

**ANIONIC DETERGENTS IN THE EASTERN HARBOUR,
ALEXANDIRA, EGYPT.**

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ABSTRACT

Surface and bottom sea water samples were collected from the Eastern Harbour during the period from May 1987 to May 1988. Detergents, salinity, total phosphorus and polyphosphates concentrations were determined. Average surface contents of detergents at the surface was 0.92 mg eq. LAS/l and at the bottom was 0.43 mg eq. LAS/l. The frequency distribution of anionic detergents showed that 68% of the analysed samples lies in the range of 0.0-0.8 mg eq. LAS/l. Total phosphorus average concentration at the surface was 3.76 $\mu\text{mol/l}$ and at the bottom was 2.1 $\mu\text{mol/l}$ and polyphosphates content at the surface was 2.96 $\mu\text{mol/l}$ and at the bottom was 1.45 $\mu\text{mol/l}$. Salinity concentration at the surface was 35.85‰ while at the bottom was 38.2‰. In June and July 1987 a significantly high negative correlation exists between both salinity and detergents, total phosphorus and polyphosphates. On the other hand detergents show high positive correlation with total phosphorus and polyphosphates in the same period. We aimed to study the distribution of anionic detergents in the Harbour and its effects on the total phosphorus content.

INTRODUCTION

Through great variety of chemicals which comprise detergents effective pollution problems may possibly arise from the discharge of laundering or cleaning processes. There are two main effects from these discharges and may be conveniently classified as the impact of dissolved inorganic compounds particularly nutrients leading towards enrichment. Phosphorus is considered as a limiting productivity factor. Therefore much attention has been paid to phosphorus control in municipal sewage. The principale sources of phosphorus are human excrement and detergents. The contribution of phosphorus from human excrement corresponding to about 1.0-1.2 lb of p/person annually but its contribution from detergents may be as high as 3.3 lb of p/person. It has been suggested that 30%-40% of all phosphorus entering the environment via detergents.

In the present work it is aimed to study the distribution of detergents in Eastern Harbour and its correlations with salinity, total phosphorus and polyphosphates and the impact of eleven outfalls which discharge untreated sewage into the Harbour.

MATERIAL AND METHODS

The Eastern Harbour is a semi-enclosed area with its mouth protected from the sea by an artificial break water leaving into two openings to the sea. The mean depth of the Harbour is about 3.5 m reaching a maximum depth of 9-11 m at some places.

Water samples were collected monthly during May 1987 to May 1988, except during October 1987 and April 1988. Surface and bottom water samples were collected from five stations inside the Harbour (Fig.1). Surface samples were collected by polyethylene bucket attached to plastic line, while bottom ones were collected by Nesken bottle. Detergents samples were analysed using methylene blue method as described by standard Method for the examination of water and waste water (1981). The absorbance of the chloroform extract of anionic surfactant and methylene blue were measured at 650 nm using Schemadzu spectrophotometer UV-150-02 and results were expressed as mg eq. LAS/l. Total phosphorus and polyphosphates samples were collected during June 1987 to May 1988. They were analysed according to Grasshoff (1976), the absorbances were measured by the same instrument and the results were expressed as $\mu\text{mol/l}$. Salinity samples were measured using salinometer "Beckman".

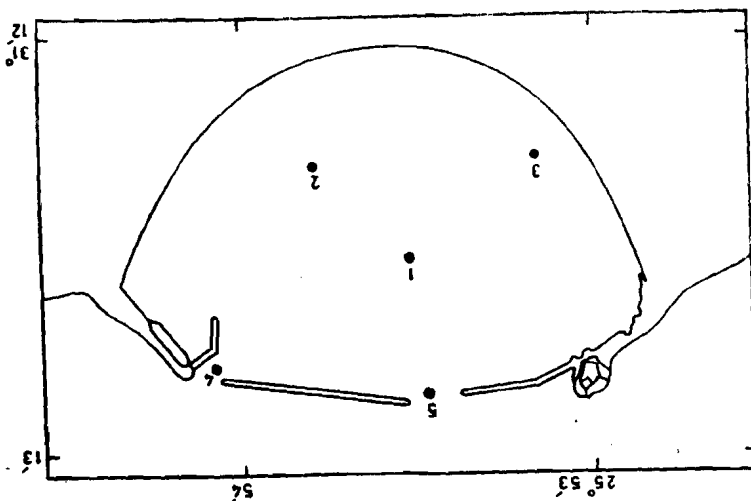


FIG. 1
Sampling stations

RESULTS AND DISCUSSION

The distribution of anionic surfactants in the Harbour is illustrated in Table 1. From this table it is observed that surface water is characterized by high concentrations of detergents, they ranged between 0.05-3.59 mg eq. LAS/l, while at the bottom they ranged between 0.00-1.57 mg eq LAS/l. This may be due to the discharge of sewage to the surface water.

