

Petroleum and Chlorinated Hydrocarbons in Water from Lake Manzala and Associated Canals

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Lake Manzala is located at the north eastern edge of Nile Delta in Egypt. It is separated from the Mediterranean sea by a sandy beach ridge. However, the lake is in connection with the sea through three opening nearby Port Said. The area of the lake is about 769 Km² (Baldwin et al., 1988) and relatively shallow with an average depth of 1.3 m.

The lake is of high economic value as a natural resource, for fishery, recreation and for migratory birds.

The lake is highly polluted as it receives wastewaters discharged by several canal (Fig.1). The present investigation aimed to asses the residue levels of petroleum hydrocarbons, chlorinated insecticides and polychlorinated biphenyls in the lake water as well as in Hadous canal , Fariskur canal and Bahr-El-Baqar canal.

MATERIALS AND METHODS

Water samples were collected from 12 stations (St) representing the lake and the three drains which contribute to the pollution and eutrophication of the lake. Sampling stations 9, 10 and 11 represented the southern area of lake Manzala whereas St₁₂ represented water quality at the northern area of the lake. Eight stations were selected to study the three canals and their discharge points in the lake Fig.1) St₁ and St₂ for Fariskur drain, ST₃ and St₄ for Hadous drain, while St₅, St₆, St₇ and St₈ for Bahar El-Baqur canal and its mouth.

Sub surface water samples were collected into 2.5 L amber coloured glass bottles previously cleaned three times with a mixture of dichloromethane and n-hexane. Water samples (1L) were extracted twice with 60 mL of 15% dichloromethane in n-hexane. The combined extracts were dried over anhydrous sodium sulphate and concentrated to 5 mL using a rotary evaporator. Further concentration of extracts to 5 mL was achieved by using a stream of nitrogen. Clean-up, separation and analysis of organochlorine compounds were carried out according to UNEP (1988).

The residue levels were determined by using Hewllet Packard 580 gas chromatograph equipped with FID and ECD detectors. A 25 mm capillary SE544

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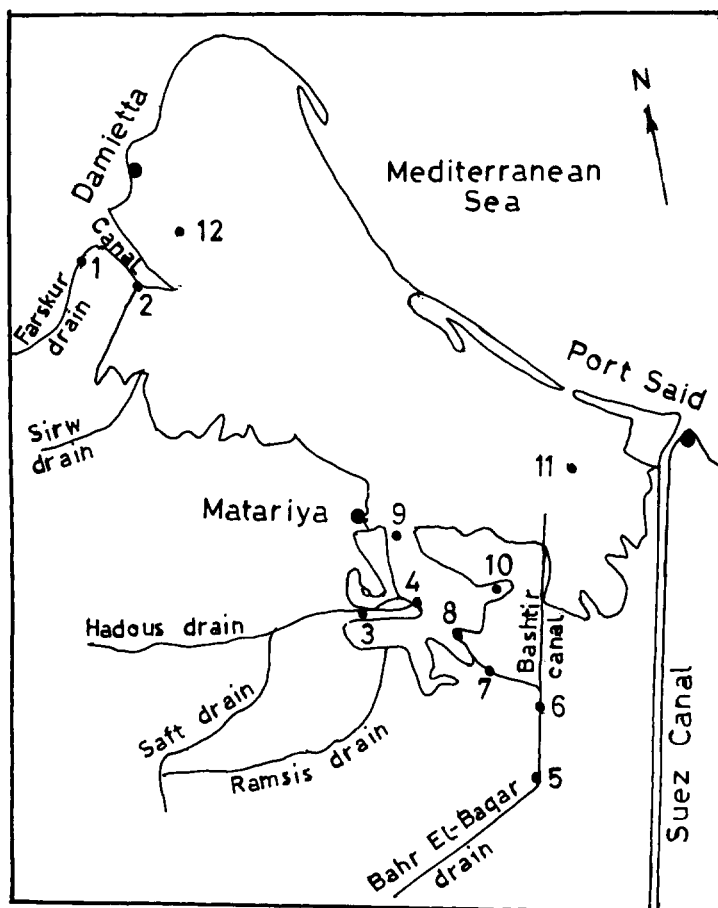


