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THE TIME VARIATION OF TEMPERATURE, SALINITY AND OXYGEN CONTENT IN THE EASTERN HARBOUR OF ALEXANDRIA

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ABSTRACT

The time-depth variations of the hydrographic parameters were studied in the Eastern Harbour of Alexandria (EHA), where the water temperature, Salinity and dissolved oxygen content were weekly determined in the period from May 14, 1985 to September 24, 1986. The effect of increasing domestic sewage quantities in the EHA on the hydrographic conditions was discussed. The results reveal that the bad effect of that domestic sewage on the hydrographic conditions of the EHA, especially for the oxygen content, which reached to near the oxygen depletion state. This might be due to the organic activities on the heavy domestic sewage materials accumulated on the harbour's bottom.

INTRODUCTION

The Eastern Harbour of Alexandria (EHA) is a relatively, protected, semi-enclosed embayment covering an area of about 2.8 Km^2 and located along the main central part of the Mediterranean coast of Alexandria (Fig. 1) . The harbour is connected with Mediterranean Sea through El-Boughaz and El-Silsila openings (Fig. 2). The harbour is shallow in most places with an average depth of about 5 m. The deepest area (about 12 m) is found near El-Boughaz inlet. The bottom slopes gradually towards the center of the harbour and El-Boughaz opening.

The EHA received an amount of 15000 m^3/day of raw domestic sewage (Shriadah, 1982). This quantity increases by time and considerably in summer, especially in the summer of 1986 (from the beginning of June, 1986), when all the domestic sewage of the eastern part of Alexandria was turned into the EHA to protect the eastern summer resort coasts of Alexandria from pollution by domestic seawge. Under the new conditions, the domestic seawge discharged into the EHA through 11 outlets was estimated to be 63000 m^3/day (Said and Maiyza, 1987).

The hydrography, plankton and nutrient of the EHA were studied by Maghraby and Halim (1959), Abdallah (1979) and Dowidar (1985). Other oceanographic investigations within the EHA were carried out by Halim (1973), El-Sayed (1980), Shriadah (1982) and Said and Maiyza (1987).

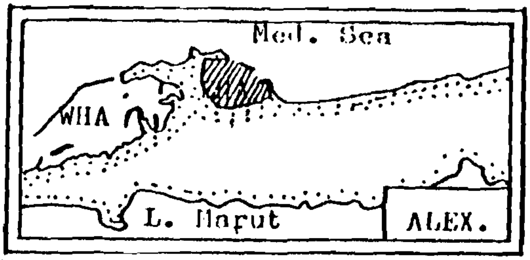

Fig. (1)
Alexandria and the Eastern Harbour of Alexandria.