Table 1

Surface and bottom distribution of anionic detergents
in the Eastern Harbour area during May 1987
to May 1988, (mg eq. LAS/l).

Station No.		May 1987	June	July	Aug.	Sept.	Nov.	Dec.	Jan. 1988	Feb.	March	May
1	S	0.95	1.30	1.02	0.96	2.16	1.63	0.53	0.05	0.33	0.43	1.0
	B	0.42	0.47	0.11	0.63	1.57	0.96	0.23	0.00	0.17	0.31	0.43
2	S	1.23	2.48	3.59	1.16	0.60	1.02	0.43	0.15	0.58	0.15	0.56
	B	0.38	0.29	0.83	0.68	0.43	0.39	0.35	0.00	0.11	0.14	0.31
3	S	1.07	1.02	0.70	1.15	3.06	1.52	0.51	0.27	0.84	0.46	0.31
	B	0.90	0.25	0.55	0.84	1.33	0.00	0.26	0.09	0.46	0.26	0.32
4	S	0.66	1.16	2.02	0.69	0.53	1.04	0.54	0.96	0.22	0.33	0.38
	B	0.45	0.23	0.51	0.62	0.90	0.66	0.34	0.19	0.1	0.22	0.23
5	S	0.71	0.73	0.81	1.26	1.47	1.26	0.55	0.69	0.26	0.39	0.33
	B	0.23	0.30	0.09	1.17	0.67	0.99	0.41	0.18	0.15	0.34	0.21

The average distributions of detergents, total phosphorus, polyphosphates and salinity are illustrated in Table 2 and Fig. 2. From the table it is noticed that the surface water had higher average concentrations of total phosphorus and polyphosphates (3.76 and 2.96 μmol , respectively) than the bottom (2.1 and 1.45 μmol respectively). On the other hand surface average salinity was less than bottom one (35.85‰ and 38.2‰ respectively). From this table it is observed that stations 2 and 3 had higher content of detergents (1.09 and 0.99 mg eq. LAS/l), total phosphorus (8.51 and 3.02 $\mu\text{mol/l}$) and polyphosphates (6.76 and 2.37 $\mu\text{mol/l}$), and they had lower salinity 35‰ and 36.01‰. This may be due to the fact that these two stations are directly affected by the untreated sewage discharged to the Harbour. On the other hand stations 4 and 5 are situated at the interferences of the Harbour and are affected by open sea water reflecting lower values.

Table 2

Average concentration of detergents, total phosphorus polyphosphates and salinity in the Eastern Harbour area during May 1987 - May 1988.

Station No.	Deterg.	T.p.	Poly.Phos	S‰	
1	S	0.95	2.79	2.190	35.79
	B	0.48	1.57	1.22	38.20
2	S	1.09	8.51	6.76	35.0
	B	0.36	4.43	2.70	38.02
3	S	0.99	3.02	2.37	36.01
	B	0.47	2.02	1.58	37.96
4	S	0.78	2.53	1.97	35.75
	B	0.40	1.14	0.82	38.26
5	S	0.77	1.94	1.51	36.68
	B	0.43	1.33	0.91	38.54
averages	S	0.92	3.76	2.96	35.85
	B	0.43	2.10	1.45	38.20

Seasonal variations of detergents in the Eastern Harbour during investigation period is shown in Table 3 and Fig. 3. From the table it is observed that higher concentration of detergents was recorded during summer and autumn; 1.34 and 1.43 mg eq. LAS/l respectively and lower one was recorded during winter 0.47 mg eq. LAS/l.

The detergents content during both summer and autumn was 6 times more than detergents content during winter and this is because more than million peoples visit Alexandria during summer.

