POLLUTION AT LAKE MARIUT

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Abstract

Lake Mariut, south Alexandria, Egypt suffered in the recent decades from intensive pollution as a result of a continuous discharge of huge amounts of agriculture wastewater that contains a large concentration of the washed pesticides and fertilizers in addition to domestic and industrial untreated wastewater. The over flow from the lake is discharged directly to the sea through El-Max pumping station via El-Umum drain.

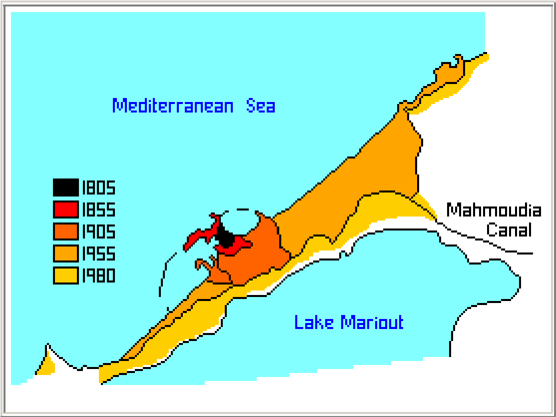
Lake Mariout is surrounded by a huge number of different industrial activities and also the desert road is cutting the lake, this means that a huge number of various pollutants cycle through the air and settle down in the lake, by the time and during different seasons these pollutants after accumulation and different chemical interactions will release again from the lake to the surrounding area affecting the surrounding zone.

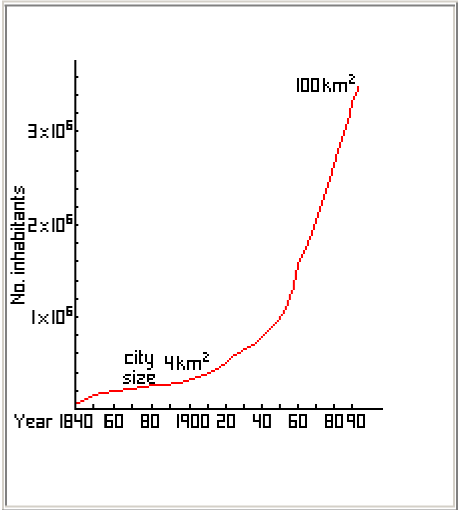
In this study we are focusing on identifying some of the air pollutants that enter the lake from the atmosphere and its effect on the surrounding areas.

I- INTRODUCTION

The environmental problems of Alexandria have grown rapidly in recent decades, in proportion to the growth in population and population density, as well as to the urban and industrial development. The rate of development has accelerated considerably since the turn of the century. In 1905, Alexandria's 370 thousand inhabitants lived in an area of about 4 km^2 between the two harbours. Since then, the city has expanded rapidly eastwards and westwards, beyond its medieval walls, occupying at present an area of about 300 km^2 with a population ten times larger, 4 million, and a density exceeding 1,200 per km^2 (Figs. 1 and 2). Modern Alexandria stretches over a narrow and irregular strip of land between the Mediterranean Sea to the north, Lake Mariout (a major coastal lagoon) to the south and Abu Qir Bay to the east. Topographically, the city appears to be encircled by a belt of aquatic environments subject to multiple human impacts.

Figure 1. The expansion of the city of Alexandria since 1805.	Figure 2. Population growth since 1840.





In Alexandria, the interface between marine and territorial environments extends along some 100 km of coastline. The city interacts with its aquatic environment in two ways: by discarding all its liquid wastes, domestic and industrial, into the sea, either directly or via Lake Mariout; and by physically altering its coastline, by coastal engineering works.

The total cumulative volume of waste water disposed of into the sea from all point sources along this stretch of coast is about equal to the Nile outflow from the Rosetta outlet: roughly 9 million m^3/day; that is, 3.33 km^3/yr. But this is not river water.

