Ministry of Higher Education and Scientific Research

Salahaddin University-Erbil

College of sciences

Environmental Science and Health Department

Determination of some parameters of wastewater in Erbil city iraq

By

Sumaya A.Ibrahim

Khanda R. Rahman

Supervised by

Chiyai M. shareef

2022-2023

Abstract

The Object is to determination of some parameters of wastewater in Erbil city iraq from three month in October and November and december, 2022 at two site of Erbil city (Garaki zhyan and Jaday kornish) and use the concentration fo water quality of studied areas with standards of kurdistan,Iraq and WHO and six chemical and physical parameters were used including (EC, pH, Tatal alkalinity, Total harness, TDS and NO_3)

Introduction

Water is considered to be one of the most essential and valuable resources on Earth as it is the most crucial factor to sustain life. It has been estimated that about 71% of the Earth's surface is covered with water but only 2.5% of it is available as freshwater . Also, the ever-increasing population is imposing tremendous pressure on natural resources. It has been estimated that the world's population will increase by more than double in the next 30 years and so will the demand for potable water thereby resulting in its global scarcity. Moreover, rapid urbanization and industrialization have resulted in improper discharge and disposal of wastewater from medical, municipal, agricultural, and industrial sources . This, in turn, has caused a rise in the amount of untreated wastewater being released thus leading to hazardous impacts on human health and the environment . The ill-effects of the growing levels of wastewater are (i) crisis of potable water, (ii) detrimental effect on aquatic flora and fauna, (iii) land and soil pollution, (iv) negative consequence on groundwater, (v) surge in health risks including death due to heavy metal (lead, mercury, cadmium) contamination, and (vi) pollution of rivers and coastal areas . Thus, it becomes imperative for both developed and developing nations to adopt measures to save water and improve the qualitative parameters of wastewater to make it harmless and reusable **.**In the current scenario, wastewater treatment (WWT) has emerged as a productive strategy for solving the problems of water shortage as well as protecting the environment from the damaging effects of wastewater . WWT can be defined as the process for the removal of contaminants and unfavorable components from polluted waters and safely recycling them back to the environment for a variety of purposes such as drinking, washing, irrigation, industrial, and other uses **.** Nowadays, increasing environmental awareness and strict enforcement of government regula tions have made conventional WWT systems dubious. In a conventional WWT system, a constant supply of oxygen (O_2) is necessary to enable the microorganisms to digest and break down the complex materials into simpler ones. It is has been calculated that biodegradable carbonaceous waste in the water have an O_2 demand in the order of 2 kg O2 kg-1 COD . Due to hazardous impacts of municipal, industrial and hospital wastewater on water, soil, air and agricultural products, wastewater treatment and the proper disposal of the sludge produced are indispensable from an envir-onmental safety point of view . Economically, effective wastewater treatment has important effects on saving water, and preventing unnecessary water losses . In arid and semiarid countries such as Iran, the water demand has increased and annual rainfall is low also in regions of North Africa, Southern Europe, and in large countries such as Australia and the United States. Consequently, reuse of sewage is the most sustainable and long-term solution to the problem of water scarcity .In the next 30 years, the world's population will increase by more than double. Due to population growth, the amount of water available in 1960 was re-duced to 3300 cubic meters and in 1995 it was reduced to 1250 cubic meters. This trend is projected to decrease to 650 cubic meters worldwide by 2025 . Due to this water shortage crisis, water from wastewater treatment need to be reused increasingly in the near future . Wastewater reuse requires treatment and application of appropriate wastewater treatment systems . In recent years, increased research has been done on wastewater treatment using simple, low-cost, easy-to-use methods in developing countries . Systems and processes such as activated sludge, aerated lagoons, stabilization ponds, natural and synthetic wetlands, trickling filters, rotating biological contactors (RBCs) have been used for wastewater treatment and removal of physical, chemical and biological contaminants . Among different contaminants of wastewater, microbial agents becoming increasingly important and their removal efficiency should be reported in different wastewater treatment systems . Biological contaminants in wastewater are different types of bacteria (Fecal coliforms and Escherichia coli, Salmonella, Shigella, Vibrio cholerae), diverse Parasite cysts and eggs, viruses and fungi. All of them can be hazardous to environmental and human health depending on the type and amount . For example, bacteria in wastewater cause cholera, typhoid fever, and tuberculosis, viruses can cause hepatitis, and protozoa can cause dysentery Many microbial agents attached to suspended solids in wastewater if inadequately treated and wastewater discharge into the environment, such