpendicular to the water flow through a channel defined by the water magnetization device [9]. Without causing any negative effect.

On the other hand, naturalists, environmentalists, and researchers are scrambling to use magnetic technology because it is derived from natural and beneficial sources without any unintended consequences. And the overall changes that occur in the water are in accordance with the principles of physics, where a magnetic field is created in the form of lines parallel to the flow tubes, without the appearance of any negative effect, as shown in Figure (1).

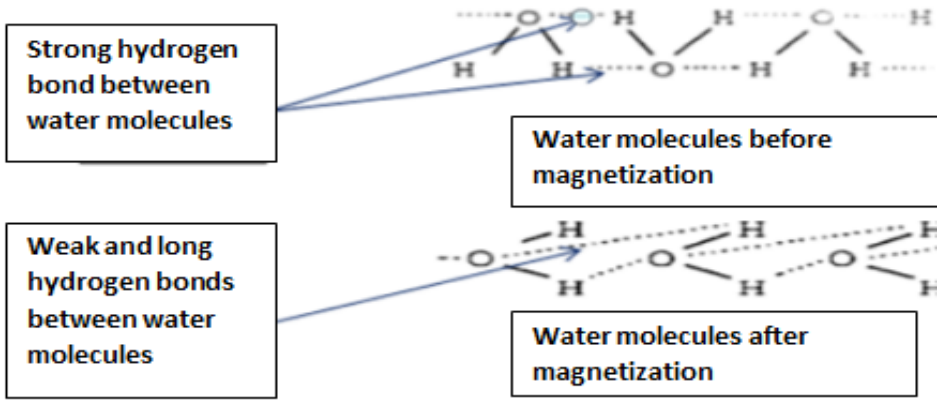

Fig. (1): Describes a comparison, arrangement of water molecules before and after the placement of the magnetic field [9]

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1.1 Magnetized water:

Magnetized water is water that has been exposed to a magnetic field for a period of time, or water that has been subjected to a magnetic field during as shown in Figure (2) before and after the influence of the magnetic field [7].

The magnetic field changes (14) properties of water, including:

- Improving the ability to dissolve and break down salts and decompose their sediments.
- Polarization of water molecules with weak ionic bonds, rearranging the irregular (random) molecules to a more efficient and effective regular arrangement.
- Improving the ability to absorb acids.
- Increase electrical conductivity and reduce surface tension.
- Increased solubility of oxygen in water by 10%.
- A change in the rate of chemical reaction, evaporation property, ductility, ductility, and an increase in permeability.
- Increase the pH value.
- Reducing water viscosity by 30-40%.

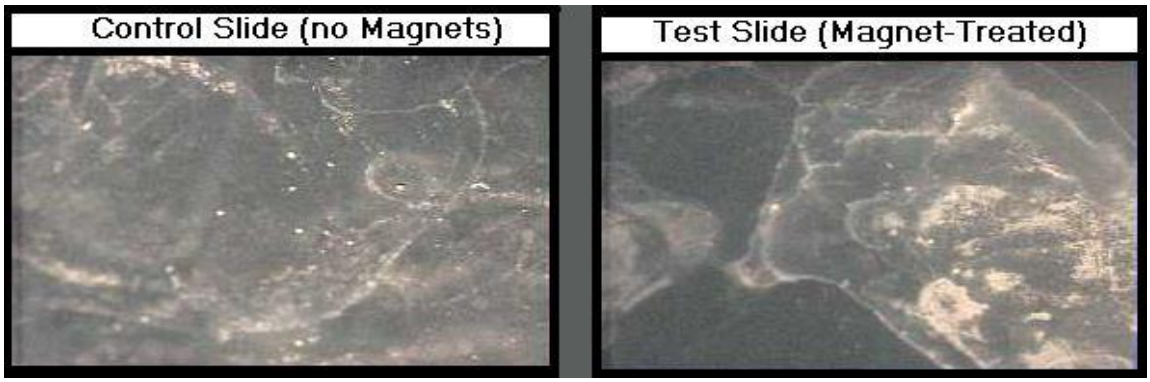

Fig. (2): Depicts magnetized and non-magnetized water models in two different states [17].