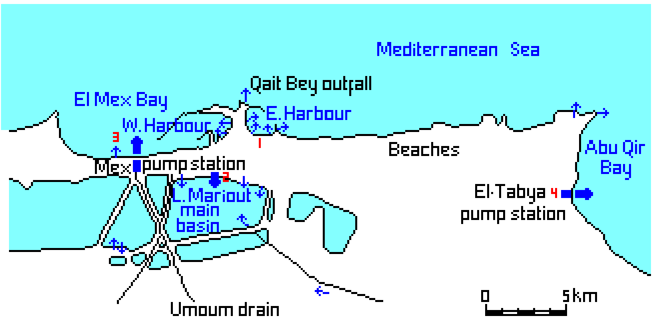
A daily volume of more than one million cubic metres of mixed sewage water is drained from the city. About one third of this is disposed of without any treatment, into the Eastern and Western Harbours and their surroundings. The Qait Bey outfall (Fig. 3), located a few hundred metres from the recently surveyed Pharos site, releases 200,000 m^3 of waste water per day. The Eastern Harbour is the recipient of 7 outfalls. This semi-closed harbour remains permanently turbid, and water visibility is drastically reduced.

Two thirds of the city waste water is released into Lake Mariout and subsequently pumped into Mex Bay, west of the city, together with agricultural runoff drained from the north-west part of the delta. Only half this volume of waste water undergoes primary treatment before being dumped into the Lake. On the eastern side of Alexandria, about 2 million m^3 of industrial waste water per day are pumped into Abu Qir Bay .

All of these outfalls add their load of suspended matter and a variety of contaminants to the inshore environment and to the Lake. Such materials, on sinking to the bottom, contribute to blanketing whatever artefacts are lying on the sea bed. They also cause hypoxic or even anoxic conditions at the bottom in some places, enhancing the processes associated with the absence of oxygen, including anaerobic bacterial processes, which end up releasing hydrogen sulphide, and chemical processes, which might accelerate corrosion, thus damaging some of the artefacts.

Figure 3. Main outfalls:

1. Qait Bey and Eastern Harbour outfalls: about 200 x $10^3.m^3.d^{-1}$ untreated waste water.
2. Lake Mariout main basin outfalls: about 500 x $10^3.m^3.d^{-1}$ primary treated + 300 x $10^3.m^3.d^{-1}$ untreated municipal waste water.
3. Mex Pump Station on Umoum drain: about 7,000 x $10^3.m^3.d^{-1}$ agricultural drainage water mixed with the overflow from L . Mariout main basin.
4. El Tabya Pump Station to Abu Qir Bay: about 2,000 x $10^3.m^3.d^{-1}$ industrial waste water.



II-Aim of the Work

The objective of this work is to evaluate the contribution of the lake to air quality conditions south of Alexandria from Lake Mariut .

III. USES AND ABUSES OF LAKES

A lake is a body of slowly moving or standing water that occupies an inland basin of appreciable size. Definitions that precisely distinguish lakes, ponds, swamps, and even rivers and other bodies of nonoceanic water are not well established. It may be said, however, that rivers and streams are relatively fast moving; marshes and swamps contain relatively large quantities of grasses, trees, or shrubs; and ponds are relatively small in comparison to lakes. Geologically defined, lakes are temporary bodies of water.

In today's industrial societies, requirements for water--much of which is derived from lakes--include its use for dilution and removal of municipal and industrial wastes, for cooling purposes, for irrigation, for power generation, and for local recreation and aesthetic displays. Obviously, these requirements vary considerably among regions, climates, and countries.

In another vein, it is convenient to use water to dilute liquid and some solid wastes to concentrations that are not intolerable to the elements of society that must be exposed to the effluent or wish to use it. The degree of dilution that may be acceptable varies from situation to situation and is often in dispute. In some cases, dilution is used purely to facilitate transport of the wastes to purification facilities. The water may then be made available for reuse.

Lake water is also used extensively for cooling purposes. Although this water may not be affected chemically, its change in thermal quality may be detrimental to the environment into which it is disposed, either directly, by affecting fish health or functions, or indirectly, by causing excessive plant production and ultimate deoxygenation due to biological decay. Both fossil- and nuclear-fuelled power plants are major users of cooling water. Steel mills and various chemical plants also require large

IV - LAKE EXTINCTION

A lake may come to its end physically through loss of its water or through infilling by sediments and other materials. Reference has previously been made to the chemical-biological death of a lake, which is not necessarily the end of it as a physical entity but may in fact be its termination as a desirable body of water.

