Chapter VI

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All natural water bodies contain variety of dissolved gases. Oxygen is essential to carry out various metabolic activities of almost all organisms including higher life (plants and animals) on this planet. It directly affects the survival and distribution of flora and fauna in an ecosystem (Vijaykumar et al., 1999). Despite the fact that all of us are taking oxygen into our bodies and converting it into carbon dioxide (CO₂) in the process of respiration to extract energy from food, the amount of oxygen in atmosphere remains remarkably stable at about 20.95% of the air (Wetzel, 1983). Plants play a significant role to return this oxygen back into the atmosphere. Plants trap solar energy (sunlight) to produce organic molecules from carbon dioxide and water and oxygen is released as a by-product during the process of photosynthesis.

Oxygen gets into water by diffusion from the surrounding air, by aeration or agitation of water and it is also produced as a by-product of photosynthesis within the water body itself. Though diffusion of gases into the water is a very slow process, the amount of oxygen dissolved in water equilibrated with air, at a given temperature and pressure, is greater than nitrogen (Wetzel, 1983) because oxygen is more soluble in water than nitrogen. The solubility of oxygen in freshwater is not fixed but it depends upon the oxygen pressure in the air, water temperature and dissolved salts present (Weiss, 1970; Mortimer, 1981). Solubility of O₂ is always greater in freshwaters than in salt waters and greater in cold waters than in warm waters. The solubility of O₂ in freshwater ranges from 14.621 mg/L at 0 °C to 6.49 mg/L at 35 °C at the same atmospheric pressure (Mortimer, 1981; Wetzel, 1983). Dissolved oxygen (D.O.) of a water body is reduced by organismal respiration, decomposition of organic matter and automatic release from surface due to increase in summer temperature (Welch, 1952). As a general rule, the more oxygen dissolved in water is an indication of better health and a constantly high content allows a water body to support more numbers and variety of aquatic organisms. Survival under low D.O. content is a specialization of a limited number of species like certain air breathing fishes. Tarzwell (1957) has
suggested that a minimum of 3.0 mg/L D.O. is necessary for healthy fish life. George (1961) has mentioned that the concentration of 1.4 mg/L oxygen is sufficient to maintain life in water. Dissolved oxygen concentration of > 5.0 mg/L favors good growth of fauna and flora (Das et al., 1995).

Dissolved oxygen of any aquatic body forms an important parameter in the assessment of water quality, which influences the life of aquatic organisms as well. Yuyao et al. (1995) discussed the possibility of measurement of community metabolism in a model pond ecosystem by using diurnal change of oxygen. Dissolved oxygen of a water body is subjected to various physical, chemical and biological controls, and at any time oxygen concentration reflects a balance between various sources and sinks for this gas in the aquatic ecosystem (Walling and Web, 1996).


**METHODOLOGY**

Collection of water samples for the study of dissolved oxygen was done from the surface for a period of 16 months. Dissolved oxygen was analyzed by Winkler’s modified technique (APHA, 1992) at the site.

**RESULTS AND DISCUSSION**

Monthly variations in dissolved oxygen content of three ponds are given in (Table 1; Fig. 3). Dissolved oxygen varied from 2.2-8.4 mg/L in the samples collected
from the three ponds. Pond I showed minimum (4.0 mg) concentration in March, 2001 and maximum (8.4 mg/L) in January, 2001, while pond II showed minimum concentration (2.6 mg/L) in November, 2000 and maximum (7.2 mg/L) during January, 2001. In pond III, minimum concentration (2.2 mg/L) was recorded during February, 2001, and maximum (6.4 mg/L) during April, 2000. Wide variations (2.2-13.5 mg/L) in D.O. content have been reported from Indian freshwaters (Haque, 1991; Sinha et al., 1992; Bose and Gorai, 1993; Pathak and Shastree, 1993; Pati and Sabu, 1993; Dash et al., 1993; Patralekh, 1994; Kumar, 1995; Sinha, 2001).

The fluctuations in D.O. content may be attributed to the fact that the concentration and solubility of this gas in a water body is not affected by a single factor but by a number of factors such as solubility of oxygen in water, intensity of light, diffusion and absorption from the atmosphere, presence and abundance of green aquatic organisms, photosynthesis and loss due to chemical and biological oxidation (Wetzel, 1983). Higher values of D.O. might be attributed to intense photosynthetic activity of phytoplankton and other green aquatic plants present in these water bodies and also due to more oxygen holding capacity of water at low temperature during winter. Higher values of dissolved oxygen in colder months have been reported by several workers (Kaushik et al., 1989; Prasad, 1990; Kaushik and Saksena, 1999).

Contrary to this, in the present study, pond III showed higher concentration during summer (April-June, 2000 and May, 2001) and low during winter (February, 2000; January and February, 2001). The higher values of oxygen observed during summer in the present investigation substantiate the views of Ayyappan and Gupta (1981), Bhatt and Negi (1985) and Vijaykumar et al. (1999). They attributed it to increased solar radiation and a considerable good standing crop of phytoplankton. In the present study too, the maximum and minimum values of D.O. content were found to be due to increase and decrease in phytoplankton and other green aquatic plant population during respective months. Statistically D.O. content showed a positive and significant correlation with phytoplankton and zooplankton at all the ponds except pond III (Table 10; Figs. 16, 35). The positive and significant correlation between D.O. and phytoplankton was also observed by Schindler (1971), Lande (1973), Saad (1973), Haque (1991) and Gaur (1998) who gave similar reasons for this relationship. In pond
Ill, it was observed that macrophytes might be contributing greater part of oxygen during this period and, therefore, an insignificant relationship existed between the two variables (Table 10). Regarding relationship of D.O. with temperature, in the present study, an insignificant relationship was observed (Table 10). Absence of significant inverse correlation between these two parameters might be due to active photosynthesis. Jindal and Kumar (1993) also did not find inverse relationship between these two variables due to similar reasons. They reported the abundance of phytoplankton during the period of high temperature resulting in the liberation of D.O. during increased photosynthetic activity. These results also coincide with the findings of Gonzalves and Joshi (1946), Sreenivasan (1972), Jindal and Vashisht (1985) and Singhal et al. (1986). Higher values during monsoon months (ponds I and III) were found to be mainly due to agitation of water caused by falling rainwater over the surface of the water bodies.

Comparatively low D.O. during some months in pond III might be due to input of detergents by washermen’s activity. Non-biodegradable detergents cause foaming (Alphonse and Peterraj, 1987) and thus aeration is not possible and hence water body exhibits strong reducing property. Similar conclusion was also drawn by Alam et al. (1995). However abundance of phytoplankton and macrophytes sometimes causes decrease in D.O. content (Odum, 1957). Other factors causing depletion in D.O. content during different months include low photosynthetic rate (Yousuf and Shah, 1988), inflowing drainage water carrying varying amount of pollutants during different months (Trivedy, 1988), respiration of micro- and macro-organisms. (Kaushik and Saksena, 1999) and entry of surface run-off and subterranean water containing high organic content with little or no D.O. during rainy season (Welch, 1952).

Oxygen consuming activity especially during decomposition of organic matter in unmanaged ponds, like pond III, is therefore responsible for oxygen depletion during certain months. These results are in agreement with the observations made by Dasgupta (1993). Under such conditions, only air breathing fishes and other living organisms can survive such as amphibians, reptiles.

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