as river water, green space, and crops, put humans and aquatic organisms at risk . There-fore, utilization of appropriate wastewater treatment systems tailored to a variety of microbial agents is essential to achieve as complete as possible elimination of biological agents. For example, in the study of Sharafi et al., (2015) with the aim of determining the removal efficiency of par-asites from wastewater using a wetland system, the re-moval rates of protozoan cysts and Parasite eggs were 99.7 and 100%, respectively . Okoh, et.al. (2010) reported that activated sludge processes, oxidation pools, activated carbon filtration, lime and chlorination coagulation elimi- nated removed 50–90% of wastewater viruses . Waste-water from wastewater treatment plants, is used in Iran without restrictions and controls like in many other countries. Therefore, it is necessary to employ proper sewage treatment systems, before water can be publicly used such as for irrigation. Problems caused by wastewaters: Human activities, such as agricultural including livestock, as well as urban and industrial development, create large quantities of wastewater that have to be treated prior their discharge in water bodies or land. If they are not treated properly, their pollutant load can cause serious environmental deterioration, with direct impact on human health. Agricultural and urban wastewater accumulate large quantities of pollutants, such as organic, nitrogen and phosphorus compounds, in surface waters, underground waters and soils. These pollutants are responsible for eutrophication and are nutrients for a variety of microbial species. Activated sludge principle: Since decades, a wide range of technologies, processes and techniques has been developed and implemented for the treatment of municipal and/or industrial wastewaters. The most commonly applied wastewater treatment application is the biological processes, i.e. the use and exploitation of bacteria species for removing pollutants. The principle idea is to cultivate a large number of bacteria colonies (activated sludge, AS), which utilize pollutants for their own needs (growth and energy production), by creating the necessary conditions for their development. Different conditions, such as aerobic, anaerobic or anoxic, enhance the growth of specific bacteria that can be manipulated for the treatment of different substrates. Biological process is followed by solids/liquid separation achieved commonly by gravitational sedimentation. A fraction of the separated solids is recirculated, while the rest is wasted. The problem of waste sludge: While biological treatment offers significant performance with relatively low cost, it also entails significant sludge production due to the accumulation of biomass and inactive sludge in the wastewater treatment plant (WWTP). The excessive accumulation of sludge hinders sedimentation efficiency and can also create problems concerning mixing and aeration of the bioreactors. Consequently, large quantities of accumulated sludge have to be disposed (waste sludge) frequently from a biological treatment plant, in order to maintain acceptable effluent quality. The quantity of waste sludge depends on influent composition and volumetric load, as well as on WWTP's operating conditions. Higher loads result in higher biomass yields, while critical operating conditions, such as hydraulic retention time (HRT), solids retention time (SRT), biomass age, food to microorganisms ratio (F/M), dissolved oxygen concentration (DO) and alternating conditions (aerobic, anoxic, anaerobic etc.), significantly affect biomass production. Landfill disposal of sludge can create negative environmental, economical and social impacts, such as soil and water pollution, threats on human health, land devaluation. Sludge treatment increases wastewater treatment cost more than 50%.1-3 Consequently, sludge minimization is a key towards sustainable operation and design of WWTPs. Sludge minimization approaches: Recently, approaches for minimizing sludge production have intrigued scientists and engineers, as it can resolve the problem of sludge management at its source. It is well known that WWTP operating conditions are linked to the biological and morphological characteristics of activated sludge and to microbial manipulation that influence sedimentation process, treatment efficiency and net sludge production.High SRT: One approach for minimizing sludge production is the amplification of microbial cell lysis and the growth of biomass from the utilization of cell lysis products, defined as cryptic growth.Starvation conditions that occur in high SRT processes enhance cryptic growth, due to the high biomass concentration and the low F/M.Microbial manipulation: Successful microbial manipulation can minimize sludge production up to where almost no sludge is disposed.5,9 Microbial manipulation is the guided growth of desired microbial species by imposing specific operating condition in the bioreactors. The successful microbial manipulation towards the growth of predator microbial species can minimize sludge production, as they feed on bacteria and particulate organics. Growth of predator microbial species can be achieved at high SRT and different operating regimes (extended aeration, cyclic alteration between anaerobic anoxic and oxic conditions etc.) that provoke metabolic changes. Consequently, in high SRT AS processes, the new cells production rate becomes equal to the decay rate.