The chemical-biological changes within a lake's history offer a fine example of ecological succession. In the early stages a lake contains little organic material and has a poorly developed littoral zone. Particularly in temperate zones, such conditions favour plentiful oxygen content, and the lake is said to be oligotrophic. As erosion progresses and as lake enrichment and organic content increase, the lake may become sufficiently productive to place an excessive demand upon the oxygen content. When periods of oxygen depletion occur, a lake is said to be eutrophic. An intermediate stage in this course of events is called mesotrophy. In the case of oligotrophy the vertical oxygen distribution is essentially uniform, or orthograde. Under eutrophic conditions, oxygen values decrease with depth, and the vertical distribution is called clinograde.

The limits of oligotrophic and eutrophic conditions have been set in terms of the rate at which oxygen is depleted from the hypolimnion. These limits are arbitrary but are approximately 0.03 and 0.05 milligrams per square centimetre per day as the upper limit of oligotrophy and the lower limit of eutrophy, respectively.

As eutrophic conditions develop, bottom sediments become enriched in organic material, and bottom plants spread throughout the littoral zone. As infilling proceeds, the plant-choked littoral zone spreads lakeward. Eventually, the littoral zone becomes a marsh, and the central part of the lake diminishes to a pond. When the lake finally ceases to exist, terrestrial vegetation may flourish, even to the extent of forestation.

V- WATER POLLUTION

The term water pollution is referred to the addition to water of an excess of material (or heat) that is harmful to humans, animals, or desirable aquatic life or otherwise causes significant departures from the normal activities of various living communities in or near bodies of water. The national water commission stated (1973) that water gets polluted if it has been not of sufficiently high quality to be suitable for the highest uses people wish to make of it at present or in the future.

In reality, the term water pollution refers to any type of aquatic contamination between two extremes: (1) a highly enriched, over productive biotic community, such as a river or lake with nutrients from sewage or fertilizer (cultural eutrophication), or (2) a body of water poisoned by toxic chemicals which eliminate living organism or even exclude all forms of life.

V.1 Unpolluted vs. Polluted water

Pollution has been any departure from purity when environmental pollution has been the topic, the term has come to mean a departure from a pure state. This has been particularly true for water. This widely distributed substance has been such a good solvent that it has been never found naturally in a completely pure state.

Even the most unpolluted geographical areas, rainwaters is having dissolved CO_2, O_2 and N_2 and may also carry in suspension dust or other particulates picked up from the atmosphere. Surface and well waters generally contain dissolved compounds of metals like Na, Mg, Ca and Fe .the term hard water is used to describe water that contains appreciable amounts of such compounds. Even drinking water has been not pure in chemical sense. Suspended solids have been removed and harmful bacteria destroyed, but many substances still remain in solution. Indeed, absolutely pure water would not be pleasant to drink; because it has been is the impurities that impart water the characteristic taste by which it is recognized.

In light of the above facts the term pure, when used in a water pollution context, will mean a state of water in which no substances is present in sufficient concentration to prevent the water from being used for purpose thought of as normal. Normal areas of use include: recreation and aesthetic, public water supply, fish and other aquatic life, wild life, agriculture and industry.

Any substance that disallows the normal use of water must be regarded as a water pollutant. Part of the complexity of the water pollution problem arises because the normal uses of water are so varied. Water suited for some used and therefore considered to be unpolluted when other uses get contemplated.

V.2 Classification of water pollutants

The signs of water pollution have been obvious to even the most casual observer. To aid in a systematic discussion of water pollutants, they will be classified into Oxygen – demanding wastes, disease-causing agents , plant nutrients, synthetic organic compounds, Oil, Inorganic chemicals , mineral substances, sediments, radioactive materials and heat (Thermal Pollution).

V.3 Sources of contamination of water pollution

The major sources of water contamination are: domestic water pollution, industrial water pollution, agricultural water pollution, solid waste, thermal pollution, shipping water pollution and radioactive waste pollution.

