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Review Article

A Review on Research and Studies on Dissolved Oxygen and Its Affecting Parameters

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ABSTRACT

The organic matter content of wastewater is expressed as chemical oxygen demand and biological oxygen demand. The dissolved oxygen content of water is important for survival of aquatic life. The disposal of high organic waste into rivers, lakes and seashore affects the fishes, other aquatic animals and plants. The dissolved oxygen content of water is measure of the water quality. Various factors affecting dissolve oxygen of water includes temperature, the respiration rate of aquatic life, the contaminants in water and water flow. Various investigators have carried out research to study factors affecting dissolved oxygen and effect of dissolved oxygen variation on aquatic life. The present review summarizes research carried out on dissolved oxygen and its effect on aquatic life and also factors affecting dissolved oxygen content of water.

Key words: Organic matter, chemical oxygen demand, temperature, aquarium, ecosystem.

INTRODUCTION

The unsaturated organic matter consumes the dissolved oxygen from water. The disposal of waste water into reservoirs, lakes, and river and sea increases organic matter content of water measured as chemical oxygen demand (COD) as biological oxygen demand (BOD). The dissolved oxygen (DO) content is also one of the important water quality parameters. There is close relation between DO and COD of water. [1,2] Removal of organic matter from waste water is very widely investigated area of investigation. The removal of organic matter from wastewater can be carried out by various physical treatment methods followed by secondary, biological treatments. Biological treatments include activated sludge process and trickling filters. [3,4] Adsorption is one of the most efficient methods for removal of organic matter from effluent. [5-8] Other advanced treatment methods such as membrane separation are also found effective for wastewater treatment. [9,10] Dissolved oxygen depends on water quality. The high temperature implies low dissolved oxygen as solubility decreases with temperature. Also it indicates high COD for water. The mechanisms involved in DO variation in water are respiration, deoxygenation, photosynthesis and diffusion. Various investigators have carried out investigations to study various aspects of DO variation in various parts of sea and important rivers, lakes and reservoirs. The present review summarizes research and studies on DO; it's affecting parameters and effect of DO variation on aquatic life.

DISSOLVED OXYGEN: AN INSIGHT INTO RESEARCH AND STUDIES

Natarajan et al. carried out an investigation on the factors like dissolved oxygen, temperature and evaporation on marine aquarium. [11] These three factors

usually cause problem in aquarium. They observed that canister filter, lighting and pump operations caused 1.3 degree rise in the temperature. The aquarium lid caused 0.5 degree Celsius rise in temperature. They suggested that perforated lid can be used to minimize the rise in temperature. Also the evaporation causes increase in salinity of water. This effect can be minimized by adding reverse osmosis treated water. Jack et al. studied dissolved oxygen in coastal region. [12] They analyzed representative samples from the surface water and underground water. They studied various quality parameters like water temperature, dissolved oxygen, salinity and pH. According to them, presence of plastic and solid waste affects dissolved oxygen and hence the ecosystem. According to them the reduction in dissolved level may lead to cascade of adverse effects on ecosystem leading to harmful effects on coastal zone in marine system.

Haider et al. carried out review on models for dissolved oxygen and biochemical oxygen demand. [13] They also presented methods for the kinetics of carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD). According to their review most of the research is aimed at solution techniques. Adequate research for understanding the mechanism is not available. It is envisaged to know the mechanism properly before finding solution to the problem. Inadequate understanding often leads to uneconomical and inefficient solution. Gautam studied effect of pollution on the dissolved oxygen of water. [14] He carried out studies for Himalayin water. He observed that during May, the dissolved oxygen value varies from 1.8 mg/l to 6.3 mg/l. During June, the value was still low. As per Indian standards this water DO falls under class E. It indicates that the water is not suitable for bathing, washing and public supply. Haas et al. investigated effect of dissolved oxygen on physiology and fluorescence of hermatypic corals and benthic algae. [15] They observed that algae were tolerant to very low level of oxygen. There was certain threshold value below which loss of coral tissue and mortality was observed. According to this study coral tissue loss during hypoxia has significant impact on coral-algae interaction processes.

