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Pollution Risk of water Quality on Human and Aquatic Life of Tigris River Reach in Mosul City / North Iraq

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Abstract
Considerable attention is now being paid to uses of rivers and lake for such purposes as domestic, fishing, aquatic life and esthetical enjoyment.
Study of water quality for Tigris River reach of Length 24 Km. in Mosul city, North Iraq, was carried out in order to assess their chemical composition and suitability for human and aquatic life.
Laboratory analysis of 15 water samples for five sites within the river reach , were performed in order to obtain the chemical concentration of Ca, Na, Mg, HCO3, SO4, Cl, NO3, TDS and pH. Certain ions may be lethal to human and other aquatic life forms when present at levels near or below the limit give by public water supplies. Copper , zinc and aluminum which are not among the metals for which limits are prescribed for public water supply, are toxic to human and many other species of aquatic life. Concentration of chemical constituents in water samples vary spatially and temporarily due to the reaction with environment, solubility of salts and human activities that find it way to the river reach.
The chemical analysis of water samples compared with the standard guideline values as recommended by the World Health Organization (WHO) for human, fisheries and aquatic life. four samples of the right bank side and one sample of site 3 in the left bank side of the river reach are fall within the poor quality type water. While the other samples of the left bank side and the deepest part of the river reach are fall within the high quality type water.

Introduction

It is very important to establish the quality of water through physical, chemical and biological variables in order to search for possible solutions and explaining of polluted water risks on aquatic environment to be chemically safe for human and other organism.

Variation of water quality in an area is a function of physical and chemical parameters that are greatly influenced by discharges and anthropogenic activities. Knowledge on hydrochemistry is more important to assess the quality of water for understanding the suitability for various need.

A considerable amounts of untreated sewage and waste water is discharged into the river reach. These sources contain high pollutants , which greatly affect the river environment.

Uses of waters of different qualities for different purposes requires that we evaluate the suitability for different purposes. An understanding of the quality of water used for human, fisheries and aquatic life needs to evaluate the physical and chemical conditions which may be changed on daily basis and may natural or human causes. Hence the present work had the objectives of understanding of chemical composition of water and its suitability for human, fisheries and aquatic life by comparing the analytical results with the recommended limits suggested by World Health Organization (WHO, 1992).

Water quality is a consequence of the natural physical and chemical state of the water as well as any alteration that may have occurred as a consequence of human activities (Freeze and Cherry, 1979).

Although highly impure water is attractive in appearance when viewed from a distance, it is obvious that even the lowest standards of pollution control must aim to produce a product reasonable pleasing to the senses of the viewer from close at hand, while walking along the shore or riding over the water in a boat. The surrounding of the water body is an important part of this esthetic impression (Hem. 1989).

Materials and Methods

Location and Description of The Studied Area:

The studied area is in the Northern part of Iraq and located approximately between latitude 36˚ 17ó 68ő – 36˚ 27ó 43ő and longitudes 43˚ 04ó 00ő – 43˚ 12ó 12ő Fig. (1). Tigris river is the main and important river which penetrates Mosul province from North to South and divided it into two banks. This river is originated from Turkey and considered to be perennial, as it carries water along the year. The only one tributary that draining water into the Tigris in the studied area is Al-Khoser. The regional slope in both sides of Mosul area is toward the Tigris River.

The climate of the studied area is considered to be semiarid , the annual precipitation being approximately (370-400) mm. It hasóó a cold winter, January of less than 5˚C , temperate climate spring and

high summer temperature, July of about 48˚ C. The most important economic activity of the northern part of the studied area is agriculture.

