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INVESTIGATION OF EL BAHR EL SAGHEIR AS A SOURCE FOR DRINKING WATER

by

Ibrahim Gar Al-Alm Rashed, (PhD)
Assoc. Prof., Faculty of Engineering, El Mansoura University, El Mansoura , Egypt

Salah El Begawy, (Eng.)
Armed Forces, Egypt

Mohamed M. El Dessouky (PhD)
Assoc. Prof. Military Technical Collage, Cairo, Egypt

Mahmoud A. El Komy, (PhD).
Lecturer, Faculty of Engineering (Shoubra), Zagazig University, Banha Branch, Egypt

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الخلاصة

فى هذا البحث تم عمل مسح كيمائى لمياه البحر الصغير من بدايته عند مدينة المنصوره ، وحتى نهايته بعد مدينة المنزلة بطول ٧٠ كيلو مترا ، حيث أن هذا المجرى المائى يستخدم فى الآونة الاخيرة كمصدر لمياه الشرب لتدعيم الشبكة الرئيسية لمياه الشرب فى جزء كبير من منطقة شرق الدقهلية والتى تأخذ مياهها من محطة بساط كريم الدين . وقد ركزت هذه الدراسة على التلوث الفلزى الموجود بهذا المجرى ، وقد وجد أن نسب عناصر الفلزات الثقيلة مثل الكروم والزنك والفضة والمنجنيز أعلى من المعايير المسموح بها عالميا ، بينما وجد أن تركيزات الكلوريدات والكبريتات والاكسجين الذائب ورقم الأس الهيدروجينى فى الحدود المسموح بها عالميا . وقد تضمن البحث مناقشة النتائج المتحصل عليها وتفسيرها بالاضافة الى توصيات بغرض إزالة أسباب التلوث الفلزى فى مياه هذا المجرى.

ABSTRACT

An examination was made on the 20th of Augest 1986 of that part of El Bahr el sagheir where it is, recently, used as a source for drinking water. It was found that this water course could not satisfy the standards recomended for drinking waters with respect to heavy metal pollutants (Cr, Zn, Ag and Mn). On the other hand it satisfies the standards recomended for Cl^-, SO_4^{--}, DO and pH. Recomendations to prevent the metal pollution of the water course are given.

1. Introduction:

Recently, El Dakhlia Governorate established small units for water treatment on the banks of El Bahr el-sagheir canal; to support the main source of drinking water comming from the water treatment plant at Bousat Kareim el-Dein. The capacity of every unit is about 100 m· /hour. The principal unit operations in these units are based on coagulation, sedimentation, filtration and disinfection. As illustrated in Fig.(1).

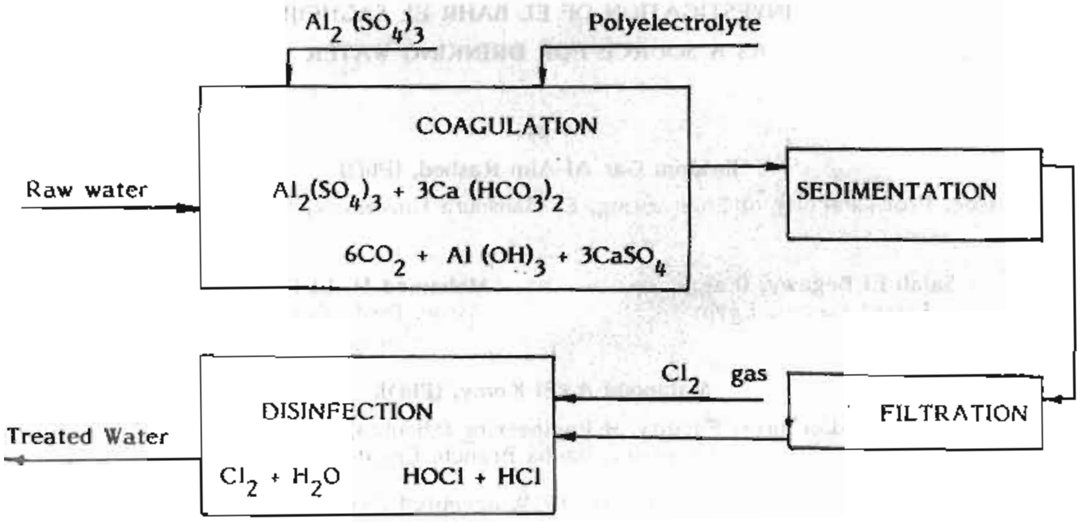

Fig.1 Principal unit operations in water treatment units.