The frequency distribution of the concentration of methylene blue active substances in the Eastern Harbour area during investigation period is represented in Fig. 4. The most abundant values are 0.0-0.4 mg eq. LAS/l which constitute about 40% of the total values while values between 0.4-0.8 mg eq. LAS/l constitute 28% of the total values. The means of detergents content in the Harbour ranged between 0.0 and 0.8 mg eq. LAS/l (68%). 18% of the total samples represents concentrations of 0.8-1.2 mg eq. LAS. 8% of the total samples was ranged between 1.2 and 1.6 mg eq. LAS/l. While values ranged between 1.6 and 3.6 mg eq.

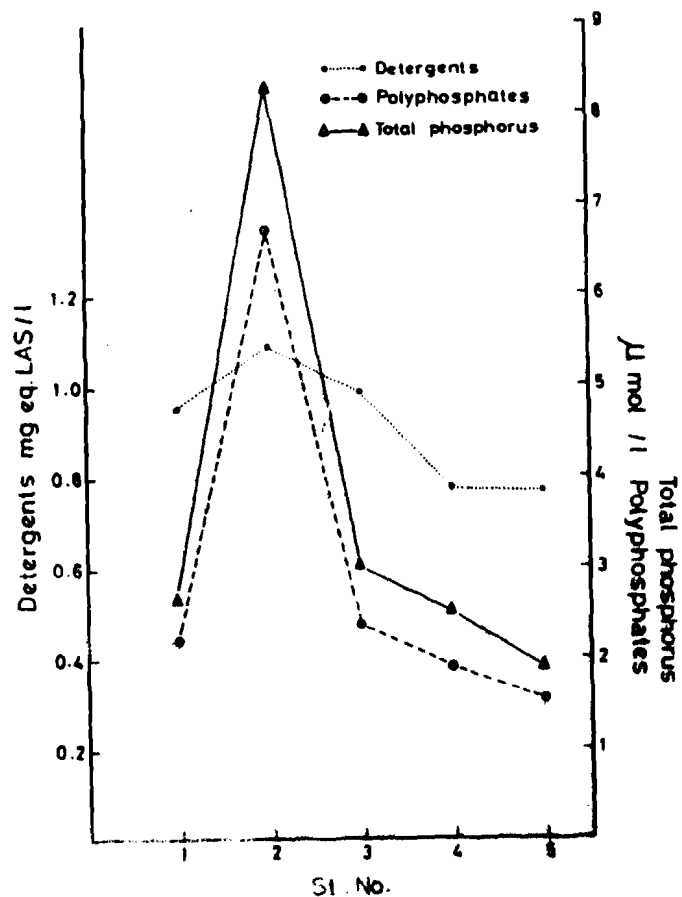


FIG. 2
Average concentrations of
detergents, polyphosphates
and total phosphorus in the
Eastern Harbour at stations
1,2,3,4 and 5.

LAS/l constitute only 5% of the total samples. Mahmoud and Beltagy (1988) found that detergents content of Lake Borollos ranged between 0.0 and 0.3 mg eq. LAS/l, which is less than the values found at the Harbour. Albaster (1978) found that acute toxicity (LC_{50}) of the non ionic surfactant most commonly used in the detergents and cleaning agents in the range of 3-7 mg/l of active substances in static test with golden rofes. Kozarac et al. (1977) found that values above 0.01 mg/l are obtained in regions under the influence of urban pollutants. He found that values between 0.0 and 0.01 mg eq. LAS/l constitute more that 40% of the total

Table 3

Seasonal variations of detergents in the Eastern Harbour

St.		Summer	Autumn	Winter	Spring	
1	S	1.09	1.900	0.34	0.79	
	B	0.40	1.26	0.13	0.39	
2	S	2.41	0.81	0.39	0.65	
	B	0.60	0.41	0.15	0.28	
3	S	0.96	2.29	0.54	0.61	
	B	0.55	0.67	0.27	0.46	
4	S	1.29	0.79	0.57	0.46	
	B	0.45	0.78	0.21	0.30	
5	S	0.93	1.37	0.50	0.48	
	B	0.52	0.83	0.25	0.26	
		S	1.34	1.43	0.47	0.60
		B	0.50	0.79	0.20	0.37

