

Detergents as indices of organic pollution in Alexandria Coastal Waters

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INTRODUCTION: Dissolved organic compounds in the sea originate from several internal & external sources. Apart of organic compounds in sea water is surface active substances which may change the solubility and physico-chemical state of other micro-constituents in sea water. The problem of pollution by detergents has been and is still discussed on a national and multinational scale, and some detergents are now restricted for domestic use.

The present work is an attempt to study retrospectively the relation between the state of pollution of Alexandria coastal waters by anionic detergents & sewage disposal during 1985-1986.

MATERIALS AND METHODS: The study area (Figure 1) lies off Alexandria between 31° 08'-31° 26' and 29° 47'-30° 04'E. It extends for about 38 Km from El-Agami (west) to Abo-Qir Head land (east), including four different zones from the pollution view points. Three of them are completely polluted with domestic sewage and waste waters, while the fourth (El-Agami) is considered the reference zone due to being far away from pollution. Alexandria beaches are highly polluted with domestic sewage and waste waters, receiving on the average about 183X10⁶ m³/yr. Out of this amount, about 36X10⁶ m³, 35X10⁶ m³ and 111.8X10⁶ m³ are discharged annually to zones I, II and III. The situation in zone III is more complicated due to being affected by agricultural run-off (brackish water, 2.57X10⁶ m³/yr) from Umom drain.

Sampling was carried out at regular monthly intervals during August 1985-November 1986 (twice a month). Sampled stations were 13, 7, 4 & 2 for zones I, II, III & IV, respectively. For the determination of anionic surfactants, water samples were taken and analyzed fresh (within 6 hrs) using the methylene blue method (APHA, 1985).

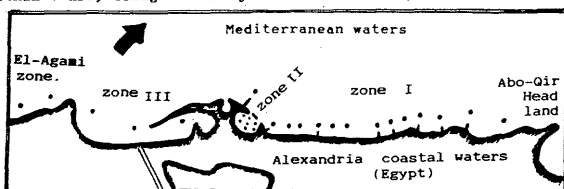


Figure 1: The study area of Alexandria during 1985-1986.

RESULTS AND DISCUSSION: The annual means and ranges of surfactants, salinity & TSM in Alexandria waters are shown in table 1. The monthly variations for anionic surfactants and TSM showed higher values during summer, and lower in winter due to the high sewage disposal in summer (Aboul-Kassim, 1987). Based on stational averages, higher values of anionic detergent were recorded at stations directly affected by sewage discharge (zones I, II & III), and lower in El-Agami zone.

According to Cosovic et al. (1985), the total surfactant content of 0.2-0.8 mg/l corresponds to naturally occurring organic substances of unpolluted sea water. Compared with the range and average concentrations of detergents in El-Agami (the reference zone) or even with that of Azmir Bay (Turkey), i.e. 0.42-4.14 (Uysal & Yaramaz, 1988) or that of lake Burullus (Egypt), i.e. 0.17 mg/l (Mahmoud and Beltagy, 1988), the average surfactant levels of zones I, II and III might indicate that Alexandria waters are highly polluted with detergents. The significant inverse correlation between detergents and salinity ($r = -0.8791$) indicates that detergents in the polluted study area are brought down with sewage disposed into Alexandria coasts.

Table 1: Means and ranges of anionic surfactants, salinity & TSM for surface & bottom waters in the coastal waters of Alexandria.

Zone	SURFACTANTS (mg/l)		SALINITY		TSM (mg/l)	
	Surface	Bottom	Surface	Bottom	Surf.	Bottom
I	0.02-4.21 (0.45)	0.02- 4.32 (0.37)	36.03	36.42	25.4	22.7
II	0.40-4.00 (1.33)	0.53- 2.52 (0.93)	33.71	34.10	53.2	47.1
III	0.46-8.31 (1.50)	0.19-12.35 (2.32)	31.72	33.21	145.0	133.0
IV	0.02-0.08 (0.03)	0.06- 0.17 (0.02)	38.94	39.11	3.1	1.2

The levels of anionic surfactants can be used as an index of organic water pollution, where their concentrations in Alexandria waters were strongly correlated with sewage disposal ($r = 0.9511$) & TSM ($r = 0.8911$), the regression equations being:

Amount of Sewage (m³/yr) = 21.341 + 23.731 Surfactants (mg/l),
TSM (mg/l) = 11.264 + 19.211 Surfactants (mg/l). The high levels of detergent in Alexandria is a further support to this assumption.

The actual amounts of detergent loading disposed to Alexandria waters were estimated to be about 86, 109 Kg/day, reaching Alexandria waters through zones I and II, while zone III discharges about 7 tons/day. The large amounts of domestic sewage, agricultural run-off and industrial wastes disposed in zone III is a further support for that highly daily load. The daily discharge of detergents in Alexandria waters is relatively small compared with that given for France in Marseille, i.e. 4.00 (Arnoux & Coruelle, 1972) or Cortiou area, i.e. 5.00-6.20 (EPOPEM, 1978) depending on the flow rate. Based on personal data, the expected total loading of detergents to the area are projected to be approximately double between now and year 2000.

According to FAO, each individual contributes to urban detergent having sewage an average value of 0.4-1 Kg/yr. Based on the daily discharge values, the population equivalent of the area will vary from 0.40-0.75, indicating that the levels of detergents in Alexandria are still far from seriousness of severe pollution and that the population equivalent is still within the typical range mentioned by FAO.

Since detergents have caused serious pollution problems in natural waters, commercial detergents should be non-toxic to aquatic organisms as well as to be biodegradable by microorganisms.

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