The Amis of this study

1. To obtain data for defintion of some parameter concentration of waste water in Erbil- city.
2. The study in selected site including (Garaki zhyan and Jaday kornish).

Material and method

Sample collection

A water samples from waste water of Erbil city were collected from 2 site including (Garaki zhyan and Jaday kornish with 2 replication) in October and November ad December of the year 2023.

Hydrogen ion concentration (pH):

It was measured in the field by electrometric method using a portable pH-meter model (JENWAY 3505). The instrument was calibrated before each sampling using buffer solutions of (pH= 4, 7 and 10), pH unit with a range of 0 to 14.

Electrical conductivity (EC):

It was measured in the laboratory using a portable EC- meter model (HANNA instruments, HI98303) calibrated with (0.01M) standard potassium chloride solution before each sampling. The instrument was supplied with an automatic temperature corrector. The results were expressed in $\mu S.cm^{-1}$.

Total dissolved solid (TDS):

It was calculated in the lab by using the formula below: TDS=Ke x EC Where : TDS=Total dissolved solids was, Ke=correlation factor (0.64) and EC= electrical conductivity in ($\mu S.cm^{-1}$ at 25 ˚C). The results were expressed in $mg.^{L-1}$.

Total alkalinity:

It was determined in the lab by titration method using standard sulfuric acid titrant (0.02 N) as described by APHA (2012), the results were expressed in mg $CaCO_3$ $^{L-1}$ using the formula bellow:

Alkalinity as mg CaCO3 L-1 = A x B x 50000/ml of sample.

Where: A= ml of standard acid used.

B= normality of standard acid.

Nitrate (NO_3):

Nitrate concentration was determined by colorimetric method using ultraviolet spectrophotometric method according to APHA (2012), using hydrochloric acid solution 1N and ultraviolet spectrophotometer (model GENWAY model 6305) with a quartz 1 cm cuvette cell at a wavelength of (220 nm) for nitrate reading and a wavelength of 275 nm to determine interference due to the dissolved organic matter. The results were expressed in mg N-NO_3 .L-1 .

Statistical analysis

Using a software program Statistical Product and Service Solutions (SPSS Statistics for Windows). One-Way ANOVA was used for comparison for means of parameters by (Tukey test) between months to know significant or not. T-test was used for comparison for means between sites to know significant or not. $P< 0.05$ was used as the significant level.

Result and Disscution

PH is calssed as one of the important water parameters measurment of Ph relates to the acidity or alkalinity of the water the normal drinking water ph range mentioned in (WHO) guidelines The highest value was recorded at site one 8.11 in October and the lowest value was at site two 7.74 in November. The pH this maybe due to the effect of geological area and buffer capacity of water (Spellman, 2008).

Table 1 : pH of studied sites and monthes

Months	Site1	Site2	MEAN
October	**8.11**	**7.83**	**7.9700**
November	**7.74**	**7.75**	**7.7450**
December	**7.64**	**7.56**	**7.6000**

Electrical conductivity is the ability of any medium water in this case to carry an electric current. The highest value was recorded at site one 1378 µs. cm^{-1}.the lowest value was at site two 647 µs. cm^{-1}.in October the high EC value possibly due to high concentration of water dissolved ion and high concentration of calcium and magnesium salts (Ahamed and Alam 2003) and the lowest and highest conductivity this can explained as reverse osmosis treatment technique is use to remove dissolved solids and turbidity and colloidal matter and others and it gives lowest conductivitvalue according to Azrina, et.al. (5] The electrical conductivity of water samples revealed significant differences ($P<0.05$) between months.