In oil refineries, water begins to be used to dissolve solid (sodium hydroxide flakes), this reaction is accompanied by the emission of energy and heat to form a kind of ionic vacuum

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between positive sodium ions and negative hydroxide ions as shown in Figure (3), for the sodium ion to react with the resulting chloride ion From the decomposition of acid (HCl), which results from the decomposition of salts (calcium, magnesium and potassium) to finally form the salt in the form of heavy particles that are drained out of the vessel [13].

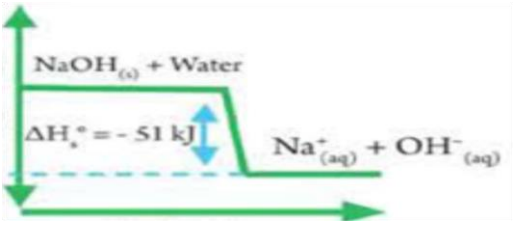

Fig. (3): Sodium hydroxide ion decomposition [13].

At this stage oil refineries use water. While the diluted sodium hydroxide in crude oil continues to flow down to the heat exchangers. The temperature of the crude oil rises to approximately (60 - 90) according to the efficiency of the heat exchange and the effectiveness of the exchangers, down to the salt removal container, to start the first stage at the desalination equipment, which is the stage of washing the crude oil with water, where the water works to dismantle the link and desalinate it from the salts that must be removed before starting operations Oil refining. For the following reasons: [14]

- Corrosion of pipes, tanks, and any container or pipe through which the crude oil passes.
- From the inside, salt is deposited on the surface of pipes, especially hot pipes (heating pipes), heat exchange pipes, or others, causing a variety of operational problems such as coal formation inside them and cracks.
- Water and oil add an operational burden to the filtration process, which is costly.

As a result, oil processing entails the removal of both water and salts, and these processing units are sometimes referred to as wet oil treatment and dewatering units (drying and desalination units), where salt refers to the salt dissolved in the oil, which accounts for the vast majority of the salts found in crude oil. [10], [15]. Figure (4) Shows the scheme of the caustic soda and water injection processes, leading to the salt removal.

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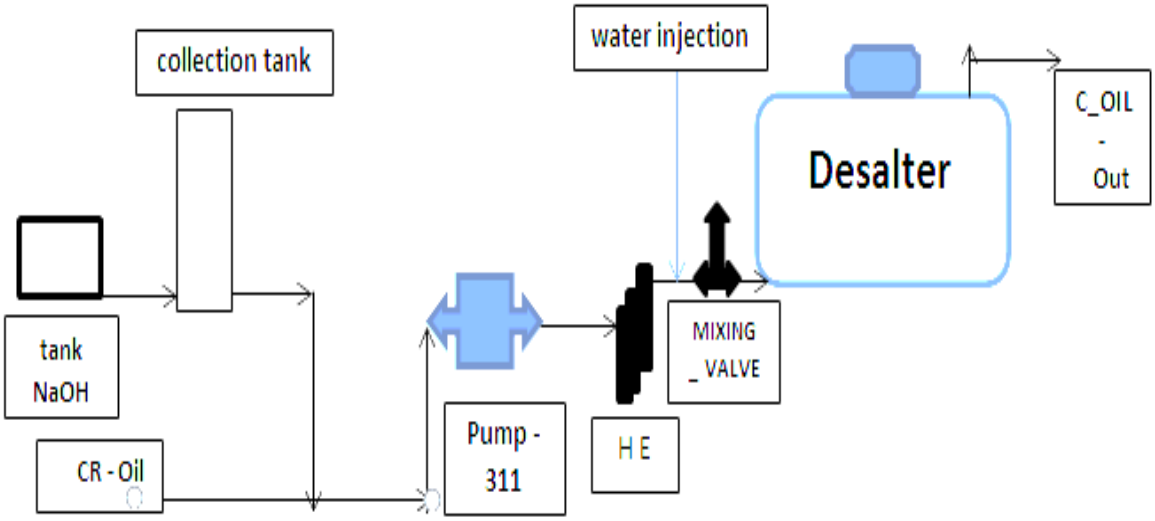

Fig. (4): Diagram showing the injection of sodium hydroxide and water into the desalination stomach [by researcher].