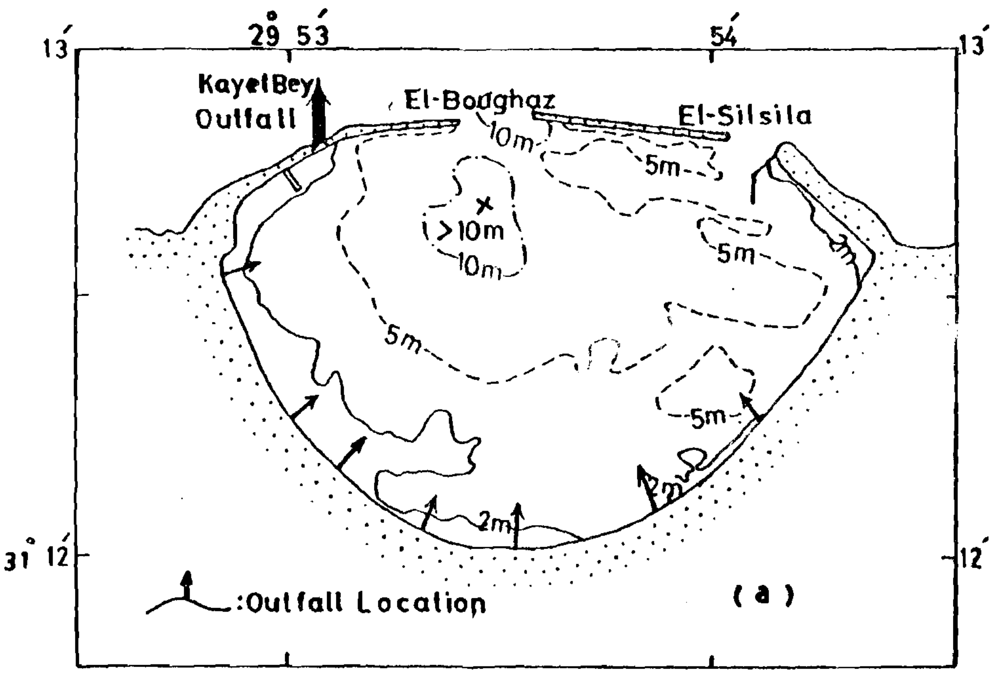

Fig. (2)
Map showing the Eastern Harbour of Alexandria (EHA), its bathymetry, outfall locations and the location of station under consideration (x).

The aim of the present work is to study the time-depth variations of the different hydrographic parameters on the EHA and to study the effect resulted from increasing the rate of discharge of the domestic sewage on the hydrographic conditions of the EHA.

DATA AND METHODS OF ANALYSIS

During the periods, from May 14, 1985 to July 22, 1985 and from October 1, 1985 to September 24, 1986, a weekly survey of the main hydrographic paramêters was carried out in one hydrographic station (Fig. 2). The location of this station chosen to be at the central and deepest (12m) part of the EHA in order to give the mean hydrographic conditions of the harbour. The water temperature, salinity and dissolved oxygen content were measured at the surface and at 5 m and 10 m depths. The water temperature was measured using protected reversing thermometers and the temperature correction was made. Water samples were collected for the salinity and dissolved oxygen. The salinity was determined using Backman Induction salinometer. The samples for oxygen determination were fixed immediately upon collection with Winkler reagents, and the dissolved oxygen content was determined in the laboratory using Winkler method.

RESULTS

Thermal Regime:

Water temperature reaches their minimum during a yearly cool period that lasts from the second half of December to the end of March (Fig. 3). This minimum temperature are about the same during the cool months, where most of the seasonal heat loss occurs at night. In the mean time the length of the nights in winter is longer than that in summer causing the minimum temperature in winter through out the year (16.0°C in January, Fig. 3 a and b).

Vertically thermal homogenity in the EHA occurs in most times of the year as shown in Fig. 3 a and b. This may be due to some factors but mainly to the wind action on a relatively small, shallow body of water nearly surrounded by land area. The vertical stratification in water temperature was observed only in upper 5 m during April and August. The water temperature increases from its minimum value in January (16.0°C) to reach its maximum value in August (30.0°C at the surface and 27.3°C near the bottom). After that the water temperature decreases to reach its minimum value in the next winter.

The maximum water temperature in summer, is a result of the solar heating with a relatively longer day-time in summer than that in winter.

The rapid decrease and increase of the water temperature occurs in autumn (October-November) and spring (May-June), respectively (Fig. 3a and b).