Experts estimate that industrial and domestic waste water introduces up to a million different pollutants into natural waters(1). These include substances that are not considered dangerous,although many of them add disagreeable odours or taste to the water and others significantly upset the ecosystem without being directly harmful to humans. Other groups do, however, have direct and indirect influences on the human organism and can cause serious damage. Substances such as polycyclic aromatics, pesticides, radioactive matter, and trace metals directly endanger human life.

The latter group of pollutants-which some of them are surveyed in this work-are of note in two respects: Firstly, trace metals are not usually eliminated from the aquatic ecosystems by natural processes, in contrast to most organic pollutants, and secondly, most metal pollutants are enriched in mineral and organic substances. Toxic metals such as silver, zinc, manganese tend to accumulate in bottom sediments from which they may be released by various processes of remobilization, and-in changing form-can move up the biologic chain, thereby reaching human beings where they produce chronic and acute ailments(2).

The aim of the undertaken work is to make a survey for the main characteristics of El Bahr el-Sagheir canal, and collect specific data pertinent to its full length from El Mansoura City to El Manzala town, in order to point out the sources of pollution affect - ing its water quality.

2. Experimental Procedure:

An examination was made on the 20th of Augest 1986 of that part of El Bahr el-Sagheir receiving its water from El Rayah el Tawfieky via Terat El Mansouria. Eight samples were taken near the water inlet of treatment units along the approximate length of 70 km of the water course prior to its end near El Manzala Lake. Other four samples were taken at different points. Another one sample was taken from one of the treatment units. The locations of sampling points are given in table (1) and shown diagramatically in Figure (2)

Analysis of spot samples from each point were made in the field for the measurements of dissolved oxygen, temperature and pH. The dissolved oxygen and temperature were measured using a digital dissolved oxygen meter fitted with a display for temperature reading (S C H O T T G E R Ä T E, W.G., model CG 867). pH values were measured using a digital pH meter, (SCHOTT GERÄTE, W.G., model CG 818). Other characteristics were measured in the laboratory at the same day of collection. Electrical conductivity was measured using a digital conductivity meter (AQUA SCIENTIFIC, England, model PTI. 18). Chlorides were determined argentometrically, sulphates were determined turbidimetrically and iron, manganese, chromium, zinc and silver were determined spectrophotometrically using a single-beam spectrophotometer (BAUSCH & LOMB, U.S.A. model Spectronic-20). All these measurements were according to the procedure outlined in Standard Methods for Examination of Water and Wastewater[3]. Results obtained are presented in table (2) and are represented graphically in Fig (3).

3. Discussion of Results:

A drop in the dissolved oxygen content (DO), is observed starting from the sampling point No.3 (at Salamon el Komash) till sampling point No.6 (at Meniet el Nasr) with an increase in electrical conductivity, chlorides and sulphates. This may be attributed to different reasons from which:

(1) At Meit Mazah there is a factory for food and milk products, where its effluents would bear an organic load affecting the oxygen balance in the water course in addition to the increase in chlorides and sulfates.

(2) Population density along this part of the water course is too high, many raw sewage from different houses-near the water course-is directly disposed to the water course.

The oxygen is depleted in the self purification process.

Progressing down stream, DO strats to increase and, also, pH, electrical conductivity, chlorides and sulphates continue in increasing. Along this length-from sampling point 7 to sampling point 12-the water course penetrates through an area with low population density. The main activity in this part is agriculture. The increased values of chlorides, sulphates and the associated electrical conductivity are due to fertilizers use. The high value of DO (11.20 mg/l) observed at sampling point 12 is attributed to the production of oxygen from the growing of green plant life in water course from sunlight, carbon dioxide, and other stream nutrients[4].