1.2 The basis of the concept of magnetic water

The basis of the concept of magnetic water is to make the water pass through a magnetic field inside the magnet system, so that the water is affected by the magnetic field, which makes it arrange the internal particles in the form of electric charges, that is, work on the magnetization of water or in other words as a result of the movement of electrons and the completion of the electronic shell through covalent bonding [8]. As shown in Figure (5).

When water is exposed to an external magnetic field, it acquires a magnetic moment related to the nature of the magnetic circuit, which is the decrease of the internal magnetic induction, which leads to the magnetization of the opposite inductor. Adding a magnet to salt water gives it potential energy, which increases the movement of water molecules and salt ions in it, and this energy can disengage bound water molecules, unlike ordinary water with weak susceptibility and dead energy. Therefore, the research paper found the importance of using magnetized water a necessary need. And a diamond when removing organic and inorganic salts from crude oil. [9]

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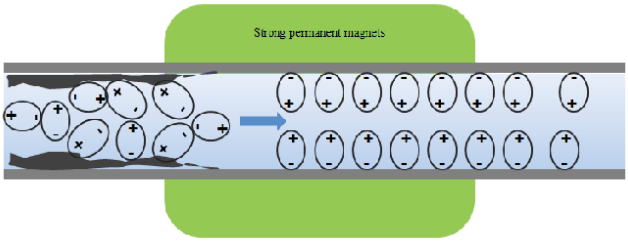

Fig (5): Shows how a magnetic field affects the order of water molecules [9].

1.3 Magnetic Force:

The magnetic field ($\vec{B}$) can be calculated using the Lorentz Force Law and the magnetic force acting on a moving charge shown by Figure (6).

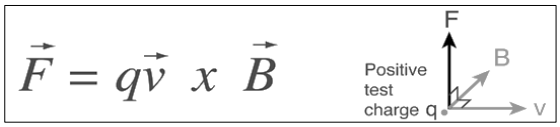

Fig. (6): Magnetic Force [16].

The magnetic field ($\vec{B}$) can be calculated using the (Lorentz Force Law) and the magnetic force acting on a moving charge [11]. The following are some possible meanings of this phrase:

1. Both the charge's velocity ($\vec{v}$) and the magnetic field ($\vec{B}$) are perpendicular to the force.

2. The force's magnitude is given by $\vec{F} = q\vec{v} \times \vec{B}$ sin, where is the angle of 180 degrees between the velocity and the magnetic field. In other words, the magnetic force acting on a charge that is either stationary or moving in a straight line parallel to the magnetic field is zero.

3. The right hand rule determines the force's direction. An example of a vector product is the force-relationship depicted, show by Figure (7).

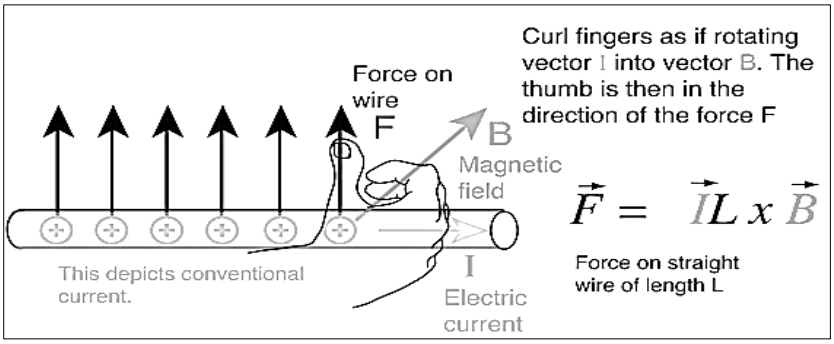

Fig. (7): Vector product is the force-relationship depicted [16].