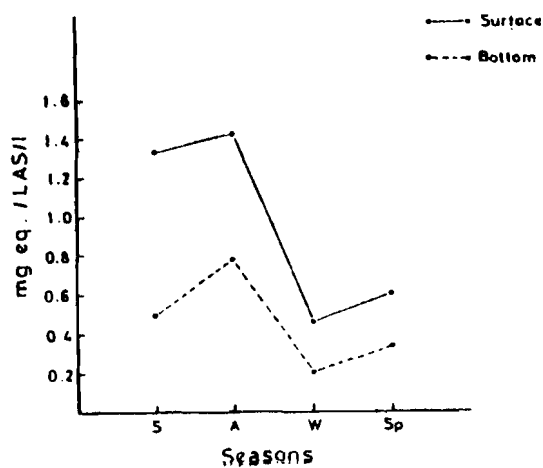


FIG. 3
Seasonal variations of detergents
in the Eastern Harbour at surface
and bottom water.

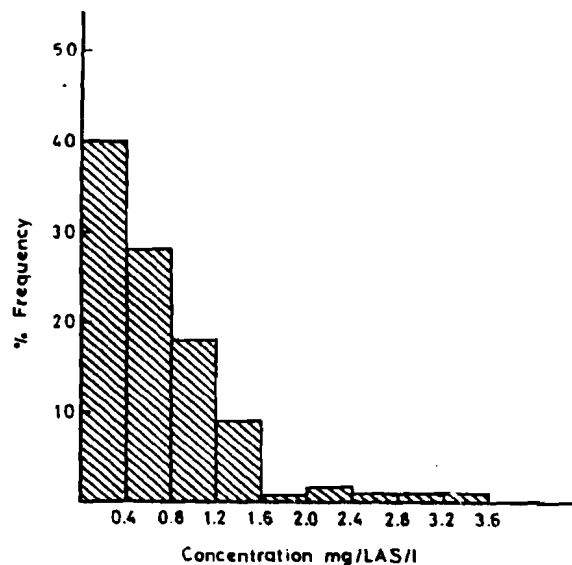


FIG. 4
Percent frequency distribution
of detergents in the Easter Harbour
during May 87-May 1988.

values at the North Adriatic. He concluded that the values below 0.01 mg/l correspond to unpolluted sea water. Cosovic et al. (1982) found that the concentrations of anionic detergents in the Adriatic Sea-off shore stations-were low and rarely exceed 0.05 mg/l, while the anionic detergents contents in Rovinj Harbour were 0.62, 0.01 and 0.08 mg/l, and its concentrations in Rejeke Harbour were 0.1 and .03 mg/l. He also found that the concentrations in Split plastics industry were 0.20-0.14 mg/l. Cosovic et al. (1979) concluded that the surface active substances modify the structure of inter boundary layers and affect the processes of mass and energy transfer. De Renzi et al. (1978) found that detergents content in coastal water in front of Italy ranged between 0.005 and 0.08 mg/l. Kozarac et al. (1975) found that the content of anionic detergents in samples of sea water ranged from 0.01 to 0.62 mg eq. SLS/l.

Correlation coefficients were calculated between detergents, total phosphorus, polyphosphates concentrations and salinity. Salinity as a conservative parameter is considered to be the most obvious indicator variable showing the extent of mixing of seawater in the Harbour with sewage discharged. During June and July (1987), there were a significantly high negative correlations between salinity, detergents, total phosphorus and polyphosphates. They were $r = -0.95, -0.93$ and -0.92 during June (1987) and

$r = -0.96, 0.7$ and -0.7 during July (1987). This reversible correlations indicate the allochthonous origin of these parameters. During February (1988) there was a negative correlation between salinity and detergents $r = -0.78$. There were no correlations between salinity and the other parameters at the rest of the year. Also during June and July (1987) detergents gave a very high positive correlations with total phosphorus and polyphosphates $r = 0.9$ and 0.9 during June 1987 and $r = 0.8$ and 0.8 during July 1987.

This high significant correlations indicate that during these two months, detergents are the main factor that increases the concentrations of total phosphorus and polyphosphates. while in February (1988) there were no correlations between detergents and these two parameters indicating that detergents did not affect their content in the Harbour.

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