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TREATMENT NEEDED FOR GROUND WATER IN SOME MIDDLE EAST COUNTRIES (CASE STUDY)

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ABSTRACT:

Water treatment plants of the traditional type are generally built to remove turbidity from raw water. Turbidity in excess of the acceptable limits is found in surface sources as rivers and resevoirs. Ground water turbidity has been found always within the acceptable limits; accordingly, no clarification treatment is needed. Some cities have built their treatment plants with its surface water treatment units to receive groundwater of very low turbidity. When it becomes exposed to the atmosphere, algae breeding takes place due to the presence of high material content, low turbidity, and exposure to light. Consequently, algae troubles as taste, odour, and filter clogging take place too. All such troubles and others relevant to the presence of algae could have been completely avoided if the raw water from the ground source bypassed the treatment plant and joined directly the clear water resevoir for disinfection, if needed, and then distribution directly. No technical reason is known to build a surface water treatment plant for a groundwater source. This is confirmed by results shown in table (1), and (2) for Geita spring water which is considered the main source of supply for the city of Beirut. As a result of a survey carried out in Lebanon where groundwater is introduced to clarification units, it can be stated safely that no need for clarification since the groundwater turbidity has been always found within the international acceptable limits.

1. INTRODUCTION:

In this part of the world, water treatment for municipal purposes is carried out to remove turbidity in the vast majority of treatment plants. Surface water is the only water that has turbidity in excess of the acceptable limits. Treatment plants in Egypt, Syria, and Iraq are provided with surface water from rivers and permanent sources. Such plants have been capable of reducing the turbidity of raw water to the acceptable levels. The relevant turbidity ranges from few units in draught time to few hundreds during flood season. The turbidity is mostly inorganic and its removal, which is the main function of many regional treatment plants, is carried out through chemical precipitation processes and sand filter operations.

Algae might contribute to the presence of turbidity especially draught time and when the turbidity level permits considerable sun light penetration as the case in Egypt after construction of the high dam. Therein, it has been reported to have a considerable ratio of organic turbidity as a result of algal abundance.

11. ASSOCIATED TROUBLES:

Algae flourish in waters of low turbidity and high mineral contents when it is exposed to light. Groundwater environment, accordingly, when it becomes exposed to the sunlight for a considerable period encourages the breed of algae which might thrive to the extent of having an algal overpopulation case with the consequent die off. This will be due to the lack of sufficient feed from the limited mineral contents of groundwater. Extensive algal growth in water supplies can result in serious deterioration of the quality of water particularly if it is to be used for domestic or industrial purposes. However, the presence of algae in water, whether alive or dead, causes tastes, odour, and filter troubles. Additionally, the ability to combine inorganic elements into organic compounds makes algae important as primary producers in aquatic food chain. Many of the blue-green algae possess the ability to fix free nitrogen which allows them to grow independant of sources of combined nitrogen.

In water treatment plants algae are best known for their ability to produce odour and taste problems, and because they clog sand filters. In addition, algae often contribute large quantities of organic material to the water, and cause pH, alkalinity, colour, and turbidity changes. During the daylight hourse algae continuously remove CO_2 from the water for photosynthesis. The CO_2 removal may be high enough to alter the amount of bicarbonates in the water causing the precipitation of carbonates and a reduction in water hardness. Another possible effect of algal photosynthesis is an increase in dissolved oxygen which increases the corrosive activity of water.

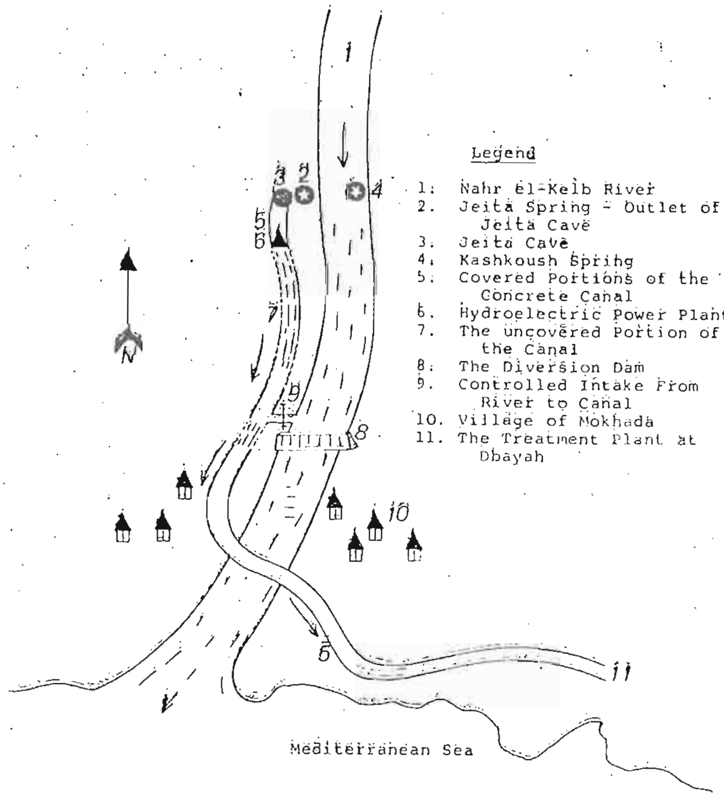
Such algal problems are mostly associated with surface water supplies. Groundwater supplies if exposed to the direct atmosphere for a considerable time will be a very suitable environment for algae breeding with the consequent algal troubles. To avoid such troubles, groundwater supplies

