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Evaluation Quality And Chemical Treatment Of The Drinking Ground Water In The Qalubia Governorate, Egypt

M.H.Abdo[1], A.A.M.Diafullah[2], M.E.Moustafa[3], A.S.Amin[4], F.M.Mohamed[5]
National Institute of Oceanography and Fisheries, Egypt, Hot lab center, Atomic Energy Authority, Egypt, Faculty of science, Benha University, Egypt, Kaha company for chemical Industries, National Authority of Military Production, Egypt.

Summary: ground water samples were collected seasonally during March 2003- Feb. 2004 at 4-stations(I, II, III and IV) from different locations in the Qalubia Governorate. Physico-chemical parameters were determined in these samples are (TS, TDS, TSS, EC, PH, COD, CO_3^{--}, HCO_3^-, Cl^-, SO_4^{--}, Na^+, K^+, Ca^{++}, Mg^{++}, NO_2^-, NO_3^-, PO_4^{---}, TP, SiO_2). In addition to some trace metals e.g. Fe, Mn, Zn, Pb, Cd and Ni. To address questions of ground water quality and to suggest a local and available treatment process for iron and manganese removal, the treatment procedure was evaluated using activated carbon prepared by chemical activation of Rice Husk using 70% H_3PO_4 at 500 ^oC. Some factors affecting adsorption process (e.g. contact time and sorbent mass) were examined.

Introduction

According to the data recently issued by the (WHO) average of 50000 people die each day from diseases associated with bad water ; one person about every two second[(1)]. The total water budget of Egypt amount 63.9 billions m^3/year of which 55.5 billion m^3/year are derived from Nile River, ground water 4.7 billion m^3 and reused drainage water 3.7 billion m^3. The demand for drinking water amount 3.2 millions m^3/year. EL-Dib(2003).[(2)]

Many investigations attribute a cardiovascular protective effect to the presence of calcium and magnesium. Neither iron nor manganese poses health risks. Both in small concentrations are essential of human health.[(3)]

Approximately 100 million tones of rice husk is available a normally for utilization in developing countries. However, this amount of rice husk available is for in excess of any local uses and thus has posed a disposal problem.[(4)] Therefore, rice husk was chosen as an adsorbent in several water treatment processes due to suitable structure, insolubility in water, chemical stability, high mechanical strength and its local availability at almost

no cost.

In the present study will give complete information on the chemical analysis of ground water at four different locations of Qalubia governorate during four successive seasons. As well as, a new method was suggested for iron and manganese removal from ground water using activated carbon prepared from rice husk.

Experimental

Sampling

Water samples were collected at four stations are: I and IV presented at Kaha city in middle, II at Toukh city in the North and III at Qalube city in the south of Qalubia Governorate. The capacity of each station is approximately (10,000 m^3/day). The samples were collected during four successive seasons starting from March 2003 to Feb. 2004. These stations are (I, II, III, IV) and (I`, II`, III`, IV`) before and after traditional treatment respectively. Traditional treatment technique was applied (aeration, oxidation, filtration and chlorination).

The chemical parameters were measured according to APHA (1998) [(5)]. EC, pH values were measured, using hydro lab, Model "Multi 340I/SET".

Preparation of activated carbon

Rice Husk was chosen as precursor for the preparation of activated carbon by impregnation with 70 % H_3PO_4 and temperature was raised at the rate of (50 ^oC/5 min.) up to 500 ^oC for 2.5 hr.

Treatment procedure

1L of ground water sample was mixed with various quantities of AC ranging between 0.002-0.01 g and agitated for 4 and 5 hrs in case of iron and manganese at room temperature respectively. The iron and manganese concentrations before and after treatment was measured by using AAS (Model: ZL 8100 Schmitzu).

Results and Discussion

(A)Physico-chemical characteristics

According to (EPA's 2004)[6], the physico-chemical characteristics of ground water are: temperature is relative constant, turbidity and suspended solids low or nil, mineral content largely constant and generally high, Fe^{2+} and Mn^{2+} are usually present, aggressive CO_2 often present in high quantities, DO usually none, Ca^{2+} and Mg^{2+} are high contents, NH_3 often found without systematically indicating pollution, SiO_2 level often high , NO_3^- level sometimes high risk of metahemoglobinaemia.

Table (1): The average values of physico-chemical parameters during four Successive seasons (2003-2004).

parameters \ stations	I	I'	II	II'	III	III'	IV	IV'
TS mg/l	956	919	937	928	983	916	1362	1310
TDS mg/l	852	874	936	923	924	859	1379	1385
TSS mg/l	72	50	84	82	72	57	113	43
EC μ mohs/cm	792	718	885	854	818	732	1395	1384
pH	7.75	7.77	7.84	8.12	7.74	8.12	7.75	7.75
COD mg/l	3.8	3	3.6	4	3.5	3.4	3.2	3.8
CO_3^{--} mg/l	nil	nil	nil	nil	nil	nil	nil	nil
HCO_3^- mg/l	508	500	496	478	549	494	715	725
Cl^- mg/l	93	82	111	105	91	75	224	212
SO_4^{--} mg/l	67	62	78	103	41	60	107	125
Ca^{2+} mg/l	78	72	84	78	77	78	63	91
Mg^{2+} mg/l	54	111	103	107	103	112	147	132
Na^+ mg/l	52	36	50	54	48	50	86	86
K^+ mg/l	7.9	7.4	7.6	7.5	7.81	7.55	10.7	13.7
NO_2^- ug/l	19	7	4	49	3	5	3.3	3.7
NO_3^- ug/l	171	38.4	196	80.5	175	55.43	270	64
NH_3 mg/l	4.34	2.6	3.4	2.64	3.41	2.68	4.47	4.76
PO_4^{3-} ug/l	77.66	61.82	112.65	97	111.27	92	131.56	135.64
TP ug/l	350	247.54	789.16	169	163	176	589.7	226.1
SiO_2 mg/l	17.1	15.31	16.65	16	14.9	14.56	17.66	16.24
Fe mg/l	2.05	0.35	1.25	0.72	2.05	0.65	2.12	0.63
Mn mg/l	3.32	0.47	3.35	0.4	3.57	0.35	2.91	0.42
Zn mg/l	0.42	0.53	0.44	0.45	0.53	0.65	0.4	0.47
Pb mg/l	0.052	0.048	0.2	0.14	0.071	0.085	0.003	0.002