Geology

Mosul city is situated within the foot hill of the unstable shelf of the Nobian Arabian platform (Buday and Jassim, 1987). Stratigraphically the study area is dominated by a sedimentary succession of clastic and non clastic sediments ranging from Middle Miocene to Quaternary); these are Al-Fatha Formation , Injana Formation and Quaternary deposits Fig. (2). The lithological constituents of Al-Fatha Formation are gypsum, anhydrite, clay, green marls, halite and limestone (Buday, 1980). The distinguishing features of this formation is its fractures, fissures and jointing and on local scale exhibits solution channels and karstic features. Injana Formation of Upper Miocene consists of sandstone, marls and siltstone (Buday and Jassim, 1984). Quaternary deposits consists of gravel and sand bar deposits, flood plain deposits, river terraces deposits and loamy soil deposits. The Quaternary deposits is an important potential resources of water supply.

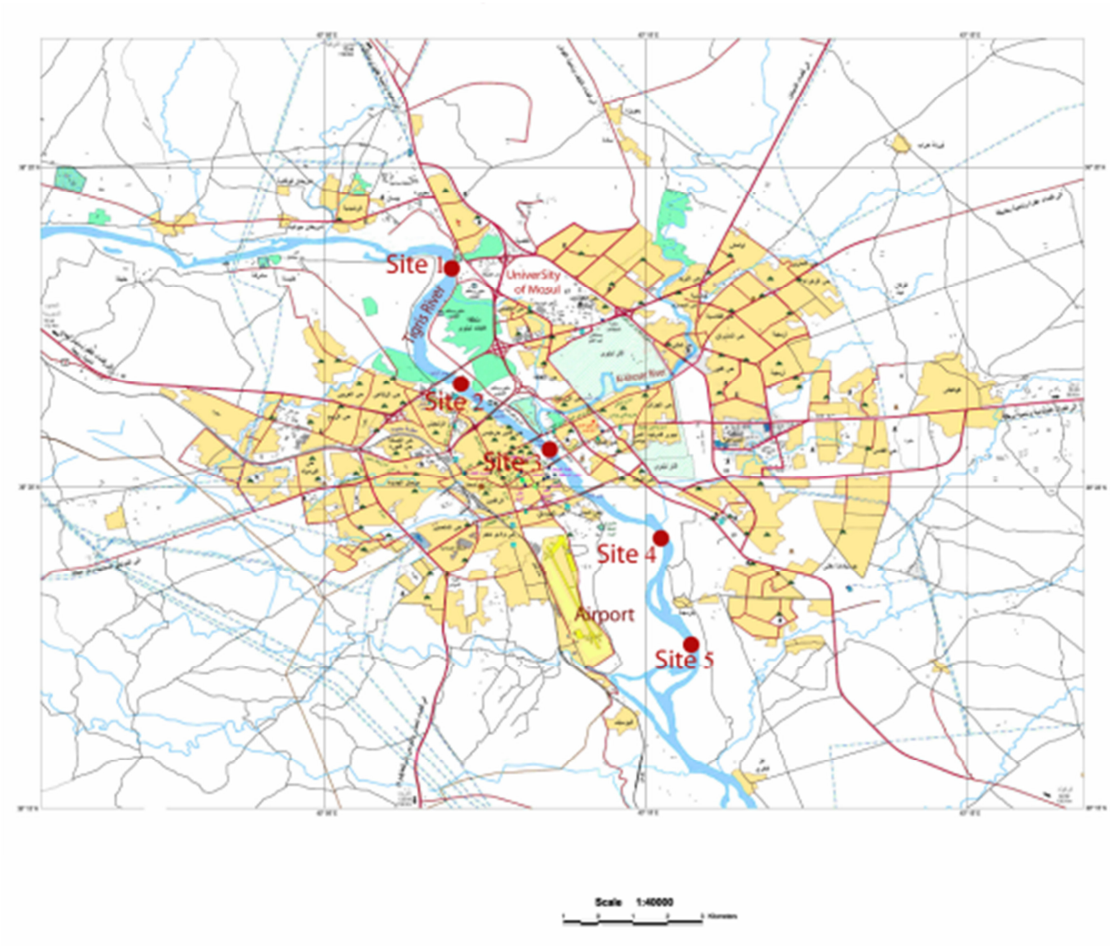

Fig.(1) location of the study area

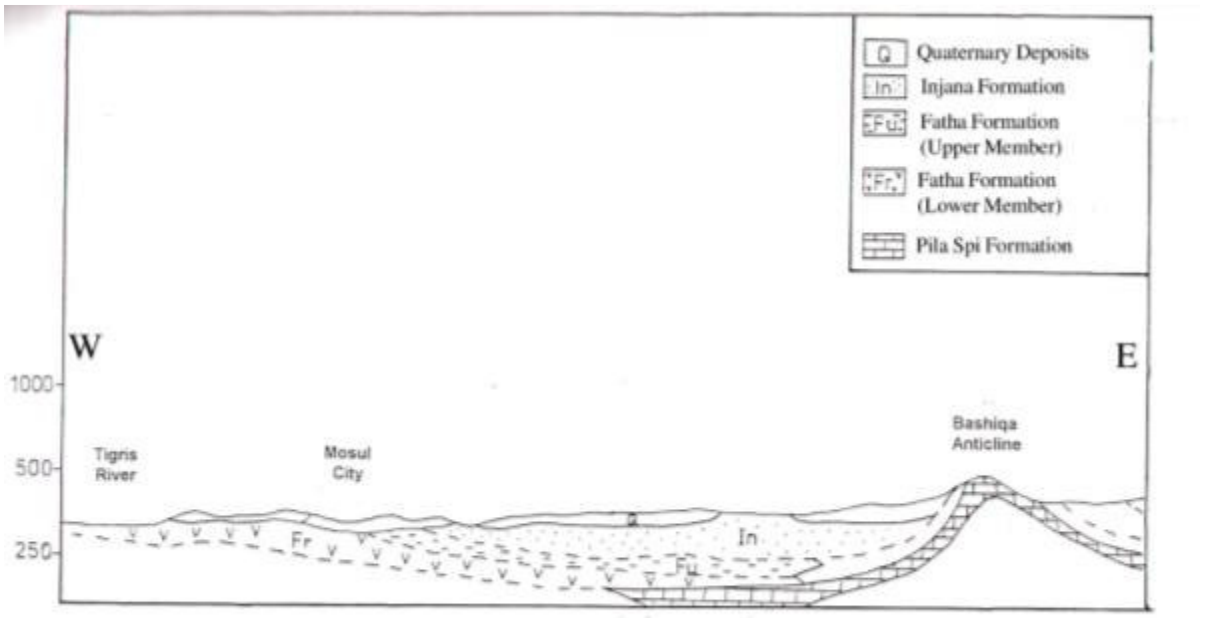

Fig. (2) Geological Cross - Section of mosul city (Geo. Surv. 1995)

Analysis of Water Samples:

In order to study the quality variations of the surface water of the river reach, 15 samples during September 2007 are collected from five sites of the river reach (three samples from the right bank, left bank and deepest point of each site of the river reach) in the vicinity of heavily densely populated area Fig. (1). These were analyzed for different chemical constituents using the standard methods as suggested by the American Public Health (APHA, 1989, 1995). The pH and electrical conductivity EC were measured using pH and EC meters immediately after sampling. The total dissolved solids (TDS) estimated by residue on evaporation methods. Ca and Mg were determined titrimetrically using standard EDTA. Na and K were measured by flame photometry. Bicarbonate HCO3 were determined by titration with HCl. Chloride Cl is determined by standard AgNO3 titration. Sulphate SO4 and Nitrate NO3, were determined by spectrophotometric techniques. The physical parameters and concentration of the chemical constituents of the water samples are presented in Table (1).

Hydrochemistry

Water and its Chemical Constituents:

Natural waters are never pure; always contain at least small amounts of dissolved gases and solids. Water is effective in dissolving salts because it has a very high dielectric constant and because its molecules tend to combine with ions to form hydrated ions (Freeze and Cherry, 1979).

