EFFECTS OF ELECTROMAGNETIC ENERGY IN IRRADIATION OF TOTAL SUSPENDED SOLIDS (TSS) AND TOTAL DESOLVED SOLIDS (TDS) AND THEIR EFFECTS ON THE TURBIDITY IN THE MUNICIPAL WASTEWATER SAMPLES

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ABSTRACT

Gamma radiation (most powerful radiation in penetrating materials) is used in the removal of the phenol from the wastewater samples taken from the effluent of sedimentation tank of AL-Rustamia wastewater treatment plant.

Many doses of radiation are used, such as 25, 50, 100, 200, 300, 400 and 500 krad. The final value is an average of the three samples for the same absorbing dose of radiation. Most of the measurements are found in the acceptable range of Iraqi limits of these tests.

Total suspended solids (TSS) response to the treatment, where the concentrations decrease from 308, 422 and 450 mg/l to 40 mg/l at 200 krad, 42 mg/l and 48 mg/l at 300 krad respectively, where the accepted value of TSS in the treated wastewater is 60 mg/l.

Also total dissolved solids (TDS) respond to the radiation, where low doses of radiation decrease the value from 10580, 12435 and 12210 mg/l to 1208 mg/l at 10 krad, 1100 mg/l and 1121 mg/l at 25 krad respectively.

As it is known, the most reasons of turbidity presence are the TDS and TSS, since the results of turbidity are matched with those tests, where the concentration of turbidity reaches 68 NTU at 50 krad, 92 NTU at 100 krad and 42 NTU at 100 krad, while the initial values are 125, 180 and 190 NTU.

Then the concentrations of turbidity increase at 500 krad to reach 120, 200 and 210 NTU. This increase can be avoided by using activated carbon as an absorbing media to absorb the excessive concentrations of dissolved organic substances.

INTRODUCTION

Humans always look for new features to solve the environmental problems, especially in the field of water pollution, for many reasons [6]: -

1. The quantity of water on earth is fixed and, for the most part, fresh water is in a constant state of recycle.
2. Among the large number of different types of users of water, there are already many who must take extraordinary steps to further treat the so-called "fresh water" because of the inability of our three principal treatment opportunities to remove all contaminants. Those three principle treatment opportunities are:-

a- The wastewater treatment facilities, which release water to the open environment.

b- The natural treatment provided by the open environment.

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c- The "fresh water" treatment facilities retaking the water from the open environment.

The rapid growth in the world population, and the intensive development of various industries all over the world led to very basic environmental problems. The worldwide application of fertilizers, pesticides, etc., in modern agriculture and disposal of large amount of chemical waste materials to rivers, seas, and oceans has led to heavy pollution of water resources. The disinfection of drinking water (containing humic substances) by chlorination has contributed further in this respect by causing the formation of mono-, di-, tri-halomethanes, as well as large quantities of TSS and TDS and their affect on the Turbidity. [4].

Radiation treatment involves the application of ionizing radiation energy to produce a useful change in a material, such as disinfection. The amount of radiation energy absorbed in a material depends on both the chemical and physical state of the material and the type and energy distribution of the radiation. Radiation dose units are the rad (100 erg/g) [6] and the gray (1 Gy = 1J/kg) [4].

The examinations on sedimentation of raw sewage, show similar variations with the sludge type. The reported improvement in settling shows10-20 % at 100-1000 krad total dose, but a decrease thereafter is attributed to degradation of the solids [1]. Various mineral sludge showed that radiation treatment give a higher density coagulates that is filtered faster than when does treated conventionally [3].

OBJECTIVE OF THE STUDY is to use the electromagnetic energy in irradiation as a new technology in the removal Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and their affect to the Turbidity value in the raw wastewater samples and determining the optimum doses of irradiation in the treatment.

ATERIALS AND METHODS

Sampling:-

Samples of wastewater were collected from AL-Rustamia sewage treatment plant for three months January, February and March by using plastic containers of 5 L TSS, TDS, and turbidity.

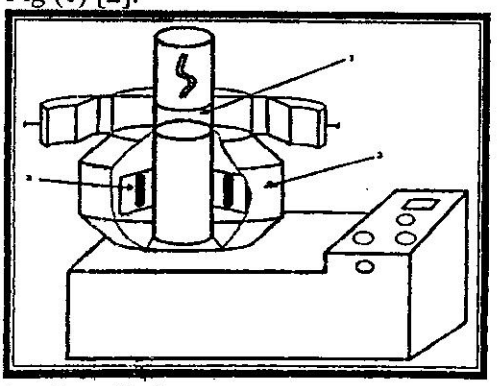
The samples are taken from the effluent of the primary settling tank by holding the bottle, or the container in the opposite direction to the water flow then its mouth is opened until filled with wastewater then closed.

The samples are kept in ice chest and transported immediately to the laboratory within short time.

