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Evaluate the efficiency of treatment by using electromagnetic field in reducing bacterial contamination in wells water

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Abstract
This study was conducted on nine wells water within Kirkuk city for the period 1st July 2015 until 13th June 2016 to assess the electromagnetic field's effectiveness in groundwater purification, where the study focused on the design apparatus with different electromagnetic fields accomplished by exposing the water to electromagnetic fields while the water is passing through the device. Electromagnetic water treatment process consists of two phases , the first by using different electromagnetic fields 1.4,1.7,1.9 Tesla with the stability of the water passage time 20 minutes through electromagnetic field and the second phase is consists of fixed electromagnetic field intensity 1.9 Tesla with change water retention time 5, 10, 20 minutes during the electromagnetic field. Study showed the effect of electromagnetic treatment on bacterial pollution indicators (total number of aerobic bacteria and total coliform bacteria) the number of bacteria colonies decreased at a rate of 90% at a field intensity 1.9 Tesla and to 93% at a retention time 20 minutes, as the coliform bacteria decreased at a rate of 94% when field intensity 1.9 Tesla ,and [98thvd retention time 20 minutes.

KeyWords: water pollution, Human activities, Pathogenic bacteria

Introduction
Water pollution with different types of organic and inorganic pollutants, such as pesticides and heavy metals are the most influential on the plants and other aquatic organisms in addition to negative effects of water pollution on human health, including infection millions of people with various diseases agents and also destruction of the ecosystem and removal of biodiversity. Perhaps the most dangerous thing in aquatic system contamination is the accumulation of pollutants in the aquatic bodies and increased its concentration from one level to another [1].

Many of studies are concerned on freshwater and groundwater pollution in particular with great interest specialists in the field of environmental protection. Water pollution intended to damage to water quality in a manner leads to reduces water ability to perform its natural role and makes them lose a lot of their economic value and cause health and environmental damage [2]. This pollution can be either from a natural source or due to human activities, Industrial, agricultural and that depending on the wells geographical location and its size, climate change and quarterly changes and influenced by the water movement. Whenever the water movement was slow increases contact time between rocks and water those results in an increase in the concentration of these dissolved pollutants in water [3].

Any undesirable addition to groundwater as a result of human activity is a pollution, and pollution that occurs in groundwater due to the leakage of some undesirable material can spread out away from the original contamination site. These sources may be direct (point sources) such as septic tanks in rural homes or non-direct (nonpoint sources) such as fertilizers and pesticides in agriculture [4].Water pollution occurs by Pathogenic microbiological is one of the problems experienced by much of the world, including the developed countries [5].

Most Pathogenic bacteria reach into the water as a result of contamination by sewage as every year about 3.4 million people, mostly children die due to diseases transmitted by contamination water and pathogenic bacteria, for example *E. coli, vibrio cholera, shigella spp, salmonella spp* [6]. In 2003 about 1.6 million deaths were document due to contaminated water and lack of health services and 90% of them were children under the age of five years [7].

It should be noted that one of the reasons for the spread of diseases by water is the weakness of drinking water treatment or a lack of potable water, leading to the population to use contaminated water .For example, what happened in India while the Indian authorities were forced during periods of drought to extend area residents paid away from the New Delhi about 190 kilometers waters are in fact the sewage to the city of New Delhi when the partial treatment is not complete to get rid of infectious germs [8]. Also, the spread of cholera in South Africa in 2000 was the reason for the lack of clean drinking water Prompting people to drink the river water directly and this cause high morbidity [6]. Many studies have concluded that the water is responsible for 4.6% of all deaths and 5.7% of the diseases that occur in the world and the most important of these diseases, diarrhea and worm infections such as Ascaris [5].

It has emerged as a recent problem the emergence of bacterial strains resistant to antibiotics, especially in some types of bacteria present in the remnants of the hospitals where who founded it resistant to some antibiotics and materials used in the sterilization of drinking water disinfection, especially when they are the discharge of such waste contain residues of antibiotics in rivers or drainage channels without full treatment, which Providing appropriate compromise

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for spread of bacteria and giving it wider space and resistance recipe and here lies the seriousness of the waste because of not being able to get rid of all kinds of pollutants bacteria in water treatment plants and human re-consumption [9]. Water is an important habitat in which pathogenic bacteria live and moves through them because it is suitable media for all vital activities for the body of life organism, including pathogenic organism, where the percentage of water in the biomass to 80% and water is vulnerable by bacterial contamination through the soil and air, in addition to human and animal wastes, factories and hospitals [10,11].

Materials and methods

In order to study the effect of the magnetic field on water properties, it has designed apparatus composed of two parts:

-The first part of the device is used for the passage of water through the magnetic field and to control the amount of water, and consists of :

1- Container: Polyethylene bottle 2.5 liters capacity and used as a source to supply the device with water.