The ions commonly determined in a water samples of this study that affect on human, fisheries and aquatic life, include SO4, NO3 and Cl. These ions forms the most risky chemical constituents and become lethal to human, fish and other aquatic life forms when present at levels near or below the limit give by public water supplies. Other physical parameters of water are: pH and EC, which are measured immediately subsequence to sampling; color and turbidity can also be noted, in which color is due to minerals or organic materials in solution, and turbidity results from suspended and colloidal matter such as silt and clay in water. Test and aroma may arise from bacteria, dissolved gases and minerals matter (Bowen 1980).

Interpretation of Water Quality Data:

Water compositions change through reaction with the environment, and water quality may yield information about the environment through which the water has circulated (Appelo and postma, 1993).

Interpretation of water quality data are made for evaluation and to determine if the water is satisfactory in quality for human, fisheries and aquatic life and other purposes. The water in most samples of the studied area has Ca – Sulphate characteristics. The Ca-SO_4 type water is dominated in the most samples of the studied area due to the presence of dissolved SO_4. The concentration of dissolved ions in water samples are generally governed by lithology, water flow, nature of geochemical reaction, solubility of salts and human activities (Karanth, 1997).

Water Quality of Fisheries and Aquatic Life:

Water to be used for human, fisheries and aquatic life is subjected to quality limitation. The water quality

evaluation in the area of study is carried out to determine their suitability for human, fisheries and aquatic life and its effect on human. The analytical results of chemical and physical parameters were compared with the standard guide line values as recommended by the World Health Organization (WHO 1983, 1998) for human, fisheries and aquatic life, Table (2 , 3). The most risky chemical constituents of water on human, fisheries and aquatic life, when exceeds maximum allowable level of the standard guide line values as recommended by WHO 1983, are: Sulphate (SO4), Nitrate (NO3), and Cl which may be lethal to human and other aquatic life forms when present at levels near or below the limit give by public water supplies. Copper , zinc and alluminium which are not among the metals for which limits are prescribed for public water supply, are toxic to human, fish and many other species of aquatic life (Hem. 1989).

Sulphate (SO_4):

A considerable sulphate concentration changes were noted in the three sites and in the direction of river flow. The high concentration, probably due to the effect of the large amounts of sewer discharge and presence of sulphur spring in the right bank of the river reach (site 2) and also due to the dissolution between water and gypsum which form the bed rock of Mosul city and the surrounding as shown in fig. (2). The effect of sulphate spring pollution extends to about (2) km. on the right bank side of the river reach in line parallel to the edge of the river.

The concentration of sulphate of the samples of the studied area range between (21-275) mg/l. Right bank sample of the river reach (site 2 and 3) exceeds the permissible level (250) mg/l recommended by World Health Organization (WHO). When sulphate concentration exceeds the maximum allowable limits is also causes A Laxative effect on human system and this may results in Gastrointestinal Irritation (Subramani et al 2005).

Nitrate (NO_3):

The concentration of nitrate is derived from fertilizer used for agriculture, as the northern part of the studied area is intensively irrigated and probably due to the return flow of water, therefore fertilizer may be the source for the elevated concentration of nitrate in water samples. The higher concentration of nitrate could be also interpreted on the basis of the decomposition of the organic materials as well as the large amounts of sewer discharged into the river. The concentration of nitrate of left bank sample (site 1 and 2) of the studied area is (45 and 42) mg/l and are slightly exceeds the desirable limits (40) mg/l as recommended by WHO for human, fisheries and aquatic life, and the concentration of nitrate for all the samples range between (8.2 - 45.0) mg/l. The high concentration of nitrate (NO3) in water samples is Toxic and also causes Blue Baby disease / Methaemoglobinaemia in children and Gastric Carcinomas (Comly 1945; Gilly et al 1984), when exceeds the permissible level (10) mg/l for drinking water as recommended by World Health organization (WHO).