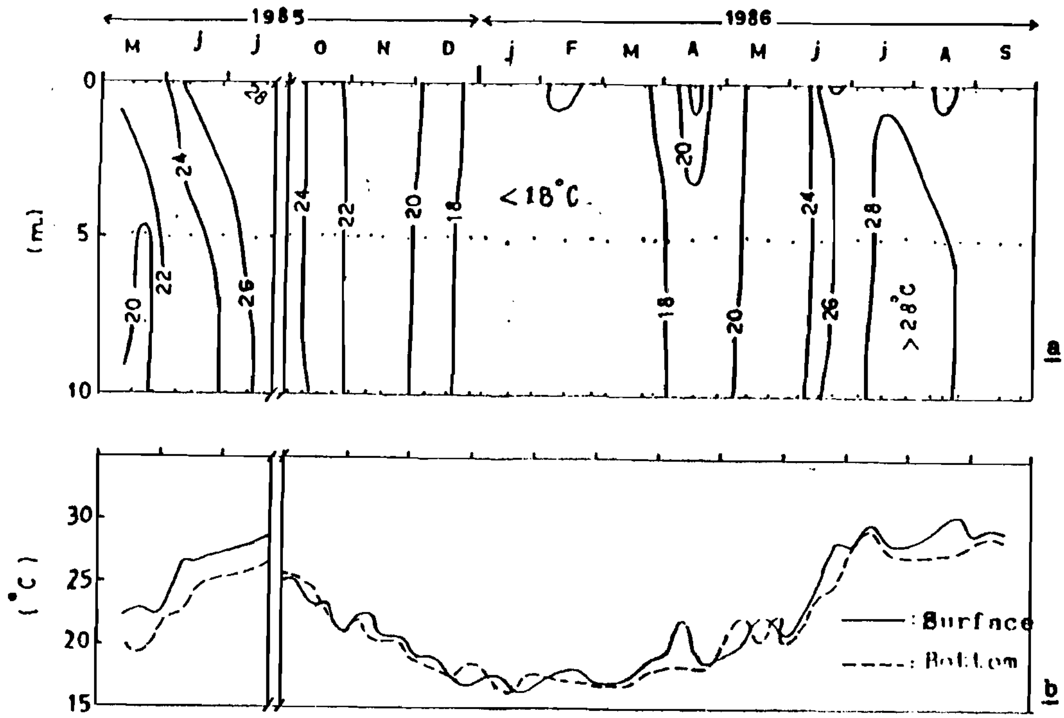

Fig. (3)
Time variation of water temperature
in the EHA.

Comparing the periods May-July of 1985 and 1986, one can notic that, an annual variation in the water temperature occurs, where the water temperature of this period in 1985 was lower, in general, than that in 1986. Also, the vertical homogenity in that period in 1986 was more identified than in the same period of 1985 (Fig. 3a and b).

Haline Structure

Figure 4 illustrates the time- depth diagram of water salinity in the EHA throughout the period of investigation. From this figure, it is clear that, the effect of domestic sewage throughout the year mainly affects the upper 5 m layer where the surface water salinity may decrease to less than 36.0‰ specially in summer 1985 (June-July) and autumn 1985 (October-November).

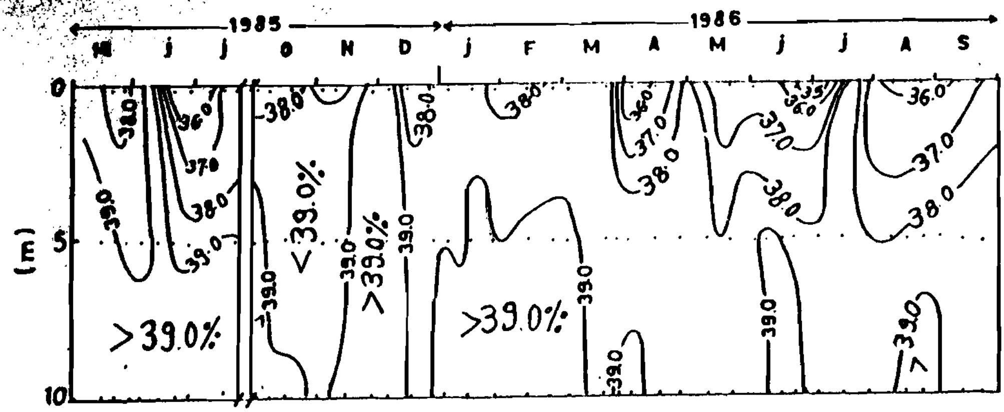

Fig. (4)
Time - depth variation of water salinity
in the EHA.

In winter 1986 (January-March) the domestic sewage affected the most upper layer for some times only and the salinity decreased to less than 38.0‰. Through the period from May 1985 to March 1986 the salinity of the deeper layer (5-10 m) scarcely decreased less than 39.9‰; i.e. throughout that period the effect of this sewage only affected the upper 5 m in the central part of the Harbour,

From the end of March 1986 the surface salinity strongly decreased, where it reached to less than 36.0‰. From the middle of April to the end of September 1986, the water of salinity less than 38.5‰, extended from the surface to the bottom except for some limited periods of times. When the salinity near the bottom was less than 38.5‰. This may be due to the increase of domestic sewage in late spring and summer of 1986.

