

Impact of Sewage Discharge on the Phosphorus Species and Dynamics in the Eastern Harbour of Alexandria, Egypt

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Phosphorus is one of the most important nutrient elements which control the growth and reproduction of phytoplankton. Mean while, when present in huge concentrations it may cause eutrophication and is considered as a potential pollutant.

This work assesses the importance of land based sources on the phosphorus species and budget in a heavily polluted basin off Alexandria coast.

The annual mean of dissolved inorganic phosphorus (DIP) in the Eastern Harbour (E.H) amounted to 0.44 ± 0.223 ug at/l. Generally, statistically significant correlations were found between DIP with particulate organic matter (POM) ($P < 0.001$) and dissolved oxygen ($P < 0.001$), indicating the importance of oxidation of organic matter as a source of DIP. The importance of the allochthonous source of DIP was demonstrated by the significant inverse correction found between DIP and salinity ($r = -0.318$, $P < 0.001$).

Dissolved organic phosphorus (DOP) constitutes between 55-60% of total dissolved phosphorus (TDP) in the harbour water. The average value of DOP concentrations for surface and bottom water layers were 0.677 ± 0.491 and 0.436 ± 0.262 ug at/l, respectively. Significant corrections were observed between DOP and chlorophyll *a* ($P < 0.001$) as well as total living biomass ($P < 0.001$), underscoring the important role of living organisms as a source of DOP in the harbour water.

Particulate phosphorus (PP) in the E.H was remarkably higher than that of TDP, constituting more than 58% of total phosphorus (TP). The overall average amounted to 1.394 ± 0.754 ug at/l. The high significant corrections between PP with POM ($P < 0.001$) and salinity ($r = -0.5399$, $P < 0.001$) indicated that the concentration of PP is directly proportional to the amount of run-off. The regression equation being : $POM = 1.767 + 0.670 PP$.

The overall average values of inorganic phosphorus, organic phosphorus and total phosphorus of the surficial sediments of the harbour basin amounted to 0.086%, 0.02% and 0.106%, respectively.

The annual inputs of DIP to the harbour basin during 1985-1986 from land sources, precipitation as well as flux from sediments were 567 kg, 6.5 kg and 520 kg, respectively. About 400 kg/yr of DIP reaches the harbour from the neritic Mediterranean waters through the eastern outlet. On the other hand, the total phosphorus input to the bay via precipitation amounted to 6.5 kg/yr. Laboratory experiments indicated that maximum phosphorus released from sediments was attained during the first five days. A total 520 kg DIP was estimated to be released to the overlying water from sediments. This amount is about 52% of the total DIP input to the harbour.

The annual rate of phytoplankton uptake of DIP was experimentally determined and amounted to 860 kg/yr. The present day standing stock of phosphorus in the harbour amounted to 209 kg. Following the circulation pattern in the bay, the outflowing water from the bay carries about 190 kg of DIP annually to the coastal water of Alexandria region. The rest of the inflowing phosphorus is either adsorbed on settling particles or sediments.