Chloride Cl:

The chloride ion concentration of the three sites varies between (20 – 65) mg/l. The values are not exceeding the maximum allowable limit (300) mg/l of the standard guide line of World Health Organization (WHO). The concentration of Cl increases in water by sewage, fertilizer and water treatment by chloride.

Sources of Contaminants in River Reach:

A variety and considerable contaminants sources find its way to the river reach and causes the high level of contaminants in addition to the human activities; these are:

Pipe line draining sewerage, erosion of natural deposits, run off from fertilizer use, leaching from septic tanks, discharge from petroleum refineries, discharge from metal refineries, discharge from plastics factories and discharge of the rest of soaps and cleaners as shown in Fig. (1) .

Table (1) Chemical Constituents of water samples of the study area (ppm).

Site	Sample No.	Ca	Mg	Na	Cl	HCO3	SO4	NO3	pH	EC	TDS
Site 1	1	68	12	18	29	130	92	36	7.4	440	425
	2	30	7	12	16	80	47	28	7.1	400	365
	3	51	8	10	24	133	42	48	7.5	420	355
Site 2	1	60	13	18	55	125	275	15.6	7.67	480	425
	2	25	6.5	12	35	77	68	16.2	7.54	410	360
	3	37	7.2	11	42	137	87	30.8	7.5	410	355
Site 3	4	58	20.4	20	53	135	120	12.2	7.9	482	466
	5	28	8.6	11.5	32	80	58	17	7.6	425	348
	6	42	18.5	25	65	142	95	44	7.7	470	420
Site 4	7	66	14.2	32	48	150	82	15.5	8.0	475	490
	8	34	12.5	20	20	90	42	20.2	7.7	428	360
	9	52	10.5	28	44	120	72	47	7.8	510	460
Site 5	1	62	13	26	44	144	85	28	7.8	485	512
	2	32	9	18	22	92	38	22	7.6	430	380
	3	47	11	20	38	157	72	46	7.8	500	490

Table(2)Water quality standards (Source :Bowen(1980);UNESCO;WHO;UNEP(1992) nd European Community (Directive 98/83/EC))

Parameters	Fisheries and aquatic life (EC-USRR)
pH	6.0-9.0
TDS	25 mg/l
Cl	300 mg/l
SO4	100 mg/l
NO3	40 mg/l
NO2	0.01-0.03 mg/l

Table(3)Water quality standards (Source :Bowen(1980);UNESCO;WHO;UNEP(1992) nd European Community (Directive 98/83/EC)) - Fisheries and aquatic life

Parameters	Very high quality	High quality	Moderate quality	Poor quality	Very poor qality
pH	6.0-9.0	6.0-9.0	5.8-6.5	3.87-5.8	<3.87
Cl	<25.01	25.01-300	240-300	240-300	>240
SO4	<38.89	80-100	80-100	80-100	>80
NO3	<8.0	8-10	10-12	>12	>12

Table(4) permissible limits prescribed by WHO for drinking purposes (1983)

Parameters	Most desirable limits	Maximum allowable limits
pH	7-8.5	9.2
TDS (mg/l)	500	1500
TH (mg/l)	100	500
Na (mg/l)	----	200
Ca (mg/l)	75	200
Mg (mg/l)	50	150
Cl (mg/l)	200	600
SO4 (mg/l)	200	400
NO3(mg/l)	45	----
F (mg/l)	----	1.5

Conclusion

This study demonstrates the relationship between the hydrographic condition, nutrient salts and solids in the river reach environment. Therefore the study of chemical and physical parameters are necessary to protect river environment. The river reach under study is located with high population density which creates large volume of liquid waste discharge into the river.

The uncommon quality of the ground water is a direct result of the many physical and chemical process of mass transport between water and rock mass that builds the river over a very long period of time.

Interpretation of the chemical analysis result in this study take into consideration the most risky chemical constituents of water samples and its effect on human, fisheries and aquatic life such as SO4, NO3, and Cl.