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2. Materials and Methods:

The water magnetization device was placed before the water entered the desalination equipment, and accordingly the practical results appeared before and after placing the device according to the conditions shown in Table No. (1).

Table (1) Operational conditions of the site of use of the device.

Conditions	Value	unit
water pump pressure	25	bar
Water flow volume	3	M^3
Water temperature	85	Celsius
Pipe diameter	1.5	inches
length of the device	1.5	M
magnetic field (G)	3000	Gauss

2.1 Design of the device:

The device was designed by placing neodymium magnet alloys. As shown in Figure (8): [(A), (B)] and Figure (8): [(C)].

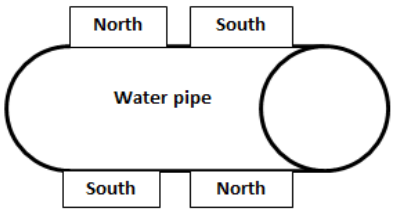

Fig.(8):(a): Side view

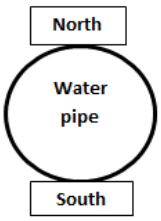

Fig.(8): (b): Front view

Fig.(8): Design device [(a): Side view , (b): Front view, (c): Shape device, Type of magnetic device].

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The shape of the magnetizing device. As shown in Figure (8).c

Magnets come in a variety of shapes and sizes to suit the needs of the user, depending on the:

• Specifications of purpose and use.

• Metal, plastic or some other material is used for the tubes.

• Operating conditions (pressure - temperature - flow).

• The thickness of the wall of the tube to be used to make the device.

2.2 Device location:

Practical experiments were conducted by placing the water magnetization device before the desalting equipment as shown in Figure (9). To see the results, water samples were taken before and after installing the device as shown in Tables (2) and (3).

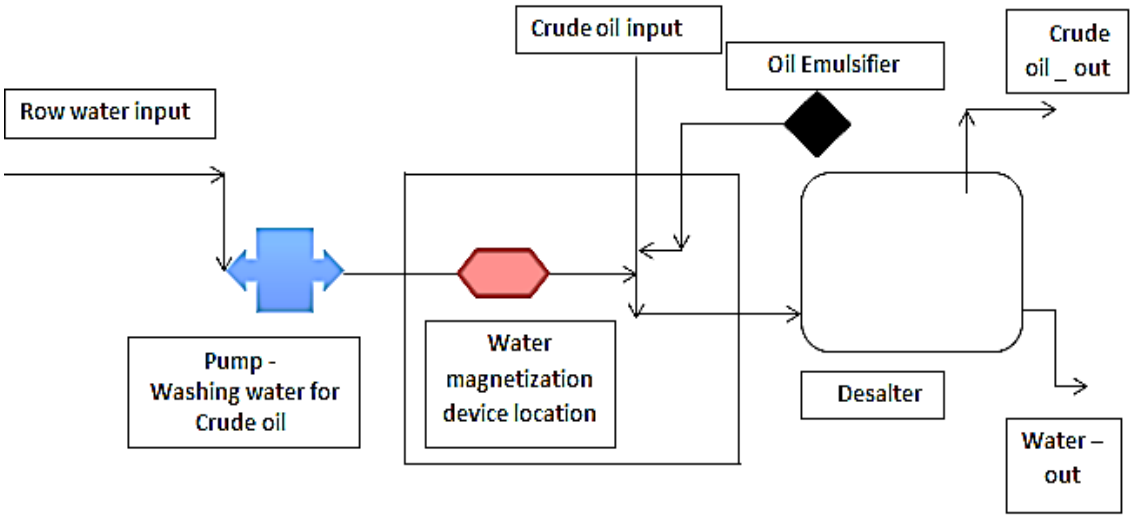

Fig (9): Diagram of the location of the magnetized water device before the de-salter on the water injection line [by researcher].