Table 2 : EC of studied sites and monthes

Months	Site1	Site2	MEAN
October	**975**	**647**	**811.00**
November	**1132**	**1136**	**1134.00**
December	**1378**	**1291**	**1334.50**

TDS are the inorganic matter and small of organic matter which are present as solution in water. The highest value was recorded at site one 881.92 mg. L^{-1} in December and the lowest value was at site two

414.08 mg. L^{-1} in October and the high TDS at site during this maybe due to ion creased flow rates during winter and atum in addition to rainfall leading to high turbidity rates how ever Shaikh. et.al.,2009) the lowest TDS at site becuse the woodland cleaned (Tiwari, 2017). The TDS of water samples revealed significant differences ($P<0.05$) between months.

Table 3: TDS of studied sites and monthes

Months	Site1	Site2	MEAN
October	**592.00**	**414.08**	**503.0400**
November	**724.48**	**727.04**	**725.7600**
December	**881.92**	**826.24**	**854.0800**

Nitrate (NO_3) is a measure of the most oxidized and stable form of nitrogen in a water body. Nitrate is the principle form of combined nitrogen found in natural water. (Langmuir, 1997). The highest value was recorded at site two 51.400 mg. L^{-1} in December and the lowest value was at site one 35.582 mg. L^{-1} in October of the high NO_3 this maybe due to the reduction efficiency of the micoorganisms by reducing ferric iron to ferrous iron this cause an increas in NO_3 concentration and Nitrates reduction in anaerobic conditions in nautral water(Tairu.et.al.,2015). Statistical analysis of NO3 reveal significant differences ($P<0.05$) between site one and two.

Table 4: NO_3 of studied sites and monthes

Months	Site1	Site2	MEAN
October	**35.582**	**36.98**	**36.28100**
November	**36.98**	**41.52**	**39.25000**
December	**37.38**	**51.40**	**44.39000**

Total Hardness is good indicator of the presence of some soluble solids in water such as calcium and magnesium ions which are common proportion (Omer, 2019) The highest value was recorded at site one 150 mg $CaCO_3$. L^{-1} in October and the lowest value was at site two 120 mg $CaCO_3$. L^{-1} in November the high total harness at site1 this maybe due to preciptation of rain containing carbon dioxide and dissolution soil (WHO,2004). Statistical Total hardness reveal significant differences ($P<0.05$) between site one and two.

Table 5: Total hardness of studied sites and monthes

Months	Site1	Site2	MEAN
October	**150**	**120**	**135.00**
November	**150**	**120**	**135.00**
December	**150**	**150**	**150.00**

Total Alkalinity: alkalinity is not a pollutant it is a total measure of the substances in water have acid Neutralizing capacity (Webber and Stamm, 1963) .The highest value was recorded at site two 800 mg $CaCO_3$ L^{-1} in December and the lowest value was at site one 350 mg $CaCO_3$ L^{-1} in October it is due to salts of weak acids and bicarbonates and is estimated in terms of an equivalent amount of calcium carbonate. No permissive and excessive values of total alkalinity are given by WHO ISI and ICMR (PHSDWS, 1962). The total alkalinity of water samples revealed significant differences ($P<0.05$) between months.

Table 6 : Total alkalinity of studied sites and monthes

Months	Site1	Site2	MEAN
October	**350**	**400**	**375**
November	**500**	**500**	**575**
December	**700**	**700**	**750**

Table 7. The concentration of standards of Kurdistan, Iraq and WHO.

Parameters	kurdistan	Iraq	WHO
EC	**400**	**600-1200**	**100-500**
TDS	**842**	**100-500**	**500-1500**
PH	**7.7**	**6.5-8.5**	**6.5-8.5**
T.hardness	**204**	**100-500**	**100-300**
T.alkalinity	**205**	**100-200**	**100-200**
NO_3	**44**	**50**	**50**

Conclution

the condition of the water in Erbil city including (Garaki zhyan and Jaday kornish) with measurements water characterisics including (pH, EC, TDS, Total alkalinity and Total harness NO_3) sources of polluants of the water come from domestic waste and industrial waste from activities that quite high in the region.