Irradiation:-

The facility used in irradiation is Gamma-cell 220 (Canadian made) supplied with ^{60}Co which has a calculated dose rate of 2 Mrad/hr and radioactivity of 50 kCi at January 1985.

Samples are arranged in the chamber of irradiation which is of cylindrical geometry of 16 cm in diameter and 20 cm in height. This room moves vertically down to the radiation sources of ^{60}Co as roods rotate around the room to supply a homogenous dose for all samples, as in Fig (1) [2].



1- Irradiation room.
2- Roods of ^{60}Co.
3- Surrounding shields of lead.

FIG (1) Gamma cell irradiation facility type 220 Canadian made [2].

ABSORBING DOSE: All tests in this study are taken as an average of three samples subjected to the same absorbing dose. The doses used are 0, 10, 25, 50, 100, 200, 300, 400, and 500 krad. The dose rate in recent time (i.e. 2002) is approximately 0.2 Mrad/hr (Calculated on the basis that the half-life of ^{60}Co is 5.26 years). The irradiation times for these dosages are 0, 3, 7.5, 15, 30, 60, 90, 120, and 150 min. respectively where: -

D = DR x T

D = Absorbing dose, (rad).
DR = Dose Rate, (rad/min.).
T = Irradiation time, (min.).

The samples after irradiation are transported to the laboratory as soon as possible for testing.

Total Suspended Solid (TSS)

Total Suspended Solids (TSS) concentration of the wastewater is important parameter because the TSS is the major cause of plugging of membrane system in wastewater treatment plant. The TSS also may cause an increase in turbidity concentration of water and TSS values are determined by using vacuum filtration. The filter papers are kept in an oven for 1 hour at a temperature of (103 – 105)0 C before and after filtration. TSS is calculated by subtraction of filter paper weight before and after filtration after which it is divided by volume of sample .The concentration of TSS in mg/l or ppm is evaluated as a unit of measurement. [6].

Total Dissolved Solids (TDS)

Total Dissolved Solid (TDS) is one of the very important parameters because its increase leads to cause fumigation of water, the filtered solution obtained by the filtration is mentioned above, The samples are dried in oven in clean weighed beaker and the net weight of solute is divided by the volume of sample to calculate the TDS in mg/l or ppm as units of measurement. [8].

Turbidity

Figure (4) reveals a decrease in turbidity measurement with respect to the increase in the dose of radiation to certain absorbing dose, then the values of turbidity start to increase with the increase of radiation doses. Sometimes the increase of turbidity reaches the starting value and more. This increasing in turbidity measurement is due to the dissolving of organic materials in the sludge [5].

RESULTS AND DISCUSSION

The ionizing radiation has a drastic effect on the organic materials in the wastewater, because of the strong activity of gamma radiation energy that changes the characteristic of pollutants in the wastewater [5].

Total Suspended Solid (TSS)_:Figure (2) shows the decrease of the total suspended solids (TSS) concentration values with respect to the increase in absorbed doses of radiation and most values of this test became within the Iraqi limit of disposal effluents to the surface water (60 mg/l) [9].

The decrease in total suspended solids (TSS) caused by degradation of organic substances and suspended matter in wastewater converts it to more settleable substance [6].

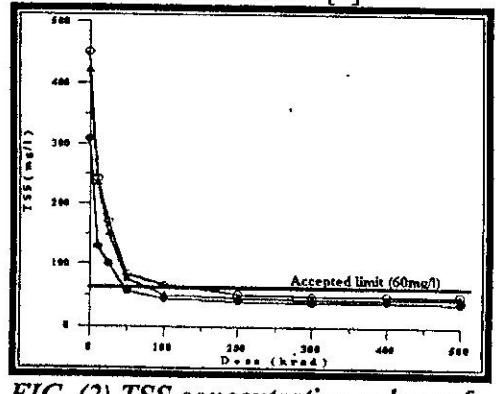


FIG. (2) TSS concentration values of irradiated sample of wastewater for ● - January, ▲- February and o - March

Total Dissolved Solid (TDS): -

Over looking on Fig (3), the decrease of TDS concentration values with respect to the increase of the absorbed doses of radiation to certain values after which an increase in the concentration values of TDS with the increase in absorbed dose of radiation. This might be due to the convergence of the dissolved organic substance to simple molecular compounds or formation of dimmers or trimmers also the high doses may dissolve the suspended solid and sludge that in the bottom of container to increase the concentration of TDS, although the TDS values never reach the starting values [6].