2. Valves: Two valves were used in this device, the first valve is tied at the base of the bottle, the purpose of the first valve is to control water flow through filling the bottle with water, while the second valve is tied into the end of the metal tube which enter within the electromagnetic field, the purpose of it is to control the time and water quantity that pass through the electromagnetic field.

3. pipes: Two types of pipes were used : the first pipe is made of transparent rubber 0.5 meter length. This pipe tied between the polyethylene bottle and the metal tube by the first valve, while the other pipe (which is the most important part) is made from carbon steel material 40 cm length and insulated electrically by an insulating material on the sides of the tube which passes through the magnetic field.

-The second part of the apparatus: There are several magnetic structures around the world, which are used to improve water properties , most of these consist of permanent magnets pairs and are linked beside each other on the pipe [12]. In the current study the used part was the fixed one (Astor) of the electric motor which consists of coil, this coil is a copper wire existing inside the electric motor, and when electric current passes through the coil it will generate electromagnetic field, this electromagnetic field is fed with electricity from an external source. The magnetic field intensity inside the electric motor dependent on two factors the number of the coil laps and on the intensity of electric current that passes in the coil.

Three different electromagnetic field coils are used:

1- Electromagnetic field 1.4 tesla is equal to 14000 gauss.

2- Electromagnetic field 1.7 tesla is equal to 17000 gauss**.**

3- Electromagnetic field 1.9 tesla is equal to 19000 gauss**.**

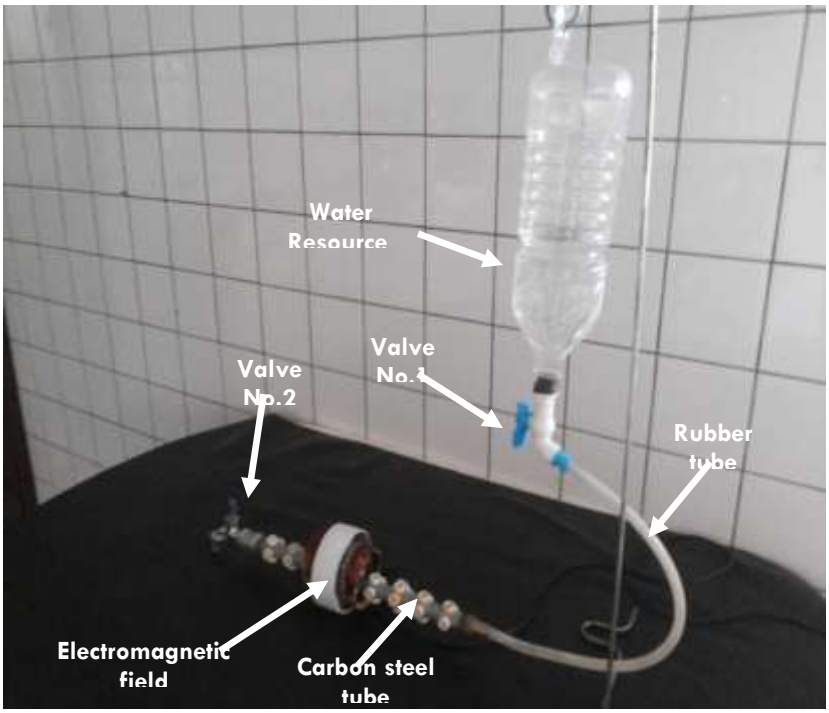

Figure (1) Water electromagnetic treatment device

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Figure (2) Different electromagnetic field coils

Bacteriological tests

Total viable count of aerobic bacteria

It adopted the pour plate method in the estimate of the total number of life bacteria [13].

Total count of coliform bacteria

Followed method of most probable number (MPN)to determination the total number of coliform contained in [14].

Results and Discussion

Total number of aerobic bacteria

The results of the present study as table (1) showed significant decrease in the total count of bacteria in wells water after treatment using different electromagnetic field intensity 1.4 , 1.7 1.9, the total count of bacteria decreased to 709 CFUx10^1/ml at percentage of 34% at field intensity1.4 Tesla and decreased to 432 CFUx10^1/ml at percentage of 61% at field intensity 1.7 Tesla and decreased to 257 CFUx10^1/ml at percentage of 78 % at field intensity 1.9 Tesla compare with the total count of bacteria 1056 CFUx10^1/ml before treatment.

Table (1) Levels of total viable count of bacteria in wells water and after treatment by different electromagnetic fields (CFUx10^{-1}).