Figure 1 : Sampling stations.

column was used for analysis. The initial column temperature was 80 °C and programmed to rise at a rate of 8°C/min to 280°C for 30 min. The injector and detector temperatures were 300°C and 350°C, respectively. Nitrogen was used as a carrier gas at a flow rate of 2 mL/min. Analysis of polyaromatic hydrocarbons was carried out by international Laboratory for Marine Radioactivity, Monaco. Physico-chemical analysis was conducted according to American Standard Methods devised by APHA (1989).

RESULTS AND DISCUSSION

Residue levels of total petroleum hydrocarbons(THC) in water samples are presented in Table (1). The mean concentration of THC ranged between 1.8 and 65.0 µg/L. The highest concentration was attained at station No.1, due to industrial inputs entering the lake from Fariskur canal. The concentration of 27.8 µg/L found in Bahr El-Baqar canal probably related to the high inputs of domestic

Table 1. Gas chromatographic analysis of water samples taken during August 1992.

ST.No.	C ₁₇ ng/L	Pristane ng/L	C ₁₈ ng/L	Phytane ng/L	Even/odd ratio	C ₁₃ -C ₃₂ µg/L	UCM µg/L	THC µg/L
1	280.0	300.0	270.0	600.0	1.2	2.2	24.0	64.0
3	18.0	5.9	23.0	6.4	1.0	0.9	0.9	1.8
4	12.0	6.2	24.0	3.8	1.3	1.2	0.8	2.0
5	531.0	500.0	380.0	500.0	1.0	15.5	11.5	27.0
6	421.0	390.0	420.0	490.0	1.0	15.8	12.0	27.8
7	400.0	280.0	390.0	400.0	1.4	14.4	10.4	24.8
8	84.0	38.0	77.0	20.0	1.2	11.4	6.2	17.6
9	120.0	66.0	180.0	70.0	1.1	20.0	17.0	37.0
10	15.0	8.2	22.0	8.4	0.9	2.6	1.9	4.5
11	113.0	66.0	120.0	60.0	1.1	11.8	11.7	23.5
12	140.0	150.0	30.0	8.4	16.8	1.0	12.0	28.8

Table 2. The levels of some polyaromatic hydrocarbons in water samples, ng/L.

Compound.	Station number				
	1	3	5	6	8
1- Methylphenanthrene	40.0	ND	ND	35.0	5.0
2- Methylphenanthrene	ND	4.1	3.4	36.0	9.0
Pyrene	67.0	3.1	10.0	29.0	3.7
1- Methylpyrene	380.0	ND	9.1	ND	ND
Flouorene	48.0	ND	12.0	340.0	48.0
Chrysene	1600.0	4.4	8.6	20.0	3.9
Benzo (a) pyrene	460.0	31.0	51.0	190.0	87.0
					270.0

wastewater carried over from Cairo, where about $850.5 \times 10^6 \text{ m}^3$ of wastewaters, including 15% industrial wastes, are discharged yearly into the canal. The mean concentration was 29.8 mg/L for the all samples collected from the lake. The lowest concentration was found in samples from St₁₀ (4.5 µg/L), while the highest level was attained at St₉ (37 mg/L) located nearby a the navigation station. Generally, the level of THC in the lake Manzala and its Associated canals is relatively high compared with several other area (Law and Andrulewicz 1983; Badawy and Al-Harthy 1991; Badawy et al. 1992).

Gas chromatographic analysis showed a marked unresolved complex mixture (µCM) with n-alkanes ranging from C12 to C32 in most samples. Even number of carbon atoms were more abundant than those with an odd number and the occurrence of isoprenoid compounds (pristane and phytane) which are presumably derived from artificial sources rather than natural sources (Farrington et al., 1973). These findings are characteristic of highly degraded oil derived hydrocarbons.