VI- Lake Mariut

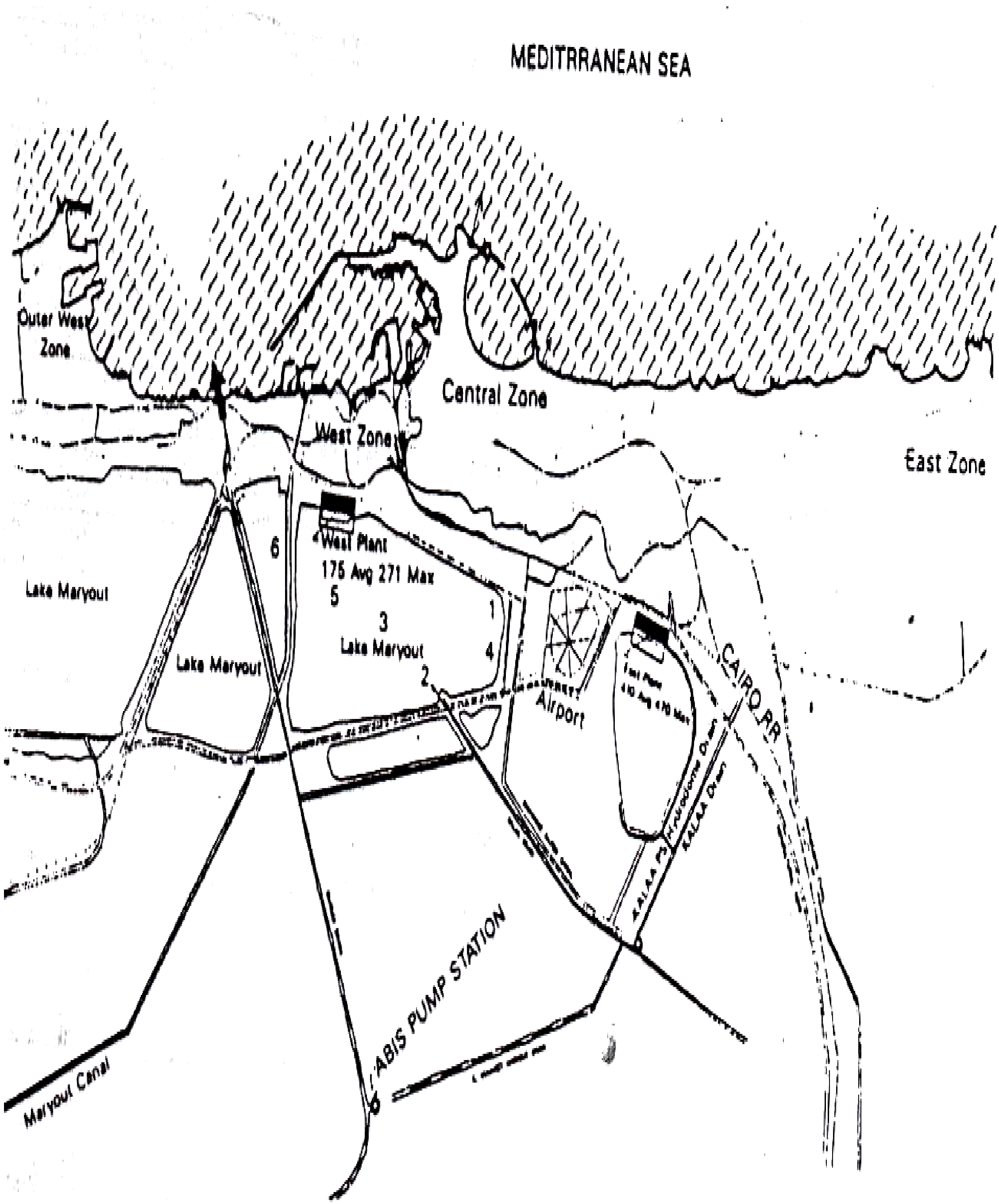
VI.2 Hydrology

Lake Mariut, south Alexandria, Egypt suffered in the recent decades from intensive pollution as a result of a continuous discharge of huge amounts of agriculture wastewater that contains a large concentration of the washed pesticides and fertilizers in addition to domestic and industrial wastewater.

Previous studies on Lake Mariut proved the availability of chlorinated pesticides, which increased with time indicating their accumulation and cycling in such environment.

Lake Mariut (Fig. 4) is the smallest of the four Delta lakes of Egypt. It is closed, brackish, very shallow lake where the depth rarely exceeds 120 cm. It is situated to the south of Alexandria at latitude 31º 10¯ N and longitude 29º 55¯ E. the lake area is divided by artificial dykes into four basins as follows: The main basin , south west basin ,south east basin and the fish farm basin.

The main basin receives industrial untreated wastewater, domestic primary treated wastewater, and agriculture wastewater. The overflow from the lake is discharged directly to the sea through El -Max pumping station via El Umum drain. This basin is suffering much, at present, from the intensive pollutants entering it through all kinds of discharge.



