

The biological approach for recycling waste water in Iraq

Muhsin A. Jabar Almosawi

**College of Applied Medical Sciences / Kerbala University, Iraq*

Abstract:

The middle and south parts of Iraq are exposed to a complicated and continuous draughts problems related, mainly, to the absence of the international law for water distribution of Euphrates and Tigris rivers between Turkey, Syria and Iraq, the climate change and unawareness to the water resources for about three decades before 2003.

The International Agency for Information and Analysis Unit of the United Nation reported that the water will be decreased in the Euphrates and Tigris up to 80% and 50% respectively by the year 2025. Therefore, the water recycling and a very sustainable use approaches will be inevitable at these circumstances. The biological treatment of sewage, industrial water, scientific laboratories effluent water and irrigation waters using EEC-Europe compact units is described here to be involved actively and quickly in solving the water shortage problem in Iraq. COD, BOD, TSS, and TFC are the main indicators which been used to assess the efficiency of these units. It has been approved that the acceptable limits of these parameters were obtained by 1/5 the period required for treating the above kinds of waters, even if they have 10 times more pollutants by these compact units as compared with the classical procedures. Moreover, they are easily operated, installed and transferred from one place to another.

In conclusion, using these treatment units will be a useful approach tackling the problem of water shortage in Iraq and could be best control method to stop the health impact water-transferable infectious diseases.

Key words: industrial waste water, biological treatment, pollution control, water recycling

1- Introduction:

Facing Iraq in general, and in particular, the middle and south parts of it, severe drought crisis because of three decades of deliberate neglect by the former regime which caused the destruction of the environment and natural water resources and made it difficult to provide drinking water or irrigation water for more than 91% of the Iraq's population of 33 million by the year 2015. The United Nations estimated at 2010 that 63% of the urban houses and 98% of the sub-urban houses are in a serious need for safe drinking water (IAU, 2010; Water Supply and Sanitation-Wikipedia, 2012).

Tigris and Euphrates rivers are the main sources for 98% of surface water in the Iraq and they originate from Turkey. Both of them passing long distances in Turkey and/or Syria before arriving the Iraqi territories. The geographical situation and the atmospheric conditions related to rainfall levels in addition to the volatility of the political problems are influencing the amount of water reach Iraq, which fluctuate in different trend every year.

This will negatively impact on the environment, economic, agriculture and health developments in Iraq. That is clearly related to the large number of dams that been belt in Turkey. More than 22 b\$ been spent on the construction of these dams. The last dam which been built on Euphrates called

Ataturk Dam which is only 80Km distance from the Iraqi borders and been designed to stop 500b M3/ sec. which is equivalent to half the water quantity and leaves the other half for both Syria and Iraq. The two countries then agreed to divide the water quantity on ratios of 42% for Syria and 58% for Iraq and established a water research institute consists of 18 water experts from each country to study the problems of the water in Euphrates river (Aquastat, 2008).

The United Nation Information Agency, did expect a high decrease in the levels of water in both Tigris and Euphrates rivers by the year 2025. In that sense the water level will decrease in Tigris from 49.2 M3/Sec.(the level of 2009) to 9.1 M3/ Sec i.e. about 80%.

On the other hand, Euphrates will loss about 50% of its water during the same period ,i. e. from 19.34 M3/Sec to 8.45 M3 /Sec. (IAU, 2010).

2- Problem of Water Scarcity:

According to the above information, the problem of water scarcity is too large "and requires all concerted efforts and energies available in the country, especially in the Iraqi government institutions such as the ministries of higher education and scientific research, agriculture, industry, environment water resources, municipalities and health.

All these ministries are invited to coordinate and cooperate for drawing a national strategy and operational plans which can be implemented as soon as possible to take into consideration the following issues that we can discuss in more details:

2-1- Recycling of Waste Waters:

The waste-waters in Iraq make a huge water reserves coming from , agricultural farms, energy power stations, industrial factories, oil refineries , research and hospital laboratories. These waters contain a large number of biological and chemical pollutants that have a serious human health hazards. Therefore, the recycling techniques should have the ability to remove or at least minimize these pollutants to an acceptable international/ national levels.

The World Health Organization reports confirmed that the drinking water and irrigation water in Iraq are with a very poor quality. The biological and chemical contaminants in the drinking water cause the emergence of 360,000 gastrointestinal infections during the first half of the year 2010., and the high salinity of the surface waters (5000 ppm), made the irrigation waters of no use for crop irrigation in Iraq (WHO/UNICEF,2010). So that a strategic plan should consider the reuse of the treated waste waters in irrigation and / or other purposes .