In view of the Table (1), we can reveal that, there is a relative increase in TS, TDS and EC values at all stations of the area under investigation. This may be attributed to the ground water included great amount of dissolved anions and cations. Also, the values of these parameter are greater than surface water in the River Nile were recorded by Abdel-

Satar (2005).[7]

The ground water of Qalubia Governorate was found in the alkaline side, however the pH values were ranged between (7.75- 8.12). The CO_3^{--} was nil at all stations during four seasons, but the HCO_3^- values were increased at all stations. This may be attributed to dissolution of CO_2, CO_3^{--} and formation of HCO_3^- according to the equation:-

$$CO_2 + CO_3^{--} + H_2O \longleftrightarrow 2\ HCO_3^-$$.[8]

The relative increase in Cl^- values may be due to the contamination of the ground water with sepatic tanks, adjacent formations and drainage water. [9] Also, these reasons may be responsible for the relative increase in Ca^{2+}, Mg^{2+}, Na^+, and K^+ concentrations.

The distribution of nutrient salts (NO_2^-, NO_3^-, NH_3, PO_4^{3-}, TP and SiO_2) were found in the same behavior of surface water except for NH_3 and SiO_2 were increased at all stations, this supported by (EPA's , 2004) [6]

The distributions of trace metal (Fe, Mn, Zn, Pb, Cd and Ni) were found to be Cd, Ni not detected at all stations during all seasons. The ranges of Fe, Mn, Zn, and Pb were fluctuated between: 0.35-2.12, 0.40-3.57, 0.40-3.65 and 0.002-0.20 mg/l respectively, which higher than surface water, was reported by .[7] The increase in Fe and Mn concentrations in ground water sample may be attributed to ground water is frequently high in CO_2 and low in DO, will readily or convert insoluble iron and manganese bearing minerals to soluble ferrous and manganouse bicarbonates respectively.[6]

Generally the comparison between the present results of the physico-chemical parameters with the Egyptian and WHO standards as recorded in Table (2).

Table (2): Physico-chemical parameters (mg/l) of the present study compared with WHO, European and Egyptian standards. [8]

Parameters \ Specification		Egyptian standard	WHO standard	European standard
	TDS	1200	1200	1500
	PH	6.5-9.5	6.5-8.5	6.5-8.5
anions	SO_4^{--}	400	200-400	25-500
	Cl^-	500	200-600	25

table (2) : continued

Parameters \ Specification		Egyptian standard	WHO standard	European standard
cations	Ca^{2+}	200	75-200	100
	Mg^{2+}	150	30-150	30-50
	Na^{+}	200	200	20-175
	K^{+}	No. set	No. set	10-12
Trace metal	Fe	1.0	0.3	0.3
	Mn	0.5	0.05-0.5	0.2-0.5
	Zn	5.0	5.0	3.0
	Pb	0.05	0.05	0.05
Nitrate salts	NO_2^-	0.01	No. set	0.1
	NO_3-	10	10	25-50
	NH_3	0.5	No. set	0.05-0.5

The most physical and chemical parameters are within normal limits except for TDS at station IV, Fe, Mn, Pb at most stations and ammonia at all stations.

(B)Chemical treatment of Fe and Mn ;Adsorption experiment

The physico-chemical properties of AC are presented in Table(3).

Table (3): The physico-chemical properties of AC.

Properties	S_{BET} (surface area)	V_{PC} Total pore volume	d (pore width)	Ash content	pH	Apparent density	Packed density	Grain size
Unit	m^2/g	cm^3/g	nm	%		g/cm^3	g/cm^3	nm
Value	419	0.213	1.076	31	3.5	0.25	0.33	0.6

The treatment procedure represented that, the uptake amount increased from 100 to 400 and from 40 to 500 mg/g in case of Fe and Mn after shaking tim 4 and 5hrs, respectively. Also, the removal percent of Fe and Mn was increased by increasing in AC amount. The minimum adsorbent dosage of 8 mg of AC was required to complete removal of Fe and Mn after contact period of 5 hrs.

Possible working mechanism

The ion exchange reaction on the silica surface is accomplished through the substitution of protons of the surface silanol group by the metal ions from solution as follows. $M^{n+} + X(\equiv\equiv SiOH) \leftrightarrow M(\equiv\equiv SiO)_x^{(n-x)} + X H^+$

where M^{n+} = metal ion with n^+ charge, ($\equiv\equiv$ SiOH) = silanol group on the SiO_2 surface and XH^+= number of protons released. The cation – exchange mechanism is expected

with the two metal ions as the sorbent contains large amounts of silica (>95%) in the ash content (31%).[10]

It is concluded that the removal of Fe and Mn ions using AC derived from rice husk is significant due to; low coast, easy operated, high efficiency and solve disposal problem of agro-residue(rice husk). Also, the studies on the ground water quality and treatment must be increase in the future due to its consider as important source for drinking water in the world and Egypt.

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