The annual variation between the periods May-July 1985 and 1986 was clear specially at the surface (surface salinity in May 1986 was more than that in May 1985). Near the bottom, the water salinity in 1985 was generally higher than that in 1986.

Dissolved Oxygen Content

The study of different distributions of dissolved oxygen content in natural waters is very important since it is considered a one of the important limiting factors for the life of aquatic organisms. Also, it is considered as an important parameter in determining the degree of pollution. Sewage pollution has been generally regarded as an organic pollution, affecting fish and other aquatic life.

The EHA is a relatively shallow, with two connections with the open sea. One of them (El-Boughaz) has a depth of more than any other parts of the harbour. So the water of the harbour is supposed to be well aeriated; i.e. the oxygen content must be near or higher than the saturated value. But this was far from the actual values in most of the time, as shown in Fig. 5 a, b. & c. This must be due to the oxygen depletion by the raw domestic sewage pumped into the harbour.

Figure 5 a & b illustrates the time- depth diagrams of the oxygen content and saturation over the study period in the central deepest point of the EHA. This figure shows that the dissolved oxygen content was very irregular both in time and stratification. In winter and spring (JanuaryMay) the oxygen content had its maximum values of more than 5 ml/l (80.0%) for the hole water column. In the other times of the studied period the high oxygen content occurred only in the upper 5 m. In summer and autumn (JuneSeptember) the oxygen content was depleted especially near the bottom, where it varied from 0.1 to 5.2 ml/l (0.4 to 100.0%).

In the period May-July 1985 the oxygen content ranged between 1.2 and 7.0 ml/l (40.0 and 120.0%), while in the same period in 1986 it ranged between 0.2 and 7.0 ml/l (12.0 and 120.0%).

The vertical stratification of dissolved oxygen content is small over the period (less than 2.0 ml/l within the 10 m depth) except in the summer and early autumn (JuneSeptember), where it reached to 9.0 ml/l wihtin the same depth (Fig. 5 c). The minimum values all-over the period, especially of the near bottom level, were observed in that period, where the dissolved oxygen content reached to near the oxygen depletion state and this might be due to the organic activities on the heavy domestic sewage materials accumulated on the Harbour's bottom.

SUMMARY

The time-depth variations of the hydrographic parameters (temperature, salinity and dissolved oxygen content) of the EHA were weekly determined in the period from May 14, 1985 to September 24, 1986. From the beginning of June 1986 the quantity of domestic sewage received in the EHA increased from 15000 to 63000 m^3/day. The effect of this increase on the hydrographic parameters was considerably observed.

The water temperature of this area varied from 16°C in January 1986 to 30°C in August 1986. The water column was thermally homogenous in April and August, 1986, when there was a thermal stratification in the upper 5 meters.

The effect of domestic sewage throughout the studied year mainly affected the upper 5 meters, when the surface salinity decreased to less than 36.0% in summer 1985 and after March 1986 due to the increasing of the domestic sewage quantity in the EHA. In the period (May-July), the water salinity in 1986 was lower than that in 1985.