Wells	Before electromagnetic treatment	Water passage through electromagnetic field 1.4 tesla in 20 minutes	Removal efficiency	Water passage through electromagnetic field 1.7 tesla in 20 minutes	Removal efficiency	Water passage through electromagnetic field 1.9 tesla in 20 minutes	Removal efficiency
1	1360	920	32%	488	65%	360	74%
2	1420	880	38%	600	58%	440	69%
3	1400	1040	24%	720	49%	520	63%
4	1280	920	28%	560	56%	360	72%
5	1640	1120	32%	720	56%	280	83%
6	840	540	36%	320	62%	120	86%
7	360	200	44%	130	64%	75	79%
8	520	320	39%	160	66%	90	83%
9	680	440	35%	190	72%	70	90%
The average	1056	709	34%	432	61%	257	78%

The highest percentage of decrease in the total count of bacteria after electromagnetic treatment it was 90% at the field intensity 1,9 Tesla in well No .9, while the lowest percentage of decrease in total count of bacteria after electromagnetic treatment it was 24% at the field intensity 1,4 Tesla in well No .3,. Also the results of the current study as table (2) showed significant decreases in the total count of bacteria after treatment using different retention 5, 10, 20 minutes. The total count of bacteria decreased from 1056 colony/ml before treatment to 838 CFUx101/ml at percentage of 21% when retention time 5 minutes and decreased to 629 CFUx101/ml at percentage of 41% during the retention time 10 minutes, while the total count of bacteria decreased to 245 CFUx101/ml at percentage of 80% at a retention time 20 minutes, and the highest percentage of decrease in the total count of bacteria after treatment it was 93% at retention time 20 minutes in well No 9, while the lowest percentage of decrease in the total count of bacteria after treatment it was 16% at retention time 5 minutes in well No.1, and it was noted that the increase in retention time was offset by decrease in the number of bacterial colonies during treatment .It is believed that water exposed to a magnetic field reduces the surface tension of water due to the rearrangement of molecules and decrease the concentration of dissolved ions in water, making

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it easier to enter water through the cell membranes in large quantities and this works to increase the size of the cell and then it exploded the cell of bacterial to the death.

Table (2) Levels of total viable count of bacteria in wells water before and after electromagnetic field treatment by different retention time (CFUx10^{-1})

Wells	Before electromagnetic treatment	Water retention time in electromagnetic field 1.9 tesla in 5 minutes	Removal efficiency	Water retention time in electromagnetic field 1.9 tesla in 10 minutes	Removal efficiency	Water retention time in electromagnetic field 1.9 tesla in 20 minutes	Removal efficiency
1	1360	1137	16%	892	34%	360	76%
2	1420	1156	19%	913	36%	385	73%
3	1400	1145	18%	910	35%	460	67%
4	1280	1040	19%	820	36%	460	74%
5	1640	1220	26%	810	51%	230	86%
6	840	660	20%	480	41%	110	87%
7	360	280	22%	210	42%	70	81%
8	520	410	21%	290	44%	80	85%
9	680	490	28%	330	51%	50	93%
The average	1056	838	21%	629	41%	245	80%

The results obtained by [15] pointed to decrease in the numbers of aerobic bacteria after magnetic treatment of 47 colony / ml to 3colony/ml using a magnetic system with different intensities 1000,1500,3000 gauss and also he noted that the field intensity 3000 gauss It was the most influential in decreasing the number of bacteria, and attributed the decrease in the number of bacteria after magnetic treatment that bacteria exposed to a magnetic field leads to break down the cell walls and the mutated bacterial cell components and thus the destruction of large numbers of them and stopped their growth, also increasing the magnetic field strength works to confuse the movement of ions within the cell and then disrupt its functions. He noted that the efficiency of magnetic field intensity in the killing of bacteria up to 95%, as well as the results of the current study agreed with the results obtained by [16], as they noted that the number of bacteria decreased after the magnetic treatment from 127 colony/ml to 117 colonies / ml after 24 hours.

total number of aerobic bacteria before electromagnetic treatment

total number of aerobic bacteria after electromagnetic treatment 1.4 Tesla

total number of aerobic bacteria after electromagnetic treatment 1.7 Tesla

total number of aerobic bacteria after electromagnetic treatment 1.9 Tesla

Figure (3) shows the effect of the magnetic field intensity on the total number of aerobic bacteria

Total coliform bacteria

Also The results of the current study as table (3) showed decrease in the total coliform bacteria during treatment of well water using different electromagnetic fields intensity1.4,1.7,1.9 Tesla, the total coliform bacteria decreased from 1091 cells/100 ml before the electromagnetic treatment to 450 cells / 100 at percentage of 63% at the field intensity 1.4 Tesla and decreased to 177 cells/100 ml at percentage of 90% at the field intensity1.7 Tesla, while the total coliform bacteria decreased to 101 cells/100ml at percentage of 90% when field intensity 1.9 Tesla, the highest percentage of decrease in total coliform bacteria after treatment it was 94% at the field intensity 1.9 Tesla in well No. 4, while the lowest percentage of decrease in total coliform bacteria after treatment it was 54% at the electromagnetic field intensity 1.4 Tesla in wells No. (1,4,5).