Sharma et al. developed mathematical model to relate absorbance with dissolved oxygen content. [16] They used Winkler method for measuring dissolved oxygen of the water sample. They used MATLAB tool for correlating dissolved oxygen with absorbance. They found the values from model were in close agreement with values obtained by Winkler method. Koehle carried out investigation of various parameters including dissolved oxygen on survival of the Topeka shiner, Notropis Topeka. [17] He studied parameters such as optimum temperature, critical lower oxygen level and critical thermal maximum. According to these studies temperature and dissolved oxygen were not much affecting the Topeka shiner population. Butler et al. carried out investigation on DO tolerance of native fish and a range of exotic species. [18] Lloyd has carried out investigation on effect of dissolved oxygen on poisons to rainbow trout. [19] According to this research there is possibility of close relation between toxicity and dissolved oxygen. Also it was observed that effect of reduction in oxygen concentration is more predominant in ammonia solution. According to him, velocity of respiratory flow affects the concentration of poison.

A study was carried out on river water of two rivers Ganga and Yamuna during Magh Mela by Kaur and Verma. [20] They observed that the parameters like pH, turbidity, DO, BOD, COD, and TDS were above permissible limits. They isolated various pathogenic microorganisms from the water. The dissolved oxygen values were obtained between 3.1 to 4.5 mg/l. BOD values varied from 11 to 13 mg/l. They concluded that the water at the SANGAM of three rivers was not fit for drinking, washing and irrigation. Hargreaves and Tucker carried out an

investigation on the measurement of dissolved oxygen in aquaculture. [21] The dissolved oxygen concentration changes very rapidly in the aquaculture. The reasons according to these investigators may be rapid consumption in respiration by aquatic flora and fauna, low diffusion rate of oxygen into water from atmosphere and low solubility of oxygen in water. Araoye carried out investigation on dissolved oxygen variation in Asa lake Ilorin in Nigeria. [22] They found that the dissolved oxygen varied between 7.60 to 8.20 mg/l. Lower values of DO were observed by them in October/November and higher values in March/April. The dissolved oxygen at bottom of lake was 2.5 mg/l and that at the top was 8.20 mg/l. They observed that the DO concentrations were uniform up to 5 m depth. According to Frieder et al., base line concentration of dissolved oxygen is important for predicting consequences of ocean deoxygenation and ocean acidification for marine ecosystems near shore. [23] They characterized DO and pH variability in the ecosystem over a year. They observed that DO and pH were strongly correlated up to 7 m depth, where they DO level was as high as 220 µmol kg^{-1}. They observed a high spatial variation between the 7 m to 17 m depth.

Kunlasak et al. investigated relationships of dissolved oxygen with chlorophyll and phytoplankton composition in aqueous system. [24] They found this relationship to be complex one as it was affected by season, nutrient inputs and elevation. Streams of the Western Corn Belt Plains Ecoregion were studied for DO fluctuations by Huggins and Anderson in report no. 130 of the Kansas biological survey via Central plains center for bio-assessment. [25] They quantified DO values and DO flux in small streams under normal or low flow conditions. Breitburg et al. investigated the effect of low DO on predation on estuarine fish larvae. [26] According to these studies the low DO has strong potential to alter the absolute and relative importance of a suite of estuarine predators of fish larvae. Hasler et al. carried out an investigation on the influence of dissolved oxygen on winter habitat selection by largemouth bass. [27] They coupled field biotelemetry and laboratory physiology in order to know the behavioral and physiological responses of fish to winter hypoxia. According to these studies DO values of 2.0 mg/l can act as threshold for behavioral responses by largemouth bass during the winter. According to the authors, there are multiple environmental factors influencing winter behavior.

Matthews and Berg carried out an investigation on Rainbow trout responses to water temperature and dissolved oxygen stress. [28] They carried out an investigation in two stream pools in southern California. Many biological, chemical, and physical variables affect the DO concentration in the pools. They found that seeps were the sources of the low DO. According to them seeps can serve as important refugia for trouts. Cornell et al. studied the DO and respiratory pattern in Old Woman Creek Estuary. [29] They carried out investigations at low and high water conditions. They found that the seasonal changes in DO, temperature at different water depths corresponds to different physic-biological phenomenon. During their four year study, they found that the gross primary productivity/respiration ratio was generally less than one.

CONCLUSION

Reduction in dissolved level may lead to cascade of adverse effects on ecosystem leading to harmful effects on in coastal zone in marine system. Presence of plastic and solid waste affects dissolved oxygen and hence the ecosystem. The dissolved oxygen concentration changes very rapidly in the aquaculture due to various factors such as low diffusion, low solubility, rapid utilization etc. Many biological, chemical, and physical variables affect the DO concentration in the pools. Base line concentration of dissolved oxygen is important for predicting consequences of

ocean deoxygenating and ocean acidification.

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