Table 1. Chemical and Physical Analysis of Water Samples collected at the Entrance to the Beirut Water Treatment Plant by Seasonal and Annual Mean Values and Yearly Standard Deviations*

Parameters	Seasonal Mean				Yearly		
	Winter	Spring	Summer	Fall	Number of Samples	Mean	SD
Conductivity (micromhos/cm) at 25°C	326	333	359	407	25	344.2	61.45
pH	8.09	8.16	7.79	7.93	24	8.06	0.288
Temperature, °C	15.0	16.3	17.4	16.5	21	16.31	1.05
Turbidity, JTU	2.2	0.71	1.75	1.47	24	1.57	1.13
Total Hardness, as $CaCO_3$	211	187	233	257	24	219.5	42.7
Calcium Hardness, as $CaCO_3$	176	146	173	175	24	168.2	39.7
Magnesium Hardness, as $CaCO_3$	35	41	60	82	24	51.3	29.8
Total Alkalinity, $CaCO_3$	195	194	168	279	24	206	46.08
Hydroxide Alkalinity, as $CaCO_3$	0	0	0	0	25	0	-
Carbonate Alkalinity, as $CaCO_3$	0	0	0	0	25	0	-
Bicarbonate Alkalinity, as $CaCO_3$	195	194	168	279	24	206	46.08
Ammonia N, as N	-	0.48	0.38	-	5	0.42	0.18
Nitrite N, as NO_2	0	0.004	0	-	4	0.00	-
Nitrate N, as NO_3	0.93	1.03	0.84	1.75	21	1.106	0.428
Phosphates, as ortho	0.23	0.25	0.27	0.23	21	0.247	0.05
Sulfates, as SO_4	10.70	8.0	8.3	21.5	25	12.2	6.3
Total dissolved solid	219	207	237	320	11	236.27	45.8
Calcium, Ca	63.5	-	67.7	63.5	4	65.6	20.12
Chloride, as Cl	11.7	15.42	25.00	17.5	14	16.96	8.89
Iron, as Fe	0.055	0.015	0.048	-	7	0.041	0.015
Magnesium, as Mg	9.35	-	21.43	-	4	15.39	6.99
Potassium, as X	1.1	0.81	0.76	-	12	0.87	0.26
Sodium, as Na	-	-	1.08	-	2	1.08	-
Dissolved Oxygen	9.85	9.92	10.75	-	9	10.17	0.4
Fluorides	0.68	0.081	0.107	-	9	0.033	0.019

* All values are in mg/l unless otherwise indicated

BEIRUT WATER TREATMENT PLANT



Sketch Showing Locations of Jeita Spring, the Concrete Water Canal, Kashkoush Spring, and Nahr el-Kelb River

Table 2: Chemical and Physical Analysis of Raw and Treated Water Samples from Beirut Water Treatment Plant, 1979/80*

Parameters	RAW No. of Samples	RAW Mean Value mg/l	TREATED** No. of Samples	TREATED** Mean Value mg/l
Conductivity (micormhos/cm)	25	344.2	14	337.5
pH	24	8.06	15	8.14
Turbidity, JTU	24	1.57	8	1.31
Total Hardness, as $CaCO_3$	24	219.5	15	229.2
Calcium Hardness, as $CaCO_3$	24	168.2	15	164.5
Magnesium Hardness, as $CaCO_3$	24	51.29	15	57.3
Total Alkalinity, as $CaCO_3$	24	206	15	226.5
Hydroxide Alkalinity, as $CaCO_3$	24	0	15	0
Carbonate Alkalinity, as $CaCO_3$	24	0	15	0
Bicarbonate Alkalinity, as $CaCO_3$	24	206	15	226.5
Nitrate N, as NO_3	21	1.106	9	1.001
Phospates, as ortho.	20	0.249	9	0.21
Sulfates, as SO_4	25	12.22	15	12.91
Chloride, as Cl	14	16.96	4	13.13
Potassium, as K^+	12	0.87	4	1.11

* All results are in mg/l unless otherwise indicated
** Filtered water, before Chlorination.