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3. Results and Discussions:

Raw water input used to desalinate and wash crude oil was tested at the Najaf Refinery in Iraq. In both cases, before and after the magnet device was used. The results were as follows: Tables (2) and (3).

Table (2) Laboratory results.

Feature	Unit	Before Magnetization	After Magnetization	Discussions
pH	-	7.75	8.08	The value of the exponent has increased
Evaporation amount	g/ h r	0.84	0.73	The value of evaporation decreased due to the change in the stability properties of water
surface tension	D y n /cm	72.45	69.4	The value of the surface tension decreased as a result of the activity of external electrons and the movement and rearrangement of molecules
refractive index	-	1.43	1.43	This feature is not affected
Electrical conductivity	$ds.m^{-1}$	1142	1152	Electrical conductivity increased by 7.7%.
Solubility	g/10ml	3.07	3.21	Increased solubility
Viscosity	Poise* 10^{-5}	802	781.2	Reducing the viscosity of the water due to the dissolution and softness of the water and an increase in its permeability by 2.6%
The amount of dissolved O_2	-	674	1104	The value of the solubility of oxygen increased as a result of the increase in energy water after magnetization
Density	mg/l	28.22	28.13	The density of water decreased as a result of rearranging its molecules and changing the nature of some properties of water after the effect of magnetization

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Table (3) Laboratory results.

Properties	The results of water analysis before installing the water magnetization device	Results of water analyzes after installing the water magnetization device
Appearance and smell	Dark and smelly water	Clear water without odor
pH	6.4	8.6
Magnesium (Mg) mmole/L	145.67	111.8
Sulfate mmole/L (SO4)	560.87	407.8
Water hardness (CaCO3)	1.62	0.29
dissolved solids	780	800

Tables (2), (3): shows the results of the experiments for the most important cases.

These Samples were taken from the water used in the washing of crude oil. The samples were studied after the effect of the magnetic field at different stages (1000-3000) Gauss for some properties such as (viscosity, density, conduction, etc.) The scientific results appeared as shown in the following Figures (10a - 10 j).

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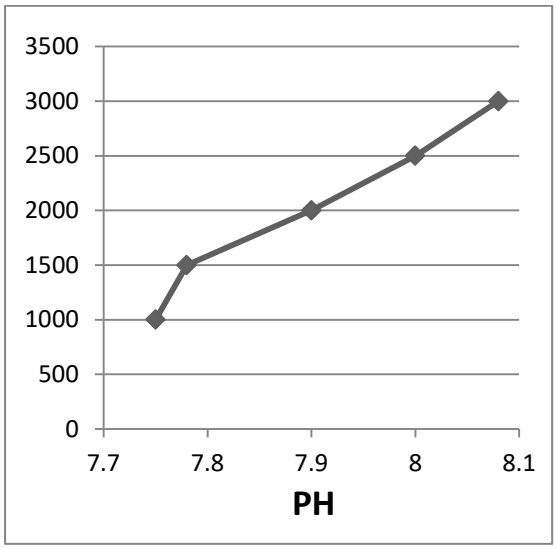

Fig. (10:a) The change in the pH value when water is placed in a magnetic field where; PH = (6.4) will change to (8.6) after the magnetizing device is placed in the flowing water.