Chlorides and sulphates leached from El Manzala Lake appear in El Bahr el-sagheir water course after leaving El Manzala town. The high values of chorides and sulphates, (Cl^{-} = 511 mg/l and $SO_4^{=}$ = 270 mg/l) makes water disagreable for domestic uses.

From an inspection for the values of the heavy metals emphasized in this work, (Cr, Zn, Mn, Fe and Ag), it is evident that the obtained values are beyond the standards recomended for drinking waters[5].

The main sources of the cited metals are attributed to industrial and domestic effluents.

The disposal of industrial wastes is often conducted without critical appraisal of the losses incurred. Usually no condsideration is taken with regard to the deleterious environmental impact upon the receiving water body.

There are numerous sources of industrial effluents leading to heavy metal in the water course under investigation. The major industrial uses of various economically important heavy metals have been compiled by Dean et al [6]. Table (3) illustrates the different industries located near the water course (or near its main source). An inspection of table (3) reveals that most heavy metals under investigation are employed in widely diversified fields, such as steel and fertilizer production. On the other hand, some industries function on a basis where only one specific heavy metal is involved, for example, the use of chromium in textile mill products and steam generation plants. However, in general, the multipurpose usage of numerous heavy metals may lead to difficulties in tracing the source of origin of water pollution conclusively.

Berrow and webber[7] reported that the concentrations of the heavy metals chromium, zinc and silver in sewage sludge to be 24, 2600 and 20 mg/kg m respectively. From theses values it is evident that hardly any enrichment can be expected from chromium. By contrast the concentrations of zince and silver revealed a marked influence of domestic effluents. The elevated levels of zinc may be due to corrosion within the urban water supply network.

The use of detergents also creats possible pollution hazard since common household detergent products can affect the water quality. Angino et al [8] found that most enzyme detergents contained trace amounts of the elements Fe, Mn, Cr and Zn. This explains the high value of Cr, (27 mg/l), observed at sampling point 10, (near El Kafr el-Gadied), where the habits of people, there, is to wash clothes, utensils ... etc, using detergents at the banks of the water course.

The significant value of iron appeared at sampling point No 12 may be attributed to the value of DO and pH through what is called Eh-pH field stability of iron. The Eh-value for water with the conditions given in sampling point No. 12 was found to be o.2781 volts using the equation

$$Eh = E_o - 0.058\ pH + 0.0154 \log (DO)$$ where :

Eh: is the oxidation reduction potential of water in volts.

E_o: is the standard potential for oxygen at the stated pH, (it is found from Ref. 10 at pH = 7.88 to be about 0.73 volts).

DO: is the dissolved oxygen concentration in mg/lit.

The Eh-pH conditions at this point favours the solubility of iron as indicated from the pH and Eh fields of stability of iron[11]. It is also evident from this solubility diagram that relatively small shifts in Eh or pH can have a large effect on the solubility of iron. Thus stable forms of iron such as pyrite or $Fe(OH)_3$ when exposed to oxygenated water, iron will be solubilized.

4. Conclusions :

El Bahr el-Sagheir, as a soure for drinking water, could not satisfy the standards recomended for drinking waters with respect to heavy metal pollutants (Cr, Zn, Ag and Mn). On the other hand it satisfies the standards concerning Cl^-, $SO_4^=$, DO and pH. After El Manzala town, high values of chlorides and sulphates make water objectionable for domestic purposes.

The sources of heavy metal pollutants are either from industrial or domestic effluents to solve this problem the following are recomended (either for El Bahr el-sagheir or for El Riah el Tawfiky) :

(1) Application of stringent standards for heavy metals in effluents entering the water courses concerned. (In Japan, poor control has led to a serious toxic situation)[9].

