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Phytoplankton Diversity and Water Quality Assessment of ONGC Pond, Hazira

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Abstract: *Oil and Natural Gas Corporation (ONGC) is leading national oil company refines crude oil and natural gas etc. Large amount of water is used in refining process. Water used in the process is non-consumptive and come out as wastewater and after treatment the treated wastewater is stored in cemented pond of 0.05 ha before discharging into Tapi river.*

Diversity of phytoplankton was investigated in same cemented pond. Water quality parameters including color, temperature, total solids, total dissolved solids, total suspended solids, pH, total hardness, total alkalinity, chloride, phosphate, silicate, nitrate, DO, BOD, COD, and ammonia were monitored.

Total seventy three genera of phytoplankton belonged to four classes viz., Euglenophyceae, Chlorphyceae, Bacillariophyceae and Cyanophyceae were identified. Chlorophyceae group was dominated among the four classes. Levels of oxygen (5.678±0.218 mg/L), nitrate (4.089 ± 0.926 mg/L), phosphate (0.257 ± 56.786 mg/L) and silicate (0.218 ± 0.029 mg/L) showed direct relationship with the diversity of phytoplankton.

Keywords: *Water quality, Cemented pond, Phytoplankton and ONGC.*

1. INTRODUCTION

Phytoplankton represents the microscopic algal communities of water bodies and the pioneer of aquatic food chain. The productivity of an aquatic system is directly related to diversity of phytoplankton. They are source of food for zooplankton, fishes and other aquatic organisms. According to Harikrishnan *et al.,* (1999), the maintenance of a healthy aquatic ecosystem depends on the physico-chemical and the biological diversity of the ecosystem. Physico-chemical parameters affect plankton distribution, occurrence and species diversity (Raymond, 1983). Diversity of phytoplankton responds rapidly to changes in the aquatic environment particularly in relation to silica and other nutrients (Eggs and Aksnes, 1992; Chellappa et al., 2008). In India, diversity of phytoplankton in different freshwater water bodies alongwith their physico-chemical characteristics were studied by various scholars (Veereshakumar and Hosmani 2006, Ravikumar *et al*. 2006, Tiwari and Shukla 2007, Senthilkumar and Das 2008).

Oil and Natural Gas Corporation (ONGC) is one of leading Oil Company of India. It refines crude oil, natural gas etc. During the process, huge amount of water is used which is non consumptive and come out as wastewater. To treat this wastewater, ONGC has set up the waste water treatment system. The treated waste water was stored in cemented pond before discharging into Tapi River and used for fish culture. No additional fertilizer or supplementary feeding was added. The fish were cultured in treated wastewater with nutrients used while treatment process. The present work was an attempt to explore the phytoplankton diversity which is natural food and water quality of ONGC cemented pond.

2. MATERIALS AND METHODS

Plankton samples were collected by filtering pond water through plankton net with 60µ mesh size. The filtrate was immediately preserved in 4% formaldehyde for the identification of phytoplankton upto genera according to identification keys given by Edmondson (1959), APHA (2005) and Roy & Datta Munshi (2010).

Surface water samples were collected from the cemented pond during the November 2009- October 2011 and analyzed in the laboratory for important physico-chemical parameters such as temperature, pH, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), total hardness (TH),

total alkalinity, dissolved oxygen (DO), biological oxygen demand (BOD), Chemical Oxygen Demand (COD), chloride, phosphate, silicate, nitrate and ammonia following the standard methods of APHA (2005) and Trivedi and Goel (1986).

3. RESULTS AND DISCUSSION

Phytoplankton was represented by four classes of algae viz. Euglenophycae, Chlorophyceae, Bacillariophyceae and Cyanophycae. Percentage wise contribution of phytoplankton groups are shown in Fig 1. Chlorophyceae group presented maximum (52%) while minimum (4%) by Euglenophycae.

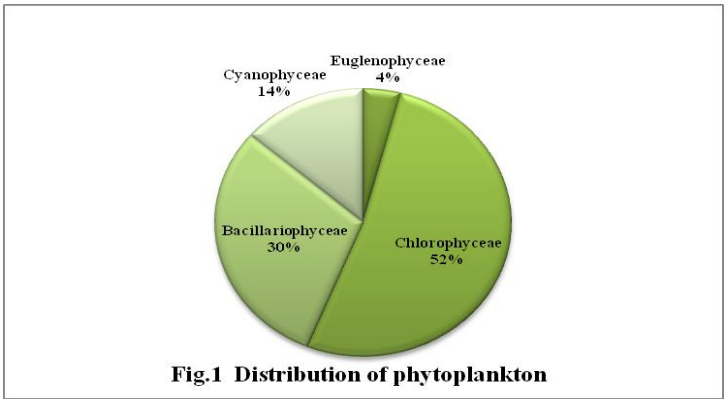


Fig.1 Distribution of phytoplankton

Diversity of phytoplankton during the study period has been given in Table 1 and Plate-I.