LAKE MARIUT Figure. 4

Pictures are taken at El-Max pump station

Mariut Lake

Mariut Lake

Fish men village

VI.2 Primary production

Primary production in the lake was reported as 7.5 m .g .m. organic C for the planktonic population of the polluted area, 5.2 m .g. m. organic C for the potamogeton area. These values showed that Lake Mariut was one of the most productive lakes in the world.

VI.5 Industrial, Agricultural and Domestic outfalls

The main basin of lake Mariut is an extremely fertile, highly productive body of water and eutrophication is well advanced. The eastern part of the basin near El-kabbary outfall is heavily polluted while the western part is relatively unpolluted (Plates 1 and 2). The lake proper receives industrial, domestic and agricultural wastewater from different sources as follows:

1-El-Umum Drain: which receives its water from secondary drains located at the south east part of Beheira province. It represents the main source of water supply to the lake.

2-EL-Qalaa Drain: discharges polluted water into the south east part of the lake. This drain was the terminal of a former canal, and changed into an agricultural drain, which receives the drainage water pumped by Qalaa pump station. In addition to agricultural drainage water pumped by Qalaa pump station. In addition to agricultural drainage, it receives different types of wastes including raw sewage, treated sewage, industrial and trade wastes. These wastes are pumped by Qalaa pump station and travel through 6 Km drain and discharge into the lake.

3-Industrical Outfall: Ten factories in the Moharram Bey region south Mahmoudia canal combine together their wastes in one collector pumped out through Moharem Bey pump station to the industrial outfall in the northeast corner of the main basin .The wastes of the different factories differ in quantity and content of dissolved and suspended solids, and organic load. Continuous pumping of this highly loaded waste results in sedimentation and accumulation of suspended solids around the outfall, forming a region of septic decomposition and floating scum-evolving smells. The flow is about 25.000 m^3 / day.

4- Gheit El Enab Outfall: This outfall is the terminal of an open drain receiving the excess from Mohsen sewage pumping station, sewage from Gheit El-Enab area together with the liquid wastes of some factories.

This drain also receives the wastes from cattle sheds and milk farms in Gheit El Enab, thus its wastes are highly loaded with soluble and suspended organic matter. The solids formed a floating scum on the water surface at the outfall, which gradually covered the whole area in front of the outfall and extended backwards until it covered about one third of the drain itself. This floating solid layer retains any floating material (wood, straw, paper etc.) and the water under it is under going active anaerobic decomposition. The flow of this drain is about 30.000 m^3 / day.

V-SITE SELECTING

Lake Mariout is surrounded by a huge number of different industrial activities and also the desert road is cutting the lake, this means that a huge number of various pollutants cycle through the air and settle down in the lake, by the time and during different seasons these pollutants after accumulation and different chemical interactions will release again from the lake to the surrounding area affecting the surrounding zone.

In this study we are focusing on identifying some of the air pollutants that enter the lake from the atmosphere and improving the understanding of how pollutants move through the lake (called cycling).

Air and water samples were collected from seven selected sites -as shown in table (1) - from Lake Mariut. Levels of pollutant in surrounding atmosphere and water were investigated.

TABLE (1) site location

	LOCATION
SITE 1	AFTRE 2ND BRIDGE ON THE DESERT ROAD
SITE 2	INFRONT OF AMRYA COMPANY
SITE 2B	INFRONT OF AMRYA COMPANY..FEW METERS FROM SITE 2
SITE 3	WADI UMR STREET
SITE 4	ABOU AZAAM ,ABOU EL KEER, ABIS AT EL UMMUM DRAIN
SITE 5	ABIS ,BEHIND CONCRETE EL SAGR CO.& ONEX LANDFILL
SITE 6	NUBARIA DRAIN
SITE 7	INFRONT OF FISH FARM AT THE BEGINNING OF DESERT ROAD

RESULTS & DISCUSSION

On site analysis was made for some of the air pollutants which were found in the ambient air surrounding the lake as hydrocarbons ,VOC, SO_x hydrogen sulphide , and methyl mercaptan , the measurements were made to evaluate the occurrence of such pollutants as shown in tables (2).

The measurements has shown that the hydrogen sulphide is relatively higher at site (1) compared to other sites, also most of the other components measured shows higher concentrations at site (1) this is because that site (1) is a discharge point for an industrial company which should try to improve the treatment of the discharged waste which is seriously affecting the ecosystem at the lake and the surrounding environment.