(2) Strict restrictions against disposal of any waste into or near the banks of the water courses, (as an example refused metal chips are dumped into El Rayah el Tafwiky near Meit Ghamer town).

(3) Annual cleaning of the bottoms of the water courses to prevent remobilization of heavy metals from the bottom sediments.

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Table (1): Location of Sampling Points

Sample No.	Sampling Point
1	El Bahr el-sagheir at its intake from El-Mansouria canal El-Mansoura city.
2	El Bahr el-sagheir after Melicofarm factory, at Meit Mazah.
3	El Bahr el-sagheir at Salamon el-komash at the intake of the water treatment unit.
4	El Bahr el-sagheir at Shoha, at the intake of the water treatment unit.
5	El Bahr el-sagheir at the end of Dikirnis town from the east.
6	El Bahr el-sagheir before reaching Menit el-Nasr town at the intake of the water treatment unit.
6A	From Menit el- Nasr treatment unit.
7	El Bahr el-sagheir before reaching Kafr Abou Zekry Village, at the intake of El Nazl Treatment unit.
8	El Bahr el sagheir, about 2km from the north of Kafr el-Kourdy Village, at the intake of the treatment unit.
9	El Bahr el sagheir at the far north of Meit Salcyl Village at the intake of the treatment unit.
10	El Bahr el sagheir at El Kafr el-Gadied Village, at the intake of the treatment unit.
11	El Bahr el sagheir inside El-Gamalia town at the intake of the water treatment unit.
12	El Bahr el-sagheir at about 2km after leaving El-Manzala town in the direction of El-Manzala Lake.

Table (2): Results of Chemical Analysis

Sample No.	Date/Time	Temp (°C)	Conductivity (μ mhos/cm)	PH	DO (mg/l)	Cl^- mg/l	$SO_4^=$ mg/l	Fe^{+++} (mg/l)	Mn^{++} (mg/l)	Cr^{+++} (mg/l)	Zn^{++} (mg/l)	Ag^+ (mg/l)
1	20.8.86/12.30	30.10	358	7.98	6.20	23.75	21.50	0	10.0	9.00	99.0	3.75
2	20.8.86/12.45	30.80	342	7.71	6.20	23.38	18.00	0	10.0	10.05	96.0	-
3	20.8.86/13.20	30.90	325	7.67	5.60	21.20	34.00	0	10.0	10.00	94.0	3.60
4	20.8.86/13.35	30.80	365	7.74	5.80	24.11	27.50	0	10.0	10.00	96.0	3.45
5	20.8.86/14.10	31.00	372	7.60	5.80	24.66	25.00	0	10.0	9.00	94.0	2.90
6	20.8.86/14.30	31.00	370	7.47	5.80	22.83	32.00	0	10.0	10.05	93.0	-
6A	20.8.86/14.40	31.30	385	6.86	7.60	21.55	98.00	0	10.0	10.00	96.0	3.70
7	20.8.86/15.45	30.80	371	7.59	7.00	24.84	33.00	0	10.0	11.00	95.0	4.20
8	20.8.86/16.25	31.00	374	7.57	7.40	21.74	37.00	0	10.0	8.00	91.0	3.60
9	20.8.86/16.50	30.80	387	7.52	7.50	25.57	35.00	0	10.0	10.00	95.0	4.00
10	20.8.86/17.25	30.80	387	7.60	7.50	26.67	29.00	0	10.0	27.00	96.0	-
11	20.8.86/17.45	30.10	380	7.53	7.60	26.85	33.50	0	10.0	10.00	95.0	2.70
12	20.8.86/18.10	31.20	2170	7.88	11.20	511.46	270.0	7	10.0	9.00	89.0	4.10

Table (3) Heavy metals employed in the major industries located in the investigated area

Industry and location	Heavy Metals			
	Cr	Fe	Mn	Zn
Organic Chemicals (El Mansoura)	x	x		x
Fertilizers (El Mansoura)	x	x	x	x
Basic steel works foundaries (El Mansoura-Meit Ghamer)	x	x		x
Basic nonferous metal-works foundaries (El Mansoura-Meit Ghamer).	x			x
Textile mill products (El Mansoura)	x			
Steam generation power plant (El Mansoura)	x			