Table 3. Monthly mean of Total Algal Units Per ml of Water by Sampling Site, and Daily Mean Value of Hours of Sunshine, 1979/80(a).

Period	Sampling Site: At Entry To Plant	Sampling Site: Effluent of the Coagulation-Sedimentation Basins	Sampling Site: Rapid Sand Filters
A - Months with daily mean between 8.00 to 11.40 hours of sunshine			
April	31,925 (2)	28,810	35,430
May	47,320 (3)	70,992	66,475
June	23,640 (2)	29,340	23,043
July	26,200 (2)	27,800	30,685
August	125,080 (2)	84,000	53,240
September	127,060 (2)	64,620	50,226
October	137,305 (3)	156,147	136,773
Mean	74,076 (16)	65,958 (16)	56,555 (16)
B - Months with daily mean between 3.38 to 7.9 hours of sunshine			
November	51,500 (2)	58,420	45,572
December	29,984 (2)	27,740	26,567
January	23,980 (2)	31,128	28,835
February	47,640 (2)	39,573	19,875
March	29,400 (3)	18,650	21,306
Mean	36,501 (11)	35,102 (11)	28,431 (11)

(a) Number within brackets represents the number of Samples should be piped from the ground source in closed pipes or conduits to storage tanks where disinfection, if needed, takes place, and then to the distribution system. Ground water supplies in the regional plants do not need any treatment except disinfection as a safeguard measure.

All groundwater plants in Egypt invest such gifts of nature and provide water supplies without any treatment. However, in Egypt chlorination should be applied as a safe guard against any probable contamination and as a control measure of summer diseases. In new expansion unit where iron and manganise may cause troubles, special units for their removal are recommended preferably of the closed type to avoid any surface contamination or exposure to the atmosphere with the relevant troubles.

III. SURVEY AND PROBLEM

In a survey on water treatment plants in Lebanon where surface water sources are not reliable, it was found that some cities are supplied with groundwater sources after passing through surface water treatment plants although such sources are not in need of any traditional treatment. These cities have built and operated their plants with surface treatment units while the raw water comes from ground sources. The exposure of groundwater with its negligible bacterial and turbidity load to the atmosphere in open channels from the source to the plant where it stays for additional several hours as detention periods in treatment units provides all favourable factors for algal growth with its sequant plant troubles. This is the case in considerable number of treatment plants where surface treatment units are introduced for some reasons which are not technical, and which are not known obviously.

The needed treatment for the groundwater from all these plants is chlorination only without any extra clarification since the trubidity recorded has always been within the international acceptable limits. Examples of some treatment plants using surface treatment units for groundwater sources in the region are those of Beirut, Syda, and Tripoli cities in Lebanon where the sources came from the springs. Jeita Cave and Kashkoush Spring near Beirut, Ras El-Nabe Spring near Syda, and Kadisha Spring near Tripoli are the soueces of groundwater which are directed to surface treatment clarification units without any technical reason. This is an extravagant way of spending money and effort which ought to be avoided by transferring the raw water in closed conuits to be chlorinated and distributed into the distribution system without passing into the present treatment plants. The presently constructed treatment plants should be demolished or altered to surface water treatment if surface water is available and needed.

IV. RESULTS

To illustrate such a survey numerically, Beirut water treatment plant is selected for presentation. Table (1) shows the chemical and physical analyses of water samples collected at the entrance to the Beirut Water Treatment Plant by seasonal and annual mean values and yearly standard deviations.

It is to be noted here that at the mouth of Jeita Cave "The source", the spring water is diverted into a concrete canal which conducts the water to the treatment plant. The canal is closed for one kilometer from the mouth of the cave. Then it is uncovered for three kilometers after which it is covered again for about 10 kilometers. The open portion of the canal runs through a narrow valley of cultivated land exposed to sunlight and to contamination from surface runoff water.

Table 2 shows the chemical and physical analyses of raw and treated water samples from Beirut water treatment plant. The difference between the raw and treated samples as regards the relevant parameters as turbidity for example is by all means insignificant especially when we notice that the turbidity of the raw water is much lesser than the maximum international limits.

Table 3 shows the monthly mean of total algal units per millimeter of water sampling site and daily mean value of hours of sunshine. The numbers of algal units shown are self explanitory and they need no comment more than that they would have been absent completely if the diverting canal was covered and the treatment plant was not built.

V. RECOMMENDATIONS:

In conclusion, the only needed treatment for groundwater in the region is disinfection mostly by chlorination. This is carried out as a factor of safety against any probable contamination. No need for clarification since the groundwater turbidity has been always within the international acceptable limits.