Figure 5 shows the variation of the hydrogen sulphide measurements at different sites ,we could find that the most polluted sites is site 1,also fig 6 is a comparison curve between hydrogen sulphide in ambient air and hydrogen sulphide in the water samples both curves indicates the high pollution of site 1 compared to other sites.

Figure 7 shows the fluctuation of the VOC concentration from one site to another according to the dense of the pollution.

Water samples were collected to give an indication for the Physico–chemical parameters including pH, COD, hydrogen sulphide, dissolved oxygen and the nutrient salt (NH_3) as shown in table (3).These results shows that site (1) has an increasing values for hydrogen sulphide, COD, NH3 and dissolved oxygen these high values assures that this point suffers from pollution problems that affects the aquatic life at the lake. The oxygen content at this point is 1.1 ppm, the COD is 169 ppm, NH_3 is 10 ppm all of these values exceeds the threshold values issued in the pollution law, it is clear that their must be a regular monitoring programme for the points of pollution to try to control the companies which discharge its wastes to the lake, it is well known that there are about 194 that discharge its wastes by direct or indirect way to the lake.

TABLE (2) on site measurements for different compounds at the selected sites

Component in ambient air	SITE (1)	SITE (2)	SITE (3)	SITE (4)	SITE (5)	SITE (6)	SITE (7)
	p.p.m	p.p.m	p.p.m	p.p.m	p.p.m	p.p.m	p.p.m
BENZENE	0.994	0.991	0.940	0.825	0.812	0.995	0.989
BROMOBENZENE	0.986	0.997	1.090	0.896	0.876	1.035	1.027
BROMOETHANE	7.710	7.740	7.750	7.320	7.520	7.620	7.530
BUTYL MERCAPTAN	0.944	0.934	0.957	0.953	0.961	0.974	0.971
CYCLOHEXANE	1.370	1.360	2.090	2.120	2.080	2.130	2.200
DIOXINE 1,2	2.720	2.760	2.710	2.590	2.450	2.780	2.790
DIOXINE1,4	2.000	2.770	2.640	2.540	2.350	2.810	2.890
DIMETHYL DI SULPHIDE	421.000	413.000	408.000	389.000	391.000	396.000	469.000
ETHYL MERCAPTAN	1.220	1.200	1.190	1.180	1.210	1.310	1.321
GASOLINE VAPOUR	1.930	1.920	1.800	1.790	1.840	1.860	1.941
HYDROGEN SULPHIDE	2.400	1.900	1.880	1.670	1.320	1.890	1.560
JET FUEL	1.210	1.380	1.260	1.340	1.290	1.390	1.340
METHYL,ETHYL KETONE	1.450	1.500	1.270	1.350	1.340	1.390	1.410
METHANOL	382.000	380.000	343.000	355.000	358.000	361.000	376.000
METHYL MERCAPTAN	1.200	1.300	1.190	1.200	1.180	1.230	1.310
PHENOL	2.400	2.500	2.040	2.050	2.030	2.060	2.050
TETRABROMOMETHANE	4.210	3.990	3.980	5.210	4.980	4.970	4.897
TRICHLOROBENZENE	1.101	1.230	1.210	0.950	0.930	1.150	1.152
TOLUENE	0.901	0.931	0.833	0.873	0.892	0.898	0.896
VOC	2.600	1.820	1.580	1.690	1.710	1.780	2.940
XYLENE P	0.819	0.818	0.748	0.775	0.789	0.799	0.798
XYLENE O	1.090	1.070	0.980	1.130	1.210	1.260	1.265