This plan should first, relay upon a data base for the types and levels of all the pollutants in every kind of waste water. This important scientific task must be fulfilled by academic scientists in the Iraqi universities and/ or scientific research centres as soon as possible by implementing a fast, cheap and reliable scientific protocols.

It may be useful, to suggest, here, a method for tackling the problem of spreading of carcinogenic chemical pollutants in the Iraqi aquatic environment. In that sense, a short biological procedure can be used to predict the possible Environmental Chemical Carcinogens in waste waters. In the aquatic environment of Iraq which is heavily polluted with thousands of chemical and biological pollutants that are continuously coming from the waste waters of sewage dumping , agricultural insecticides and fungicides , oil refineries, power stations , hospitals and research institutes and university laboratories. Many of these pollutants may be carcinogenic and/or terratogenic and mutagenic which need to be determined sooner than later to avoid their impact on human health.

All kinds of contaminants from any category in drinking water and recreational water need to be determined and controlled to get rid of them or at least minimize their impact effects on human health or environment. The large number of chemical contaminants in the aquatic Iraqi environment creating a serious danger to the Iraqi's people , through drinking water, vegetables , fruits and fish that make a large source in the Iraqis food chain.

In these circumstances short-term bioassays using bacteria as bio-indicators, may be the best approach for detection and identification of many environmental carcinogens. The usual animal carcinogenicity tests are taking long time with very high cost where only a very limited numbers of water contaminants can be identified as carcinogens.. in fact, the examination of a single chemical to make sure that may or may not cause cancer using laboratory animals may take more than 3 years and cost up to 200 million Iraqi Dinars. This will make the test of hundreds or thousands of contaminated chemicals that are spread in the environment , an impossible task. Therefore, the short term bioassays should be considered as best scientific methods to achieve this task. The short term biological assays expeditious manner and internationally certified method to predict the environmental carcinogens as mutagens in bacterial strains.

Here we must point out that Ames test could be the best method since the seventies of the twentieth century which is still used in most parts of the world for the predicting of environmental carcinogens through its Salmonella strains and specifically designed "to detect more than one type of genetic mutations. The mechanism of this test is almost relying on the specific design of Salmonella stain that require amino acid histidine in its growth culture .

This method has been implemented to examine more than 300 chemical substance known to be carcinogenic for human body or in laboratory animals , and make sure through thousands of research protocols conducted over four decades. The reported data showed that about 90% of these carcinogens were mutagenic in Salmonella (Farmer and Walker, 2006; Ames et al., 1973; Mc Cann, et al, 1975)) and the remaining (10%) has emerged mostly positive "in the examination (Fluctuation Test) which exposed the bacteria to Article Chemical in a special aqueous solution or after the addition of rat liver enzyme(S-9 enzymes).

The reported research data talking about three axes in the field of water pollution :in aquatic environment, for screening environmental carcinogens/ mutagens :

The first axis: analysis of chemical elements in the water and identify all its chemical components. Then test each one for its mutagenicity and/ or carcinogenicity. This task is usually tedious due to the large number of water chemical constituents.

The second axis: concentration the chemical components of the water and examine the impact of the concentrate by the short-term bioassay, (Simmon and Tadriff, 1976). In this method socket great result in the emergence of toxicity of some substances in the mixture and tyranny at least mutagenic substances. However the toxicity of some constituent may block influence of other mutagenic.

Therefore, the following axis is usually preferable to identify the mutagenic contaminants in the aquatic environment :This approach has overcome the reluctance that gets in the above cases and get benefit from aquaculture in the aquatic environment to be scanned for the presence of the mutagenic substances as evidence of a carcinogenic substances or those may cause fatal abnormalities in the newborn babies. It is summarised by extraction of the living tissues of some living organisms from the aquatic environment such as fish, algae or shellfish and examine them by Ames test (Barnes and Klekowski, 1978)and continues to this method is followed in most organizations

Therefore, Ames test are usually used by health authorities and local governments to control the imported or new produced commercial products to make sure that they are free of mutagenic chemicals (Oualemsrtun; Ames and Gold, 1990; Farmer and Walker, 2006; Teasdale, 2011). It is also used to differentiate between the harmful pesticides to human health safe products.

In the province of Karbala, this approach been also used for the first time to determine the length of stay of pesticides on some largely consumed vegetables such as cucumbers and tomatoes. (Al-Mossawi,et al. 2010).