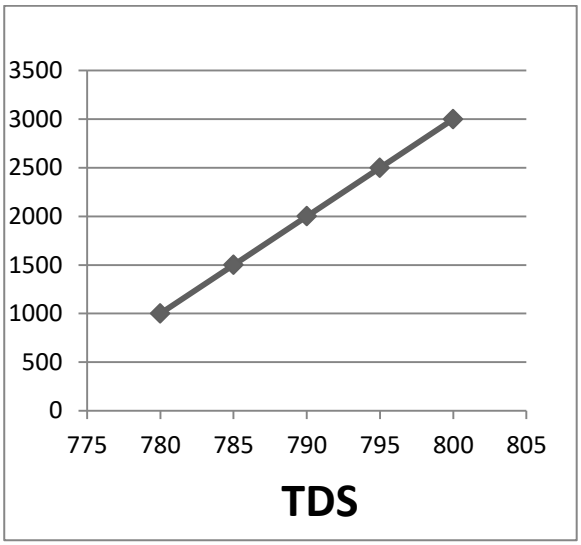

Fig. (10:b) It is clear that the magnetic field increases the rate of dissociation between the water molecule and the amounts of salt and dissolved solids, and thus the ratio of TDS = (800-780) decreases, as the sodium or calcium ions become ineffective.

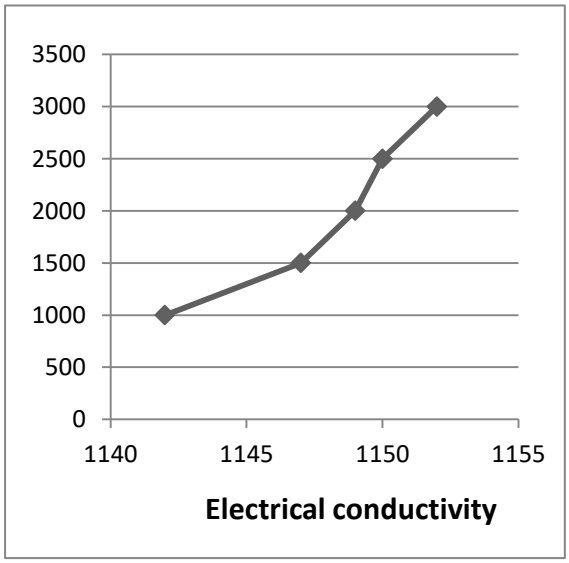

Fig. (10:c) The electrical conductivity will increase (COND = 1142 - 1152) as a result of the increase in the vital energy in the outer shells of water molecules.

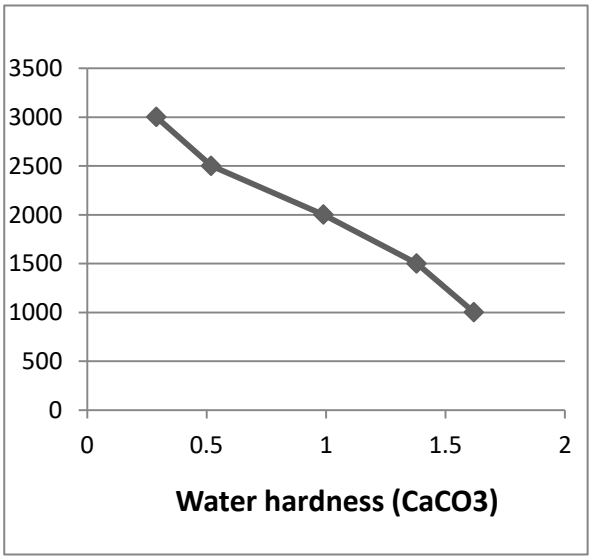

Fig. (10:d) It indicates that the magnetic field has an effect on the water hardness, as the hardness decreased from 1.62 - 0.29.

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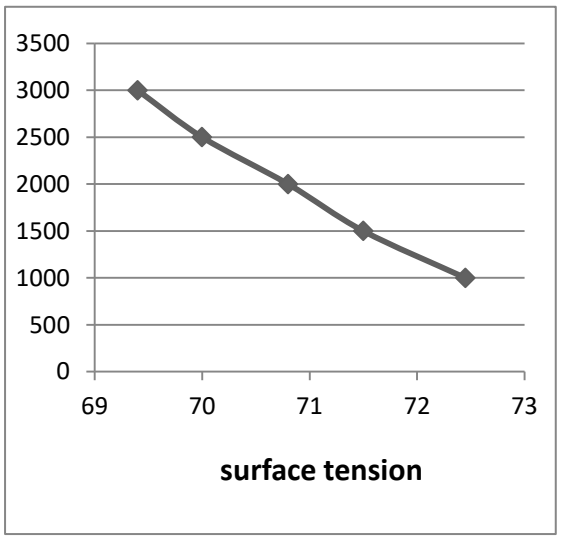