The physico-chemical parameters of cemented pond of ONGC have been depicted in Table 1. The water was found dark green in color. Temperature of water was 24.515 ± 0.920°C where as the pH of water was found almost neutral during the study period (6.828 ± 0.117). Total solids, total dissolved solids and total suspended solids were found 610.839 ± 67.742 mg/L, 312.355 ± 28.511 mg/L and 321.661 ± 55.372 mg/L respectively. Total hardness and Total alkalinity recorded were 109.875 ± 9.131 mg/L and 94.015 ± 9.282 mg/L from the pond. In cemented pond concentration of chloride was found 140.262 ± 13.668 mg/L. In present study DO, BOD and COD values were recorded 5.678 ± 0.218 mg/L, 46.279 ± 8.652 mg/L and 16.437 ± 2.188 mg/L respectively. Nutrients like phosphate, silicate and nitrate were found as 0.257 ± 56.786 mg/L, 0.218 ± 0.029 mg/L and 4.089 ± 0.926 mg/L respectively. Ammonia recorded from the cemented pond was 2.059 ± 0.286 µg/L.

Table1. *Physico-chemical analysis of ONGC Cemented pond*

S.N.	Parameter	Treated wastewater
1.	Color	Dark green
2.	Temperature (0C)	24.515 ± 0.920
3.	Total Solids (mg/l)	610.839 ± 67.742
4.	Total Dissolved Solids (mg/l)	312.355 ± 28.511
5.	Total Suspended Solids (mg/l)	321.661 ± 55.372
6.	pH	6.828 ± 0.117
7.	Dissolved Oxygen (mg/l)	5.678 ± 0.218
8.	Biochemical Oxygen Demand (mg/l)	46.279 ± 8.652
9.	Chemical Oxygen Demand (mg/l)	16.437 ± 2.188
10.	Total Hardness (mg/l)	109.875 ± 9.131
11.	Total Alkalinity (mg/l)	94.015 ± 9.282
12.	Chloride (mg/l)	140.262 ± 13.668
14.	Phosphate (mg/l)	0.257 ± 56.786
15.	Silicate (mg/l)	0.218 ± 0.029
16.	Nitrate (mg/l)	4.089 ± 0.926
17.	Ammonia (µg/l)	2.059 ± 0.286

Chlorophyceae was the most significant group of phytoplankton contributing 52 % (Fig. 1) from the total phytoplankton population. The group was mostly represented by *Ankistrodesmus* sp., *Arthrodesmus* sp., *Characium* sp., *Chariopsis* sp., *Chlorella* sp., *Chlorococcum* sp., *Coelastrum* sp., *Cosmarium* sp., *Crucigenia* sp., *Dictyosphaerium* sp., *Gleobtrys* sp., *Golenkinia* sp., *Hydrodictyon* sp., *Kirchneriella* sp., *Oocystis* sp., *Pediastrum* sp., *Scenedesmus* sp., *Sphaerocystis* sp., *Spirogyra* sp.,

Stigeoclonium sp., *Tetraedron* sp. and *Zygnema* sp. etc., as shown in Table 2. According to Philipose (1967), Chlorophyceae group dominate the water that is rich in nutrients such as nitrate and phosphate.

Table2. *List of identified plankton from ONGC Cemented pond*

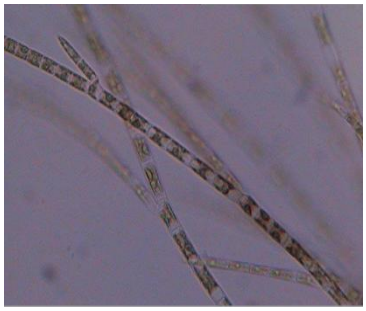
Phytoplankton	
Euglenophyceae	**Bacillariophyceae**
1. *Anisonema* sp.	1. *Achnanthes* sp.
2. *Entosiphon* sp.	2. *Amphipleura* sp.
3. *Lepocynclis* sp.	3. *Amphora sp.*
Chlorophyceae	4. *Anomoeoneis* sp.
1. *Ankistrodesmus* sp.	5. *Brebissonia* sp.
2. *Arthrodesmus* sp.	6. *Caloneis* sp.
3. *Botrydiopsis* sp.	7. *Cocconeis* sp.
4. *Chaetophora* sp.	8. *Cyclotella* sp.
5. *Characium* sp.	9. *Cymatopleura* sp.
6. *Chariopsis* sp.	10. *Diatoma* sp.
7. *Chlorella* sp.	11. *Fragillaria* sp.
8. *Chlorochytrium* sp.	12. *Frustulia* sp.
9. *Chlorococcum* sp.	13. *Gomphoneis* sp.
10. *Chlorosarcina* sp.	14. *Gomphonema* sp.
11. *Coelastrum* sp.	15. *Gyrosigma* sp.
12. *Cosmarium* sp.	16. *Navicula* sp.
13. *Crucigenia* sp.	17. *Nedium* sp.
14. *Desmidium* sp.	18. *Nitzschia* sp.
15. *Dictyosphaerium* sp.	19. *Pinnularia* sp.
16. *Geminella* sp.	20. *Stauroneis* sp.
17. *Gleobtrys* sp.	21. *Synadra* sp.
18. *Gloeocapsa* sp.	22. *Tabellaria* sp.
19. *Golenkinia* sp.	**Cyanophyceae**
20. *Hydrodictyon* sp.	1. *Merismopedia* sp.
21. *Kirchneriella* sp.	2. *Anabaena* sp.
22. *Microspora* sp.	3. *Anacystis* sp.
23. *Myrmecia* sp.	4. *Aphanizomenon* sp.
24. *Oocystis* sp.	5. *Chrococcus* sp.
25. *Palmella* sp.	6. *Fohannesbaptistia* sp.
26. *Palmellococcus* sp.	7. *Gomphosphaeria* sp.
27. *Pediastrum* sp.	8. *Lyngbya* sp.
28. *Phytoconis* sp.	9. *Oscillatoria* sp.
29. *Scenedesmus* sp.	10. *Spirulina* sp.
30. *Sphaerocystis* sp.	
31. *Spirogyra* sp.	
32. *Stigeoclonium* sp.	
33. *Tetraedron* sp.	
34. *Trachychloron* sp.	
35. *Tribonema* sp.	
36. *Ulothrix* sp.	
37. *Volvox* sp.	
38. *Zygnema* sp.	