In general, this technique can be considered as a fast, cheap and reliable method to get the database for all chemical pollutants that cause genetic mutations or cancer in the aquatic environment, to identify their input sources and control their spread in the aquatic environment.

The coordination between members of the chemical analysis research team and biologists using the short-term bioassay can also be used as a guide for the chemical analysis protocols lead to identify the input source(s) of any hazardous chemical. (Al-Mossawi, 1978).

2-2 The Pathogenic Bacteria in water:

Many types of microbes especially the pathogenic bacteria and viruses are polluting the aquatic environment in Iraq making it as incubator for different kinds of diseases. These microbial pollutants are coming from food factories, hospitals, laboratories of the hospitals, universities and scientific research centres. This is clearly reflected in the most rural areas whose population drink water without chlorine disinfection.

These polluted waters are lacking the necessary treatments in most Iraqi cities and villages and there are more than 63% of the residential houses in the cities and 98% of residential houses in the villages of Iraq needs to be disinfected water for drinking (Water Supply and Sanitation-Wikipedia, 2012)). For instance, Sulaimaniyah province in 2010 had more than 1,500 cases of cholera infections, 2000 cases of hepatitis viral infections in eastern Baghdad' (AlSadr City) and more than 450,000 cases of intestinal Dysentery in most villages Iraqi, clearly related to contamination of the drinking waters with sewage (IAU, 2010). This problem requires a quick and firm decision to stop the environmental disasters like those mentioned above. A national applicable policy tackling these pollution problems as soon as possible may be the urgent task of the local and /or central governments.

3-Recycling of waste water:

On the other hand, the quick fixing of COMPACT UNITS BIO. TECH dependent upon the biological treatment that do not affect the environment and fitted easily with no odours and relatively at a low cost could be the best solution of this problem. The main advantage of this technique is as follows:

- treating the sewage and heavily polluted industrial waters with high efficiency at 1/5 time required by other ordinary methods.
- purify water emerging from college laboratories mentioned and get the results in addition to the determinants of temperature and acidic pH and oil derivatives
- easily bringing the following pollution determinants as detected in the affluent of research laboratory of Medical Faculty;.

BOD * = Biological Oxygen Demand (273 ppm) ,COD * = Chemical Oxygen Demand(592 ppm)

TSS * = Total Dissolved Salts (5000 ppm) ,TFC * = Total Fecal Coliforms (100000 / ml)

- bring to the best acceptable standards which are less than the global determinants required and can be used safely for watering gardens according to the following determinants (EEC Global Operation LLC, personnel communication)
- sterilized water by UV which do not adversely affect "on the environment:

BOD = 10 ppm (96.7%); TSS = 10 mg / L (96.7%);

COD = 38ppm (96.7%) TFC = 0 -1 / ml. ; Oil & Grease = 0

in addition to the determinants of temperature, acidic pH, oil derivati

The experimental unit of 120KL P/D High-Speed Bio Systems as presented in Figure1 is fully automatic systems with automatic sludge separation. Main components pre-assembled and tested before shipping; Each comprising of following:

- Main Bio Reactor Tank with three chambers. Epoxy coated.
- AMB Bio Media™ **Proprietary Media 950 m²/m³**. 20 Years warranty
- SS Course Air Distribution systems with butterfly valves, coarse air, No clogging. EEC Design
- Non-Return valves (Check valves)
- Necessary Cables & Accessories
- Tube Settler
- UV Sterlizer
- Pressure Sand Filter
- Rotary Displacement Blower.
- Submersible Feed Pump with cutter.
- Displacement Sludge / Recycling Pump.
- EEC automatic sludge separator.
- Necessary PVC Piping & valves
- Motor Control Panel.

EEC Clients

- **Videolar – EEC High-Speed Bio Tec – 120 m³/day**



Figure 1 : A model of EEC High-Speed Bio- Tech unit for treatment of domestic and industrial waste waters.