The dissolved oxygen content in the EHA was very irregular both in time

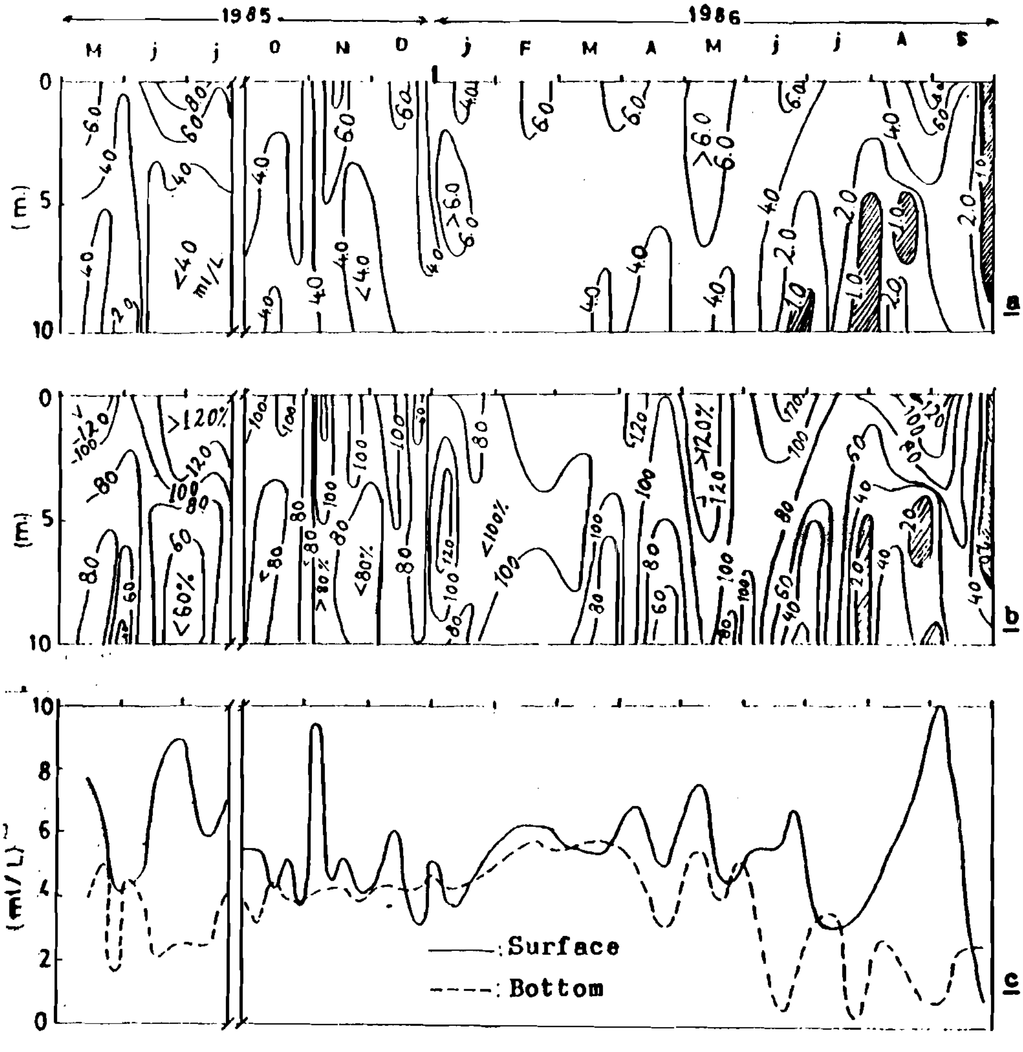

Fig. (5)
Time - depth variation of dissolved oxygen content (a), oxygen saturation (b) and time variation (c).

and stratification. The increasing of the amount of sewage in the EHA decreased the dissolved oxygen content to nearly the complete oxygen depletion near the bottom.

REFERENCES

Abdallah, M.A., 1979. **Study of currents and hydrographic structure of the water masses in front of Alexandria coast.** M.Sc. Thesis, Alexandria University, P 100.

Dowidar, N.M., 1965. **Distribution and ecology of marine plankton in the region of Alexandria, Egypt.** -Ph.D. Thesis, Faculty of Science, Alexandria University.

El-Maghraby, A.M. and Y. Halim, 1959. The plankton of Alexandria waters in 1957.- **Hydrobiology,** vol. 25, 1-2: 221-238.

El-Sayed, M.A. and M. Kh. El-Sayed, 1980. Levels of heavy metals in the surface water of a semi-enclosed basin along the Egyptian Mediterranean Coast. **IVes Journes Etud. Pollution,** Cagliari, C.I.E.S.M., 223-228.

Halim, Y., 1973. Marine biology studies in the Egyptian Mediterranean waters: A review. **Acta Adriat.,** 18: 31-38.

Said, M.A. and I.A.,Maiyza, 1987. Effect of the domestic sewage discharge on the hydrographic regime of the Eastern Harbour of Alexandria. **Bull. Inst. Oceanogr. and Fish.,** 13: 1-20.

Shriadah, M., 1982. **Studies on the chemical composition of the Eastern Harbour water-Alexandria.** M.Sc. Thesis, Faculty of Science, Alexandria University, p 143.