Fig. (10: e) The effect of the magnetic field on surface tension is evident where a reduction in the surface tension value can be observed as a consequence of the activity and rearrangement of external electrons.

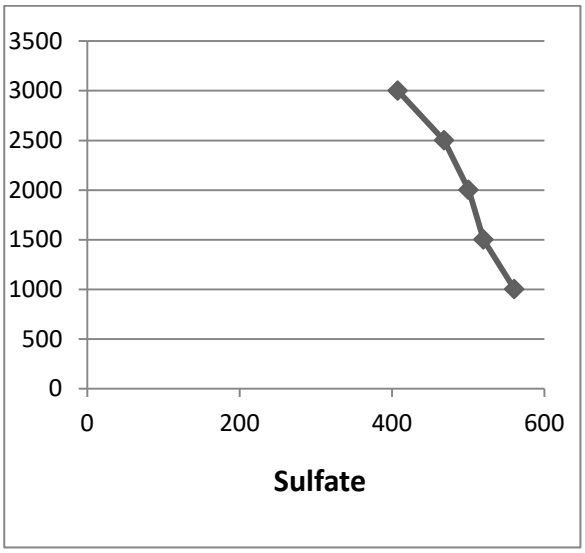

Fig. (10: f) The effect of the magnetic field on the sulfate is evident, the value of the sulfate decreases with the increase in the intensity of the magnetic field.

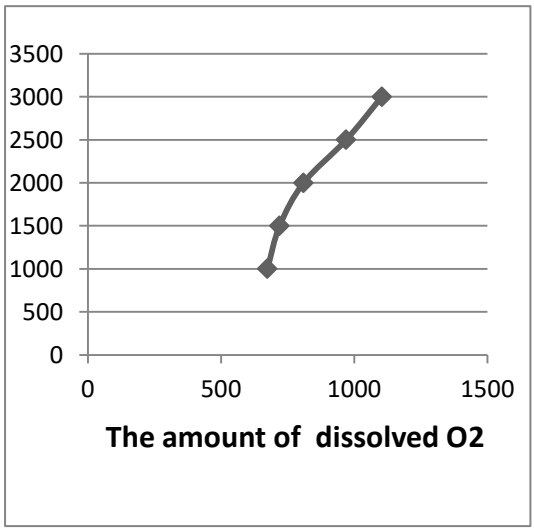

Fig. (10:g) The effect of the magnetic field on oxygen melting is explained, the higher the magnetic field, the value of dissolved oxygen the higher appears.

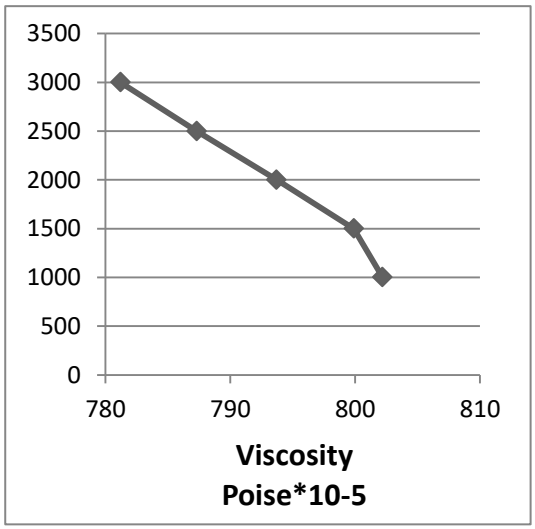

Fig. (10:h) The magnetic field's effect upon viscosity is shown: the higher the magnetic field value, the lower the viscosity.