These processing units are the optimal way to treat contaminated water and use it to irrigate crops and public parks and at a relatively low cost "to handle ten times the pollutants that fill heavy water waste water and industrial water in 1/5 of the time required. Compared to classical methods as a result of the development of mobile bio-film expands the surface area of the biological action up to 950 square meters per cubic meter. At the same time, pea-size varies middle of the bacteria according to the proportion

In order to create a database of microbial contamination in the surface waters of the Iraqi environment to be used for the introduction of, the latest scientific techniques such as diagnostics indicators of microbial contaminants, which causes intestinal epidemics especially cholera and Salmonella, Shigilla and virus hepatitis,(Carson, et al, 2001; Ritchey and Coyne 2009; Dombek, et al, 2000 ;Guan, et al, 2002)

It may be very important to take some cases of resistance to antibiotics into consideration for their direct

With the advent of human cases in and greatly help to know the sources of pollution dangerous pathogenic bacteria in addition to identify the public health in a research environment. The bacteria resistance to antibiotics are effective in identifying the sources of pollution in Al-Mossawi, et al., 1982b, Al-Mossawi, et al.,1983 ;Graves, et al., 2002; Hagedom, et.al, 1999; Weggins et. al, 1999,Harwood, et al., 2000; Grave et.al., 2002).

Conclusions:

Severe that our strategy current encourages wasteful and extravagant in when we see countries that do not suffer from any problem in the provision of water stresses a lot, "to preserve its wealth of water at the individual level status metrics to determine the exchange domestic water or take advantage of some means of preventing the waste of water in the personal use .

Find the best new technologies to irrigate crops and stop the wastage of these very precious wealth "and to benefit from water recycling techniques or take advantage of the groundwater and surface the best of modern roads.

Establishing advanced scientific centre at each Iraqi university to study the situation of water resources in each province and develop scientific solutions appropriate to the problems of current and future That occur at any time for reference, "scientifically" of the Supreme National Committee to make decisions appropriate to address the critical cases to the problems of the existing water pollution, Environmental water sources.

References:

- 1 -Al-Mossawi, M.A.J; Kadri, M., Salama M.,Salem, A. (1982a): The efficiency of various solvents in the extraction of chemical mutagens
From living tissues: a comparative study. Mut. Res. 104: 43
- 2- Al-Mossawi, M.A.J H. Abdul Ridha, Al-Hashimi and Al-Isa, Rafid
(2010) The use of Bacteria to control spreading of health hazardeous Insecticides. Journal of Karbal University /Proceeding of the Sixth International Conference ./special Issue
- 3-Al-Mossawi, M.A.J., M. Kadri, Salem, A. and Salama, M. (1982 b): Incidence of antibiotic resistant fecal coliforms in the coastal waters of Kuwait. Water, Air and Soil Pollu. 17: 141
- 4-Al-Mossawi, M.A.J.(1983) : Detection of antibiotic resistant coliforms in sea water by membrane filtration method: Microbios Let. 23 : 67

- 5- Ames, B. N. , Lee, F.D., and Dunston, W. E. (1973): An Improved bacterial test system for the detection and classification of mutagens and carcinogens. Proc.Nat.Acad. Sci. (UAS) 70 ; 782-786
- 6- Ames , B.N. and Gold L.S.,(1990)Chemical Carcinogenesis: too many Rodent carcinogens. Proc. Nat. Acad. Sci. (USA):87;7772
- 7- Aquastat. Irrigation in the Middle East region in figures ,2008(On line)
<http://www.fao.org/nr/iraq/index.stm>
- 8- Barenes, W. S. and Klekowski, E.J (1978) Testing the environment for dispersed mutagens: Use of plan bioconcentrators coupled with Microbial mutagen assays. Environ. Health Perspect. 27: 61
- 9- Bridges, B.A.; (1976): Short term screening tests for carcinogens. Narue :261;195
- 10- Bridges, B. A. (1980), The fluctuation test . Biomed. & life Sci.46: 41
- 11- Carson , C.A., Shear ,B.L., Ellersieck, M. R and Asfaw, A. (2001)Identification of fecal *Escherichia coli* from human and animal by ribotyping. Applied and Environ. Microbiol. 67 :1503
- 12- Conney, A.H. (1982): Induction of microsomal enzymes by foreign chemicals and carcinogenesis by polycyclic aromatic hydrocarbons
Cancer Res.,42 : 4875
- 13- Farmer,P.B. and Walker, J.M. (2006) :The Molecular Basis of Cancer.
Krieger Publishing Co.
- 14- Dombek, P. E., Johnson, L. K., Zimmerley, S. T., & Sadowsky, M. J. (2000). Use of repetitive DNA sequences and the PCR to differentiate *Escherichia coli* isolates from human and animal sources. *Applied and Environmental Microbiology*, 66, 2572
- 15- Gatehouse,D. (1978) Detection of mutagenic derivatives of cyclophosphomide and a variety of other mutagens in a microtiter
@fluctuation test without microsomal activation Mutat. Res. 53:,289
- 16- Graves, A. K., Hagedorn, C., Teetor, A., Mahal, M., Booth, A. M., & Reneau, R. B. (2002). Antibiotic resistance profiles to determine sources of fecal contamination in a rural Virginia watershed. *Journal of Environmental Quality*, 31, 1300
- 17- Green , M.H.L., Muriel, W.J. and Bridges, B.A. (1976)Use of simplified fluctuation test to detect low level of mutagens. Mutation. Res. 38: 33
- 18- Guan, S., Xu, R., Chen, S., Odumeru, J., & Gyles, C. (2002). Development of a procedure for discriminating among *Escherichia coli* isolates from animal and human sources. *Applied Environmental Technology*, 68, 2690.
- 19- Hagedorn, C., Robinson, S. L., Filtz, J. R., Grubbs, S. M., Angier, T. A., & Reneau, R. B. (1999). Determining sources of fecal pollution in a rural Virginia watershed with antibiotic resistance patterns in fecal streptococci. *Applied and Environmental Microbiology*, 65, 5522
- 20- Harwood, V. J., Whitlock, J., & Withington, V. (2000). Classification of antibiotic resistance patterns of indicator bacteria by discriminant analysis: Use in predicting the source of fecal contamination in subtropical waters. *Applied and Environmental Microbiology*, 66, 3698