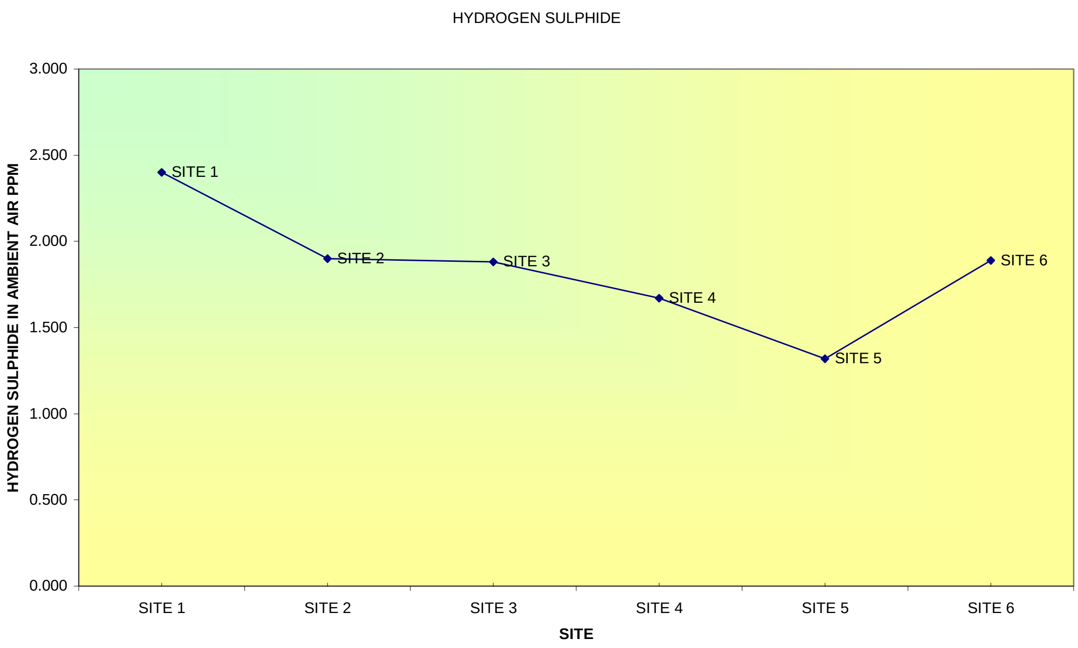


Figure (5) The variation of hydrogen sulpide measurements at different sites

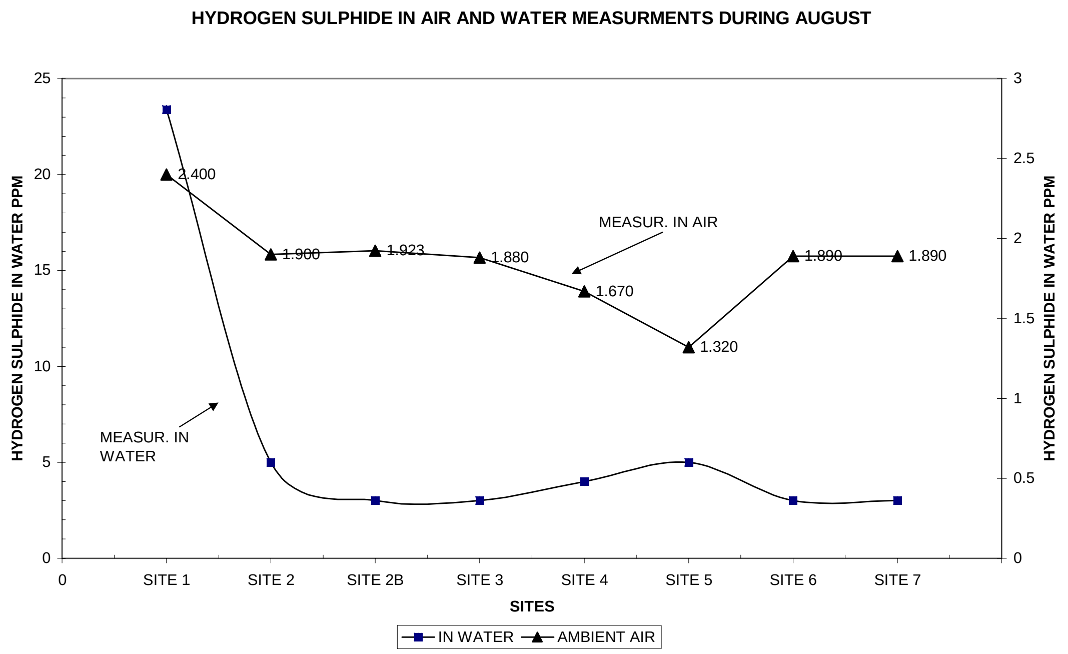


Figure (6) The variation of hydrogen sulpide measurements at different sites in ambient air and water samples