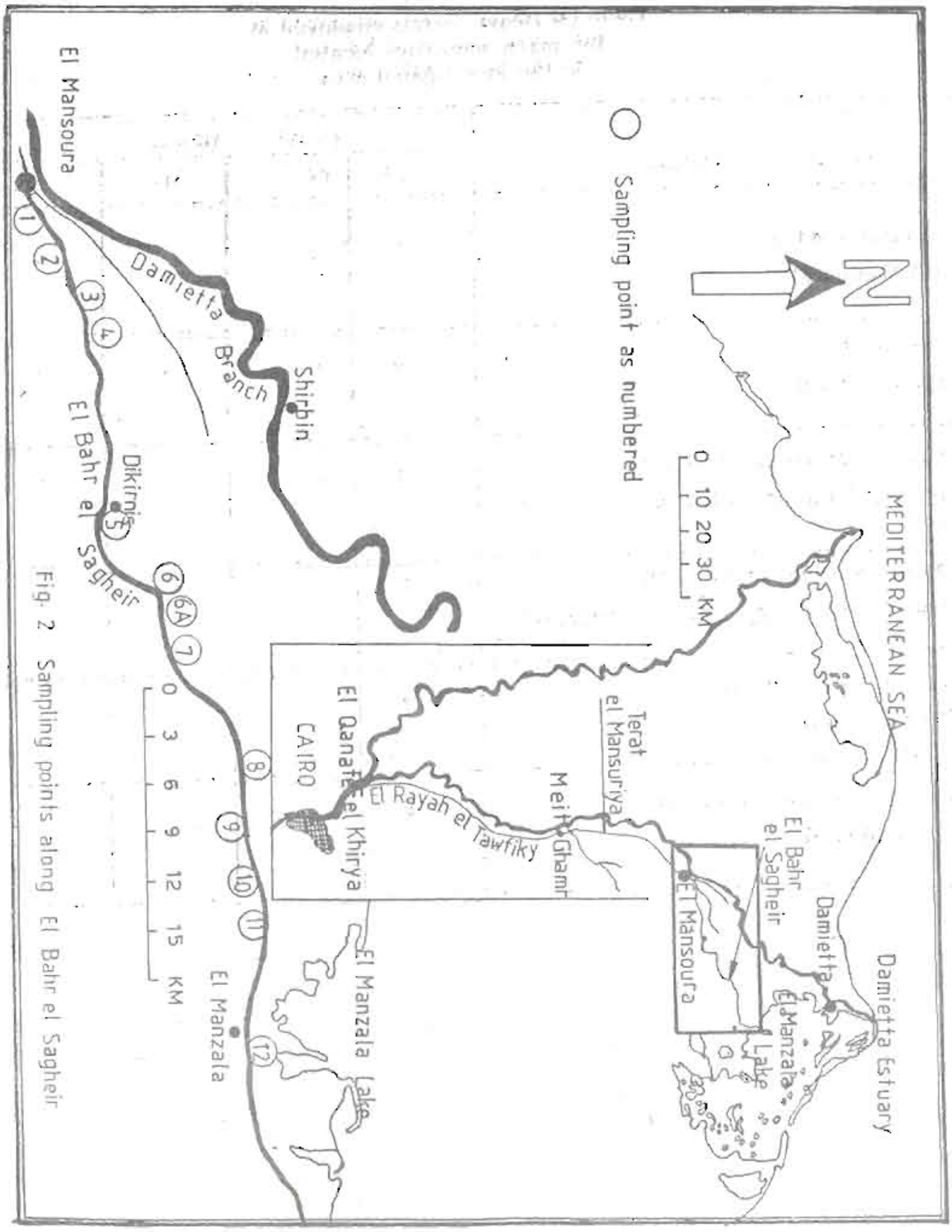

Fig. 2 Sampling points along El Bahr el Sagheir

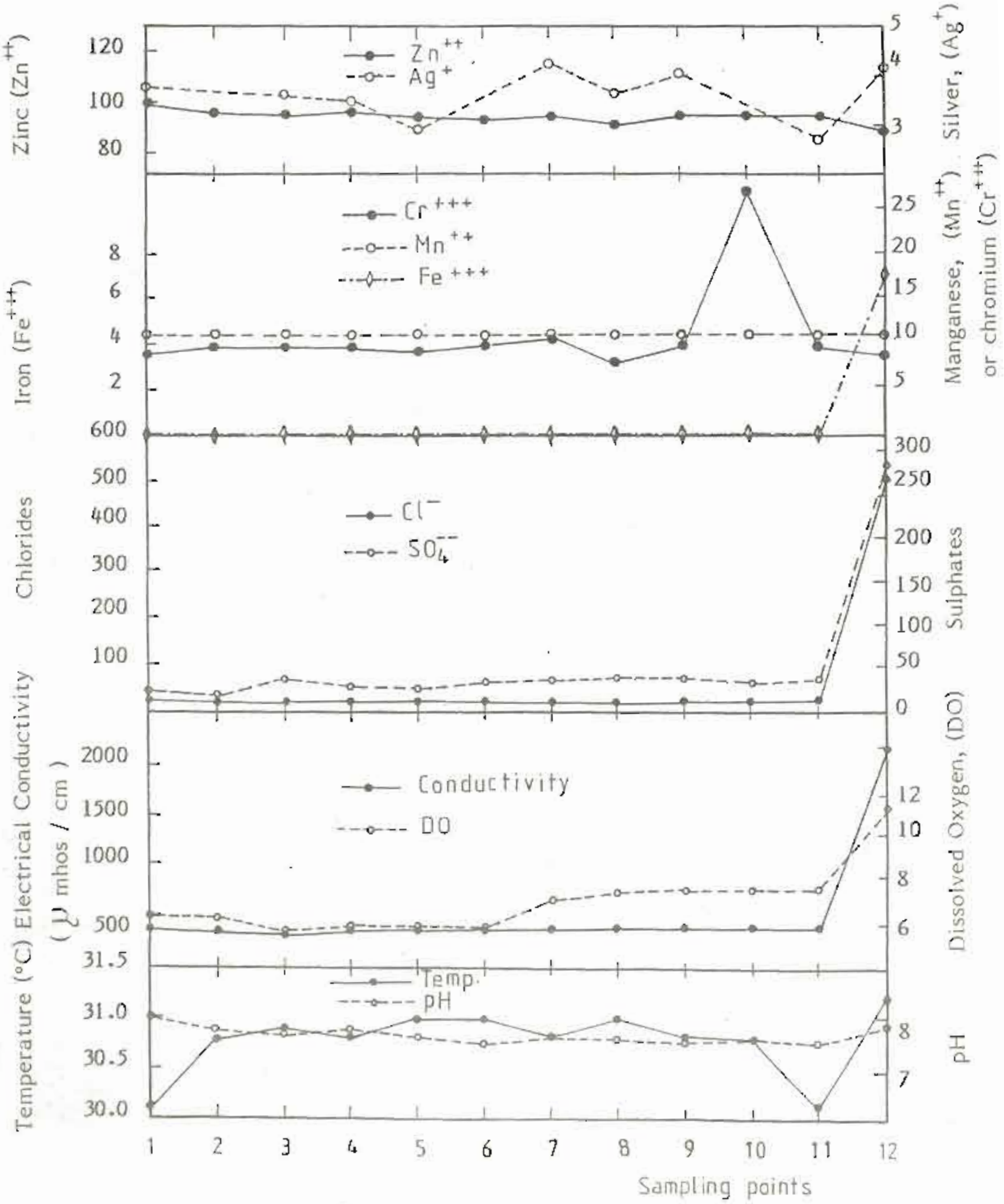

Fig. 3: Graphical representation of chemical analysis at different samplingg points from El Bahr el sagheir, (All values in mg/litre, otherwise stated).