- 21- IAU (2010)- International Agency for Information and analysis Unit. Water in Iraq Facts sheet. October,2010
- 22- Mayoralty of Baghdad* . Republic of Iraq(2010):Joint Monitoring Programme Water Supply and Sanitation, Estimates for the use of Improved Sanitation facilities. *أمانة العاصمة بغداد
- 23- . Mc Cann, J.; Choi, E.; Yamasaki, E.; Ames, B. N. (1975). "Detection of carcinogens as mutagens in the Salmonella/microsome test: Assay of 300 chemicals". *Proceedings of the National Academy of Sciences of the United States of America* 72 (12): 5135
- 24- Mc Cann, J. and Ames, B. N. (1976): Detection of carcinogens as mutagens in Salmonella / microsom test assay: assay of 300 chemicals: Discussion . Proc. Nat. Acad. Sci. (USA) 73: 950
- 25- Moore, P. and Strauss, B. S.(1979): Sites inhibition of the in vitro DNA synthesis in carcinogen and UV treated OX174DNA. *Nature*, 278
- 26- Parry, J. M. , D. J. Tweats and M.A.J. Al-Mossawi (1976): Monitoring the marine environment for chemical mutagens. *Nature* ,264 :538
- 27- Parry , J. M. and M. A. J. Al-Mossawi, (1979):The detection of mutagenic chemicals in the tissues of *Mytillus edulis* . *Environ.Pollut.*13: 175
- 28 -Ritchey , S. A. and Coyne' M. S. (2009):Applying MAR Analysis to Identify Human and Non-Human Fecal Sources in Small Kentucky Watersheds *Water, Air, & Soil Pollution* 196:115
- 29 - Simmon V. F. and Tardiff, R. (1976): Mutagenic activity of drinking water concentrats. *Mutation Res.* 38; 389
- 30- Simmon, V. F. ,Kauhanen, K. and Tardiff, R.G. (1977): Mutagenic activity of chemicals identified in drinking water. P 249 in: *Progress In genetic toxicology* (eds) Scott et al., Elsevier / North Holland.
- 31- US AID (2007):The bottled water market in Iraq.
- 32- Water Supply and Sanitation in Iraq (2012)Wikipedia , the Freeencyclopedia.www.wikipedia.org/wiki/water_supply_and_sanitation_in_iraq
- 33- WHO/UNICEF (2010): Joint monitoring programme for water for water supply and sanitation , Estimates for the use of improved Drinking water sources.
- 34-Wiggins, B. A., Andrews, R. W., Conway, R. A., Corr, C. L., Dobratz, E. J., Dougherty, D. P., et al. (1999). Use of antibiotic resistance analysis to identify nonpoint sources of fecal pollution. *Applied and Environmental Microbiology*, 65, 3483
- 35-Al-Mossawi, M.A.J H. Abdul Ridha, Al-Hashimi and Al-Isa, Rafid (2010) The use of Bacteria to control spreading of health hazardeous Insecticides. *Journal of Karbal University /Proceeding of the Sixth International Conference ./special Issue*