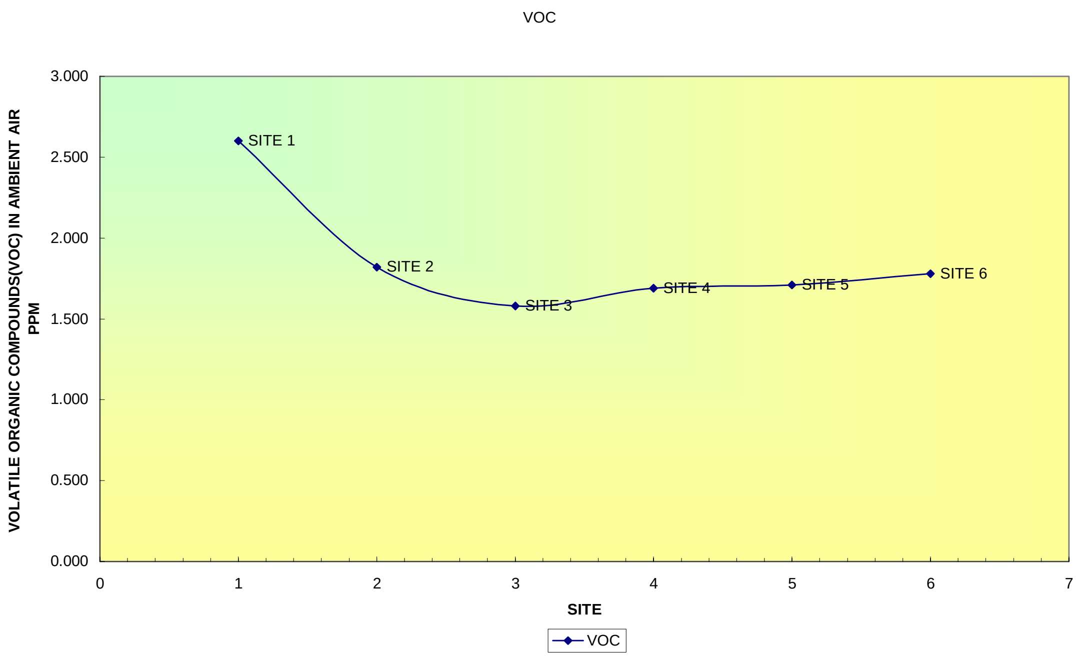


Figure (7) *The variation of VOC measurements at different sites*

Table (3) Characterization for the samples taken from the selected sites

TEST	METHOD	Unit	LOCATION							
			SITE 1	SITE 2	SITE 2B	SITE 3	SITE 4	SITE 5	SITE 6	SITE 7
PH	ASTM D 1293		7.3	7.9	8.1	8	8.2	8.1	8.2	8.4
Dissolved Oxygen	ASTM D 888B	ppm	1.1	5.8	5.5	5.6	5.7	5.4	5.4	5.3
Hydrogen sulphide	ASTM D 1294	ppm	23.4	5	3	3	4	5	3	3
Mercaptan	ASTM D 1295	ppm	NIL							
NH3	ASTM D 1296	ppm	10	1.4	1.5	1.5	1.6	1.6	1.7	2
COD	ASTM D 1297	ppm	169	60	16	15	13	14	12	42

RECOMMENDATION

It is obviously clear that there is a total lack of data collected in a reliable scientific way following a properly planned coordinated programme covering a simultaneously the physics, chemistry and biology of the lake.

So it is recommended to encourage the researches which evaluate the pollution at the lake and to make monitoring program for the air and water pollution in the lake to find out the variations in different chemical and physical parameters as to try to identify the main sources of pollution and find the best ways to control it.

REFERENCES

1- Tyagi, O .D, Text book of environmental chemistry, Macmillan Co., New York, N.Y, 1986.

2- Technical Guidance Note E1: Best Practicable Environmental Option Assessments for Integrated Pollution Control Volume I: Technical Data, Environment Agency, 1997.

3-Moore and khan, Biological Treatment of Industrial effluents, Pakistan journal of biological sciences 3 (10):1673-1680, 2000.

4-Carlson, R. E, Trophic state index for lakes, Limnol Oceangr. Reinhold Publishing Corp., New York, 1977.

5-Wilson, C. B. and W. W. Walker Jr., Development of lake assessment methods based on the aquatic ecoregion concept, McGraw-Hill, New York, 1989.