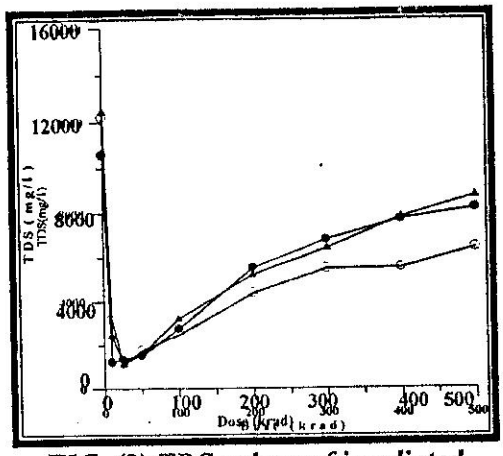


FIG. (3) TDS values of irradiated sample of wastewater for ●- January, ▲- February and o - March.

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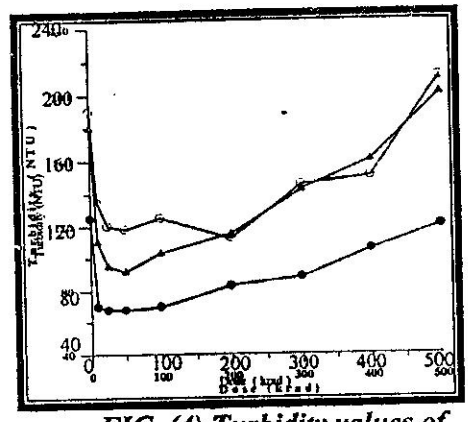

FIG. (4) Turbidity values of irradiated sample of wastewater for ●- January, ▲- February and o - March.

TABLE (1) Suitable doses to minimize each parameter to the accepted value.

Parameter	Initial value * (mg/l)	suitable dose (krad)	Final value * (mg/l)
TSS	393.33	100-150	44
TDS	11741.67	25	972
Turbidity	165 (NTU)	100-200	103.33 (NTU)

Conclusions

1. Irradiation by gamma radiation is an efficient physical way to destroy organic compounds, as long as the radiation parameters delivered are correctly suited to the application. Under the experimental conditions, the optimal doses were mentioned in table (1); even at these values the radiation efficiency for most parameters is, surprising, and not completely satisfactory.
2. Due to the irradiation we found the concentration of the Turbidity was increased according to the increasing of the dose of the radiation, and that means we need to think about sufficient combined process with the irradiation to absorb the excessive concentration of the dissolved Organic Substances such as absorbing activated carbon units.

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تاثير الطاقة الكهرومغناطيسية في الاشعة على المواد الصلبة العالقة الكلية والمواد الصلبة الذائبة الكلية وتاثيراتها على العكارة في عينات المياه الثقيلة المحلية

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الخلاصة

لقد استعملت اشعة كاما (اشعة قوية تخترق المعادن).في ازالة الفينول من نماذج المياه الثقيلة التي استحصلت من الترسبات للمياه الجارية في خزانات موقع الرستمية لمعالجة المياه الثقيلة.

جربت عدة جرعات من الاشعة (25 ، 50 ، 100 ، 200 ، 300 ، 400 ، 500) كيلو راد .واعتمدت القيمة النهائية للقراءات التي تمثل متوسط ثلاث عينات لنفس الجرعة الممتصة من الاشعة .وقد وجد ان معظم القياسات هي ضمن المدى المقبول للحدود المسموح بها في العراق.

لقد وجد ان قيمة المواد العالقة الكلية(TSS) تستجيب للمعالجة عندما انخفضت التراكيز من (308 ، 422 ، 450)ملغم / لترالى 40 ملغم/لتر في الجرعة 200 كيلو راد والى 42 ملغم / لتر و 48 ملغم/ لتر في الجرعة 300 كيلو راد على التوالي في حين ان القيمة المقبولة للـ (TSS) في المياه الثقيلة المعالجة هي 60 ملغم / لتر.

كذلك فان المواد الصلبة الذائبة الكلية (TDS) استجابت لتاثير الاشعة اذ عند استعمال جرعات منخفضة تناقصت القيم من (12210,12432,10580) ملغم/لتر الى 1208 ملغم/لتر مع جرعة 15كيلوراد والى 1100 ملغم/لتر و1121 ملغم/لتر في 25 كيلو راد على التوالي.

وكما هو معروف فان اهم الاسباب لوجود العكارة هي (TSS) والـ (TDS) وقد تماثلت نتائج العكارة وتلاءمت مع تلك الاختبارات حيث ان تراكيز العكارة وصلت الى 68 NTU عند استعمال 50 كيلوراد والى 92 NTU عند استعمال 100 كيلوراد والى 42 NTU عند 100 كيلوراد ايضا عندما كانت القيم الاولية للعكاره هي (,125 , 180, 190) NTU .

ثم ان تراكيز العكارة ازدادت في الجرعة 500 كيلوراد لتصل الى (120,200,210)NTU .

يمكن تفادي الزيادة باستخدام الكاربون المنشط كوسط امتصاص لامتصاص الزيادة من تراكيز المواد العضوية الذائبة.