

IMPACT OF WASTEWATER ON PHYTOPLANKTON

M. Jiyalal Ram Jaiswar

National Institute of Oceanography,
Regional Centre, Mumbai-400 053

Phytoplankton : All the drifting organisms which cannot swim against the winds and currents are called plankton. The plant components of plankton are known as phytoplankton. In other words the suspended particulate matter in the sea consists of living organisms called plankton and dead particles commonly referred to as detritus.

Importance : Phytoplankton being autotrophs fix solar energy by photosynthesis using carbon dioxide, nutrients and trace metals. They are the basic component of food chain. They also play a major role in generation of petroleum hydrocarbons. Most phytoplankton have density greater than that of water. The higher density is in part caused by skeletons which consist of silica, calcium, carbonate and cellulose. Phytoplankters are of great ecological significance because they comprise the major portion of primary producers. Phytoplankton may be used to identify "natural regions" of the oceans. These regions can be characterized by typical species. Phytoplankters are good indicator of water pollution. Thus they play a major role in pollution monitoring studies. Phytoplankters are the basic aspects for environmental impact assessment studies.

Methods of Analyses : The estimation of primary productivity, phytoplankton pigments and phytoplankton population were carried out as follows:

a) **Primary productivity** : A known amount of radioactivity ($^{14}\text{CO}_3^{2-}$) was injected to the seawater sample in light and dark bottle. The sample was filtered through a 0.45 μ Millipore membrane filter paper after incubation. The radioactivity of the phytoplankton cells retained on the filter paper was assayed using a LKB1214 Rack beta Liquid Scintillation Counter by following the methods of Vollen Weider (1969).

b) **Phytoplankton Pigment** : A known volume of water filtered through 0.45 μ Millipore membrane filter paper and the pigments retained on the filter paper were extracted in 10ml of 90% acetone. The absorbance (OD) was measured at 750 and 665 nm before and after treatment with 0.1N HCl. The further estimation of chlorophyll a and phaeophytin was carried out by following the Standard Methods (APHA, 1992).

c) **Phytoplankton population** : A known volume of water sample was preserved in Lugol's solution for the quantitative and qualitative estimation of phytoplankton.

Enumeration and identification of phytoplankton were done using a compound microscope and Sedgwick – Rafter slide as per the Standard Methods (APHA, 1992).

Studies : A number of studies on phytoplankton were conducted by NIO at Thane Creek, Ulhas River estuary, Versova Creek and Mahim Creek under Coastal Ocean Monitoring and Prediction System (COMAPS) programme during the period from 1990 to 2000. The present information is in general and reveals the impact of wastewater on phytoplankton.

Observation : The polluted locations were characterized by significantly enhanced phytoplankton population and poor algal species diversity. At these locations the ratios of chlorophyll a / phaeophytin were markedly low indicating an unhealthy conditions of phytoplankton cells. Primary productivity followed the same trend of distribution as phytoplankton population under the normal weather condition. Similar results were recorded at Thane Creek, Ulhas River estuary and Mahim Creek.

The values of phytoplankton population, pigments and primary productivity were significantly higher at these polluted locations than those of offshore waters which were associated with markedly depleted dissolved oxygen and enhanced nutrient level observed particularly during low tide. However declined phytoplankton population were observed at highly polluted location like Versova Creek.

Skeletonema costatum, *Nitzschia closterium*, *Oscillatoria chlorina*, *Spirulina major*, *Thalassiosira subtilis*, *Chaetoceros decipiens*, *Melosira sulcata*, *Asterionella japonica* were the dominant species in polluted estuarine system where as offshore water sustained *Thalassiothrix longissima*, *T. fraunfeldii*, *Coscinodiscus excentricus*, *C. marginatus*, *C. lineatus*, *C. nitidus*, *Chaetoceros simplex*, *C. socialis*, *Biddulphia sinensis*, *B. mobilensis*, *Pleurosigma directum*, *P. elongatum*, *P. normanii*, *Surirella fastuosa*, *Gyrosigma balticum*, *Gyrosigma sp*, *Trichodesmium thiebauti*, *Rhizosolenia hebetata*, *R. robusta*, *R. fragilissima*, *R. stolterfolthii*, *R. delicatula*, *Corethron coriophyllum*, *Guinardia flaccida*, *Ceratium hirundinella*, *Peridinium sp* as the major species.

Results : A few examples of the overall average values of different parameters are presented below

Location	Parameters				Species Diversity
	Primary productivity (mg C/m ³ /h)	Phytopigments		Phytopopulation	
		Chlorophyll a (mg/m ³)	Phaeophytin (mg/m ³)	Cell Count (no. x 10 ³ / l)	
Creek waters	3.3	13.45	3.6	1398.1	0.002
Offshore waters	0.9	2.0	1.4	80.0	0.704

The prominent features observed on the basis of results are summarized below.

Sr no.	Location	Phytoplankton Status
1	Polluted enriched water	Enhanced phytopopulation & pigment. Poor ratios of chlo a / phaeo. Poor species diversity
1a	Nearshore waters	Enhanced phytopopulation & pigment. Poor ratios of chlo a / phaeo. Comparatively lower species diversity
1b	Creek systems	Enhanced phytopopulation & pigments. Poor ratios of chlo a / phaeo. Poor species diversity
1c	Estuarine systems	Enhanced phytopopulation & pigments. Poor ratios of chlo a / phaeo. Comparatively lower species diversity
2	Offshore waters	Comparatively lower phytopopulation and pigments but sufficient food for the organisms of secondary and tertiary trophic level. Healthy ratio of Chlo a / phaeo. Enhanced species diversity
3	Highly polluted waters	Poor phytopopulation and pigments. Poor ratios of chlo a / phaeo. Poor species diversity.