The pH values were found to lie on the alkaline side, ranged from (7.5-8.0). And TDS range between (410 – 512) mg/l.

Concentration of most ions increased in the flow of direction of the river reach, as a result of sewage water discharged into the river.

The water in the right bank of the river reach (site 2) has Ca-sulphate characteristics. Sulphate spring in this location is the main cause for the presence of dissolved SO_4 and high smelly H_2S.

As a result of comparable between measured ions and the standard guide line of the World Health Organization (WHO) for fisheries and aquatic life . Sulphate concentration of the right bank (Site 2) is exceeding the permissible level of the World Health Organization (WHO) standard for hunan, fisheries and aquatic life (250) mg/l.

NO_3 concentration of the left bank of both sites (2 & 3) is slightly higher than the permissible level (40) mg/l.

Three samples of the right bank side and one sample of the left bank side of the river reach are fall within the poor quality type water. While the other samples of the left bank side and the deepest part of the river reach are fall within the high quality type water.

For a better understanding, a complete study should be done in the future including concentration of NO_2, Cu, Zinc and Aluminum to show the real and complete quality of the water.

A considerable attention should be paid , in future, to recreational uses of rivers, lakes for such purposes as swimming, fishing and for simple esthetical enjoyment.

The variation in water quality is due to agricultural, industrial and human activities that find its way to the river reach

References

APHA. 1989 Standard Methods for examination of water and waste water. 17th edn. American Public Health Association. Washington, DC.

APHA. 1995 Standard Methods for examination of water and waste water. 19th edn. American Public Health Association. Washington, DC.

Appelo, C.; D. Postma. 1993. Geochemistry, Ground water and pollution. Balkema. Rotterdam, The Netherland. 536p.

Buday, T. 1980. The Regional Geology of Iraq, SOM Library Unpub. Report, Baghdad, Iraq.

Buday, T. Jassim, S. Z. 1984 Final report and the Regional Geological Survey of Iraq, Unpub. Report, SOM. Library, V2. Tectonic Frame WorK, Baghdad.

Buday , T. Jassim, S. Z. 1987. The Regional Geology of Iraq. Vol. 2 Tectonism, Magmatism & Metamophism, Edited by Kassab, I.I.M. & Abbas, M.J., Baghdad.

Comly, H. H. 1945. Cyanosis in Infants caused by Nitrate in Well water. J. Am. Mwd. Assoc. 129:12-114

Freeze, A & Chery. 1979. Ground water. Prentice Hall Inc. New Jersey, USA. 604 p.

Gilly, G. Corrao, G. Favilli, S. 1984. Concentration of Nitrates in drinking water and incidence of Gastric Carcinomas. First Descriptive Studyof the Piemonate Region, Italy. Sci Total Environ 34:35-37.

Hem, J. D. 1989, Study and the Interpretation of the chemical characteristics of natural water. Third Edition. U.S. Geological Survey water-supply paper 2254. Washington, D.C. USA 263 p.

Hounslow, A. W. 1995. Water Quality Data. Analysis and Interpretation. Lewis Publishers. USA. 397 p.

Karanth, K. R. 1997. Ground Water Assessment, Development and Management. Tata McGraw-Hill, New Delhi.

Subramani, T. Elango, L. Damodara samy, S. R. 2005. Ground Water Quality and its Suitablity for Drinking and Agricultural Use in Chithar River Basin, Tamil Nadu, India.

UNESCO; WHO; UNEP. 1992. Water Quality Assessments. A Guide to the use of Biota, Sediments and water in Environmental Monitoring. Edited by Debora Chapman. Chapman-Hill, Cambridge, Great Britain, 585 p.

WHO, 1983. Guidelines to Drinking water Quality. World Health Organization, Geneva, pp 186.

WHO. 1998. Drinking water quality standard for the Europian Community. Directive 98/83/EC.

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