The data in Table (2) showed the occurrence of polyaromatic hydrocarbons (PAH) in the water samples. Benzo [a] pyrene which is considered as an indicator of the carcinogenic pollutants derived primarily from combustion processes was detected in all samples and its concentration ranged from 31 to 460 µg/L. The highest concentration is shown to be associated with industrial discharges from Fariskur canal. The attained levels are higher than those detected in River Rhine (4 to 100 ng/L) and within range reported for the River Trent in the UK ((5 to 504 ng/L). Benzantracene at concentration of 180 ng/L and dibenzanthracene (1500 ng/L) were detected in samples collected from St₉ only.

The residue levels of lindane, p,p' DDT, p,p' DDD, p,p' DDE and PCP's in the water samples are given in Table (3). The results confirm low level of background organochlorine compounds in this area, p,p' DDT was not detected in samples from Hadous and Bahr El-Baqar canals. However, p, p' DDT was detected in all samples collected from the lake and its concentration ranged from 0.5 to 1.6 ng/L, with an average value of 1.2 ng/L.

Residue levels of organochlorine pesticides attained by the present study are relatively lower than those previously reported by Abou-Donia (1990) for water samples derived from the same sampling locations. Such results indicate that the residues of organochlorine insecticides are generally decreasing especially Σ DDT which declined from 107.4 ng/L to 17.3 ng/L.

It is clear that lake Manzala is currently suffering from increasing pollution caused by discharge of untreated wastewater from Cairo through Bahr El-Baqar canal as well as other areas discharging into Hadous, Fariskur and El-Sirew canals. Generally, about $3745 \times 10^6 \text{ m}^3$ wastewater are discharged yearly into the lake. It was estimated that as much as $9.7 \times 10^6 \text{ Kg}$, BOD, $89.7 \times 10^6 \text{ Kg}$ suspended particulate, $8.22 \times 10^6 \text{ Kg}$ COD, $7.4 \times 10^6 \text{ Kg}$ phosphate and $45 \times 10^6 \text{ Kg}$ of petroleum hydrocarbon are released into the lake yearly (Table 4).

Table 3. Levels of some organochlorine compounds in water samples during August 1992 (ng/L)

Station number	Lindane	DDE	DDD	DDT	DDT	PCB's
1	4.4	3.4	2.2	1.3	6.9	14.5
3	7.6	20.9	3.9	ND	24.8	2.5
4	2.2	18.3	7.2	ND	25.5	3.6
5	11.4	9.4	3.0	ND	12.4	19.4
6	9.2	8.0	2.9	ND	10.9	13.1
7	6.7	7.0	7.9	ND	4.9	14.5
8	4.2	2.0	1.4	ND	3.4	4.0
9	5.9	7.3	1.9	0.5	9.2	9.5
10	3.2	8.1	8.6	1.6	18.3	4.5
11	1.2	15.3	2.9	1.1	19.3	ND
12	5.5	13.4	2.2	1.2	16.8	10.0

PCB's were measured as Aroclor 1254.

Table 4. Pollution load to lake Manzala from major drains.

Sources	$M^3 \times 10^6/\text{year}$	$Kg \times 10^6/\text{year}$				
		S.S	BOD	COD	T.P.	THC
Bahr El-Baqar	850.53	46.28	6.89	42.62	3.25	22.5
Hadous	1491.60	36.84	2.39	40.12	2.54	3.0
Serw	597.85	—	—	—	—	—
Matariya	379.12	—	—	—	—	—
Fariskur	303.00	6.06	0.43	9.39	1.3	19.4
Port Said	69.53	—	—	—	—	—
Damiatte	54.75	54.75	—	—	—	—

— = not analysed T.P = total phosphate.

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