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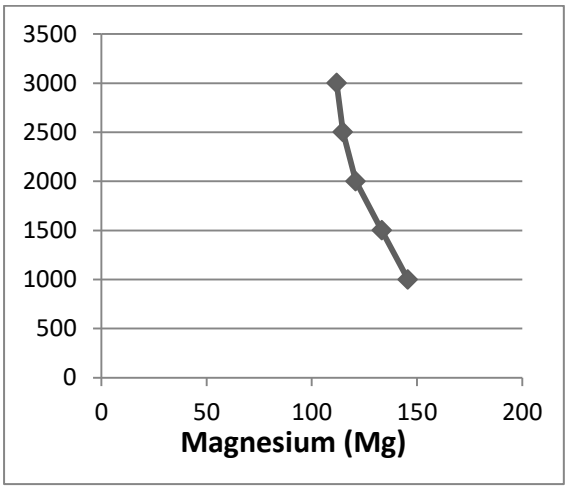

Fig. (10: i) The magnetic field effect appears on the value of the magnesium salts .The higher the value of the magnetic field the lower and less effective the value of the salts of magnesium in water.

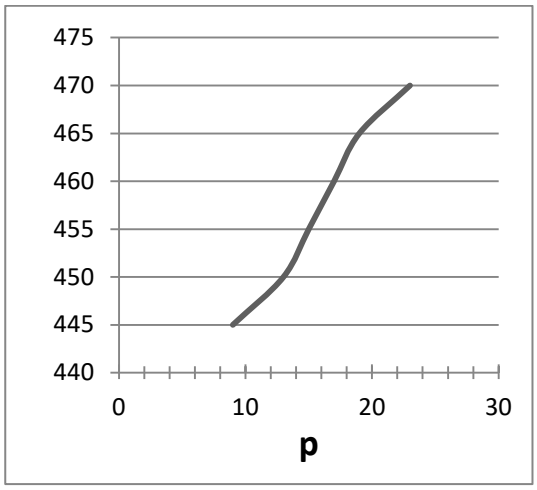

Fig. (10:j) It shows the relationship between water pressure and electrical conductivity (in a water magnetization device). As the electrical conductivity increases, the magnetic field and pressure increase, and this shows an improvement in the disintegration process and evidence of the effectiveness of the water used for the purpose of washing crude oil from the accompanying salts.

As a result of the results collected in this study, the following benefits of using a water magnetization device can be explained.

- It self-sterilizes water by reducing water hardness and changing the shape of water molecules.
- Killing many components of bacteria and algae that produce pollution in areas where water is used, for example (cooling towers and water coolers)
- According to the study, this method helps prevent sediment buildup in storage tanks and pipelines by removing scales and preventing waterborne pollutants from sticking to walls or pipes.
- Magnetic water treatment devices are the perfect solution to improve water quality, increase its efficiency and reduce iron overload problems.
- Magnetic devices are self-operating and do not require an external power source because they work with magnetic energy that has the same strength as the magnetic energy is permanent and continuous.

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- Magnetic devices are not affected by weather factors such as rust or corrosion because they are made of weather-resistant metals and have a long service life.
- There is no need to change any spare parts or do any continuous maintenance, so there are no material costs or manpower requirements.

4. Conclusions:

According to the results, the magnetized water used in the crude oil washing process in oil desalination equipment is compatible with all the physical and chemical processes on the practical site without the appearance of any practical problems. The laboratory results supported the scientific change and the advantages of magnetic forces on the properties of water. The water samples were analyzed before and after the installation of the magnet device according to the water usage criteria in the crude oil washing stage. It has been proven that the use of magnetized water continuously and the salinity is less than PPM 12000, the properties of the water improve and the accumulation of mineral salts gradually decreases and this is a great development, as the magnetized water devices have been manufactured with different specifications based on the operating conditions and the intended use.

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