Bacillariophyceae group contributed 30% of total phytoplankton recorded in the cemented pond (Fig. 1). Presence of phosphate, nitrate, silicate and total hardness promoted the growth of diatoms. Munawar (1970) suggested that regular supply of nitrate encouraged the growth of diatoms. In present work there was good supply of nitrate for the growth of diatoms.

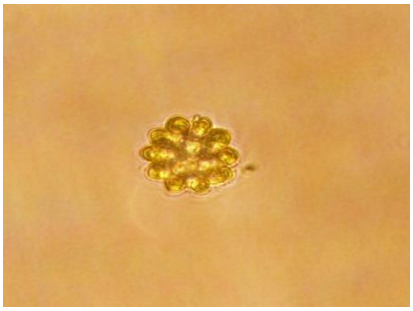
Cyanophyceae group was mostly represented by *Merismopedia* sp., *Anabaena* sp., *Anacystis* sp., *Chrococcus* sp., *Gomphosphaeria* sp., *Lyngbya* sp., *Oscillatoria* sp. and *Spirulina* sp. This group contributed 14 % of total phytoplankton (Fig. 1). The growth of plankton may be due to the high value of dissolved oxygen, TDS, phosphate, nitrate and BOD. Prescotte (1984) and Zafar (1964) reported that high value of nutrients favored the growth of Cyanophyceae.

Chlorophyceae

Pediastrum sp.

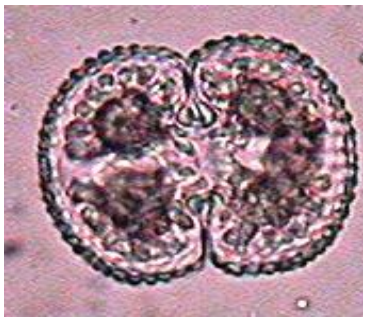


Stigeoclonium sp.



Coelastrum sp.

Crucigenia sp.



Cosmarium sp.

Scendesmus sp.

Bacillariophyceae

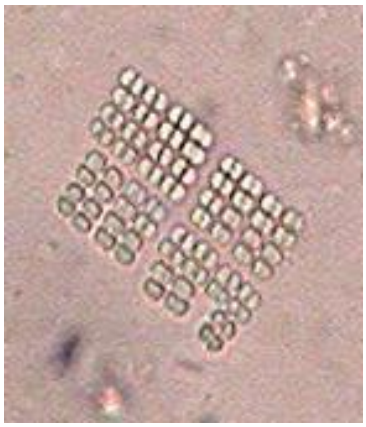
Gyrosigma sp.

Nitzschia sp.

Navicula sp.

Cyanophyceae

Oscillatoria sp.



Merismopedia sp.

Lyngbya sp.

PLATE-I

Only three species of Euglenophyceae viz., *Anisonema* sp., *Entosiphon* sp., *Lepocynclis* sp. were identified from the cemented pond. The high temperature, chloride, TDS, and BOD might have played an important role in growth and development of Euglenophyceae. Seeneyya (1971) reported that temperature above 25°C was good for the growth of Euglenophyceae.

4. CONCLUSION

The study revealed that the cemented pond of ONGC, Hazira had a diversified group of phytoplankton dominated by Chlorophyceae members followed by Bacillariophyceae, Cyanophyceae, and Eugleanophyceae. Results indicated that the level of oxygen, nitrate, phosphate and silicate were responsible for diverse group of phytoplankton in cemented pond.

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