References

Ahamed, A and M. Alam.2003. Physico - chemical and Toxicological studies of Industrial effluents in andaround Delhi and Ground water quality of some areas in Delhi city. Chem. Envir. Research. 12 (1&2):5-13.

Aghalari .Zahra , Dahms .Hans-Uwe, Sillanpää .Mika, Sosa-Hernandez . Eduardo.Juan and Parra-Saldívar. Roberto. (2020). Effectiveness of wastewater treatment systems in removing microbial agents: a systematic review Globalization and Health. 16:13 https://doi.org/10.1186/s12992-020-0546-y

Azrina A., H. E. Khoo, M. A. Idris, I. Amin, and M. R. Razman, “Major inorganic elements in tap water samples in Peninsular Malaysia,” Malaysian Journal of Nutrition, vol. 17, no. 2, pp. 271– 276.

APHA (AMERICAN PUBLIC HEALTH ASSOCIATION). (2012). Standard methods for the examination of water and wastewater (A. E. G. a. A. D. E. Lenore

Clesceri. S. Ed. 22th ed.): American Public Health Association, American Water Works Association, Water Environment Federation.

Langmuir, D. (1997). Aqueous Environmental Geochemistry: New Jersey. Prentice-Hall, USA.

Nayla Hassan Omer.(2019). Water Quality Parameters. DOI: 10.5772/intechopen.89657 .

Okoh .AI, Sibanda. T, Gusha .SS. (2010).Inadequately treated wastewater as a source of human enteric viruses in the environment. Int J Environ Res Public Health.;7(6):2620–37. https://doi.org/10.3390/ijerph7062620.

Rahmanian, N., ALI, S. H. B., Homayoonfard, M., ALI, N., Rehan, M., SADEF, Y. & Nizami, A. 2015. Analysis of physiochemical parameters to evaluate the drinking water quality in the State of Perak, Malaysia. Journal of Chemistry, 2015, 1-10.

Sharafi .K, Moradi .M, Azari .A, Sharafi. H, Pirsaheb .M. (2016).Comparative evaluation of parasitic removal in municipal wastewater using constructed wetland and extended aeration–activated sludge system in Kermanshah province, Iran. Inter J Health Life Sci. 2016;2(1):16–21.

Singha. Divya, Goswamib. Kumar. Rahul , Agrawalb. Komal, Chaturvedia .Venkatesh, Veramb. Pradeep. (2022). Bio-inspired remediation of wastewater: A contemporary approach for environmental clean-up (2022) www.elsevier.com/journals/ current-research-in-green-and-sustainable-chemistry/2666-0865

Shaikh, A.M., Mandre, P.N.2009. Seasonal study of physic-chemical parameters of drinking water in Khed Lote industrial area.Shodh, Samiksho aur Mulyankan. Int. Res. J.,117:169-171.

Spellman, F.R.(2008).The science of water. CRC press Boca Raton, London, New York.

Tairu, H. M., T. A. Kolawole, K. A. Adaramola, S. M. Oladejo, P. O. Oladokun, and T. V. Bada,(2015). Impact of human population and household latrines on groundwater contamination in Igboora Community, Ibarapa Central Local Government Area of Oyo State, South-Western Nigeria. International Journal of Water Resources and Environmental Engineering, vol.7, no. 6, pp. 84–91, 2015

Tiwari, p .(2017)'Water quality assessment for drinking and irrigation purpose; 13(2), pp. 140-142

Trikoilidou .E, Samiotis. G, Bellos .D and Amanatidou .E. (2016).Sustainable operation of a biological wastewater treatment plant. IOP Conference Series: Materials Science and Engineering.

WHO (World Health Organization) (2006). Guidelines for safe recreational water environments Vol 2: Swimming pools and similar environments. Strategies communications SA,Geneva.

Webber Jr. W.J. and W. Stamm, 1963. Mechanism of hydrogen ion buffering in natural waters 102 water, Journal of American Water Works Association, 55 ; 1553.