Table (3) Levels of total coliform bacteria in wells water before and after treatment by different electromagnetic fields (cell/100ml).

Wells	Before electromagnetic treatment	Water passage through electromagnetic field 1.4 tesla in 20 minutes	Removal efficiency	Water passage through electromagnetic field 1.7 tesla in 20 minutes	Removal efficiency	Water passage through electromagnetic field 1.9 tesla in 20 minutes	Removal efficiency
1	2400	1100	54%	460	81%	240	90%
2	1100	240	78%	150	86%	93	92%
3	460	150	67%	93	80%	75	86%
4	2400	1100	54%	240	90%	150	94%
5	2400	1100	54%	460	81%	240	90%
6	240	75	69%	43	82%	21	91%
7	150	48	68%	21	74%	21	86%
8	460	150	67%	75	86%	48	90%
9	210	93	56%	48	77%	23	89%
The average	1091	451	63%	177	82%	101	90%

Also the results of the present study as table (4) showed according to F-test that there were significant decrease at the significance level 0.01 in the total coliform bacteria in wells water after electromagnetic treatment using different retention time 5,10,20 minutes, total coliform bacteria decreased from 1091 cell /100ml before treatment to 506 cell/100 ml at percentage of 51% at retention time 5 minutes and decreased to 237 cell/100ml at percentage of 73% at retention time of 10 minutes and to 94 cell/100 ml at percentage of 90% when the retention time 20 minutes, the highest percentage of decrease in total coliform bacteria after electromagnetic treatment it was 94% at retention time 20 minutes in the well No.5, while the lowest percentage of decrease in total coliform bacteria after electromagnetic treatment it was 37% at retention time 5 minutes in the well No.6, and it was noticed that the increase in retention time appeared a clear impact in reducing the total coliform bacteria.

Table (4) Levels of total coliform bacteria in wells water before and after electromagnetic field treatment by different retention time (cell/100ml)

Wells	Before electromagnetic treatment	Water retention time in electromagnetic field 1.9 tesla in 5 minutes	Removal efficiency	Water retention time in electromagnetic field s 1.9 tesla in 10 minute	Removal efficiency	Water retention time in electromagnetic field 1.9 tesla in 20 minutes	Removal efficiency
1	2400	1100	54%	460	81%	150	94%
2	1100	460	59%	260	76%	75	93%
3	460	240	48%	150	67%	75	86%
4	2400	1100	54%	460	81%	240	90%
5	2400	1100	54%	460	81%	150	94%
6	240	150	37%	93	61%	23	90%
7	150	93	38%	48	68%	21	86%
8	460	240	48%	150	67%	93	80%
9	210	75	64%	48	77%	21	90%
The average	1091	506	51%	237	73%	94	89%

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تقييم كفاءة المعالجة باستخدام المجال الكهرومغناطيسي في تقليل التلوث البكتيري لمياه الآبار

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الملخص

أجريت الدراسة على مياه تسعة آبـار ضمن مدينة كركوك للفترة 7/1 /2015 ولغاية 13/ 6/ 2016 لتقييم فعالية المجال الكهرومغناطيسي في معالجة المياه الجوفية, اذ ركزت الدراسة على تصميم جهاز يولد مجالات كهرومغناطيسية مختلفة تتعرض للماء المار خلاله. تضمنت عملية المعالجة الكهرومغناطيسية للمياه مرحلتين الأولى باستخدام مجالات كهرومغناطيسية مختلفة 1.4,1.7,1.9 تسلا مع ثبات زمن مرور الماء 20 دقيقة خلال المجال الكهرومغناطيسي والمرحلة الثانية هي ثبوت شدة المجال الكهرومغناطيسي 1.9 تسلا مع تغيير زمن استبقاء الماء 5, 10, 20 دقيقة خلال المجال. اظهرت الدراسة تاثير المجال الكهرومغناطيسي في دلائل التلوث البكتيري (العدد الكلي للبكتريا الهوائية والعدد الكلي لبكتريا القولون) اذ انخفضت اعداد البكتريا الهوائية بنسبة 90% عند شدة مجال كهرومغناطيسي 1.9 تسلا والى 93% عند زمن استبقاء 20 دقيقة وشدة مجال 1.9 تسلا, في حين انخفض العدد الكلي لبكتريا القولون بنسبة94% عند شدة مجال كهرومغناطيسي 1.9 تسلا وزمن استبقاء 20 دقيقة.