PERFORMANCE OF AN OXIDATION POND
-A CASE STUDY

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

Bachelor of Technology
in
Civil Engineering

By

ASHISH KUMAR NAYAK

ROLL NO-10501007

DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA

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Under the Guidance of

Prof. SOMESH JENA

DEPARTMENT OF CIVIL ENGINEERING

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National Institute of Technology
Rourkela

CERTIFICATE

This is to certify that the thesis entitled, "Performance of an Oxidation Pond-A case study" submitted by Sri Ashish Kumar Nayak in partial fulfillment of his requirements for the award of Bachelor of Technology, Degree in Civil Engineering at the National Institute of Technology, Rourkela is an authentic work carried out by him under my supervision and guidance.

To the best of my knowledge the matter embodied in the thesis has not been submitted to any other Institute/University for the award of any Degree or Diploma.

Date:

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CONTENTS

LISTS OF FIGURES

ABSTRACT

The treatment performance of the sewage treatment oxidation pond of a Rourkela Steel Plant was assessed in terms of pH, biochemical oxygen demand (BOD_5), turbidity and dissolved oxygen from the influent. These parameters were simultaneously monitored in the receiving stream, influent and effluents .Significant pollution of the receiving stream was indicated for BOD_5, dissolved oxygen and pH.

In this study, an attempt has been made to assess the levels of some water quality parameters-pH, BOD_5, Turbidity, Dissolved solids and total solids suspended solids in the sewage treatment oxidation pond of Rourkela steel plant.

CHAPTER 1

INTRODUCTION

INTRODUCTION

Sewage discharge is a major component of water pollution, contributing to oxygen demand and nutrient loading of the water bodies , promoting toxic algal blooms and leading to a destabilized aquatic ecosystem . This problem is compounded in areas where wastewater treatment systems are simple and not efficient.

The oxidation pond was built as an aerobic and anaerobic pond system in which the sewage treatment occurs naturally without added chemicals. This is anaerobic pond system in which the sewage treatment occurs naturally without added chemicals. This is unfortunate, since the problem of too high an inflow load results in a poor level of sewage purification and consequently results in the pollution of the receiving stream. It is a tributary to a major Brahmani river and some communities downstream use water from this stream for a variety of purposes like fishing, recreation and drinking without prior treatment and it is of great importance that the stream remains in a 'healthy' state. Some peasant farmers along the course of the receiving stream also use water from the stream to water their food crops especially vegetables during the dry season.

However, fears have been raised that, due to the continual discharge of effluent from the oxidation pond the receiving stream could be excessively polluted. Untreated domestic waste or raw sewage wastewater is usually gray brown, odiferous and relatively dilutes (99% water). Some of the important constituents of domestic and raw sewage wastewaters that are targeted for removal through treatment are total suspended solids (TSS), biochemical oxygen demand (BOD), nutrient-nitrogen (NO_3^+) and phosphorous (PO_4^+).

High or low pH values in a river have been reported to affect aquatic life and alter toxicity of other pollutants in one form or the other . Low pH values in a river for example impair recreational uses of water and affect aquatic life. A decrease in pH values could also decrease the solubility of certain essential elements such as selenium while at the same time low pH increases the solubility of many other elements such as Al, B, Cu, Cd, Hg, Mn and Fe . High pH values affect the toxicity of some pollutants e.g. at high pH values (pH>8.5) free ammonia (NH_3) is more toxic to aquatic biota than when it is in the oxidized form (NH_4^+) .

High nitrate concentrations are frequently encountered in treated wastewater, as a result of ammonium nitrogen (which is prevalent in raw waste) being totally or partially oxidized to nitrate by microbiological action . High nitrate levels in waste effluents could also contribute to eutrophication effects, particularly in freshwater Various workers have reported that the potential health risk from nitrate in drinking water above threshold of 45 mg LG may give rise to the condition known as methaemoglobinemia in infants and pregnant women . Nitrate in waste effluents can originate from domestic and agricultural wastes especially from nitrogen-containing fertilizers.

Furthermore, phosphates in sewage effluents arise from human wastes and domestic phosphate-based detergents. Unfortunately, phosphate anions are not desirable in receiving waters because they act as the most important growth-limiting factor in eutrophication and result in a variety of adverse ecological effects

EC of water is a useful and easy indicator of its salinity or total salt content. Wastewater effluents often contain high amounts of dissolved salts from domestic sewage. Salts such as sodium chloride and potassium sulphate pass through conventional water and wastewater treatment unaffected. High salt concentrations in waste effluents however, can increase the salinity of the receiving water, which may result in adverse ecological effects on aquatic biota.

The accumulation of metals in an aquatic environment has direct consequences to man and to the ecosystem. Metals like Zn, Pb and Cd are common pollutants which are widely distributed in aquatic environment. Their sources may be atmospheric deposition; domestic effluents; urban storm water runoff and soil heaps. Extensive literature on the aquatic toxicity of Zn and especially its toxicity to fishes has been reviewed. It is unusual in that it has low toxicity to man, but relatively high toxicity to fish

Cadmium has been found to be toxic to fish and other aquatic organisms. Toxicity effect of Cd in man includes kidney damage and pain bones. The mutagenic, carcinogenic and teratogenic effects of cadmium have also been reported. The major effect of the presence of Fe and Mn in domestic water is aesthetic because of the colour.

Lead is a potentially hazardous element to most forms of life and is considered toxic and relatively accessible to aquatic organisms. Lead is bioaccumulated by benthic bacteria, fresh water plants, invertebrates and fish. . The chronic effect of Pb on man includes neurological disorders, especially in the foetus and in children.

Biochemical oxygen demand (BOD) measures the amount of oxygen required by bacteria for breaking down to simpler substances the decomposable organic matter present in any water, wastewater or treated effluents. It is taken as a measure of the concentration of organic matter present in such water. The greater the decomposable matter present, the greater the oxygen demand and the greater the BOD value. It is an important parameter for river and industrial waste studies and control of waste treatment plants.

The pH of water body determines the chemical species of many metals and thereby alters the availability and toxicity in their aquatic environment .Metals such as Cd, Pb, Mn and Zn are most likely to have increased detrimental environmental effects as a result of a lowered pH.

In this study, an attempt was made to assess the levels of some water quality parameters-pH, BOD_5, Dissolved oxygen, Turbidity and total solids suspended solids in the sewage treatment oxidation pond of Rourkela steel plant.

CHAPTER 2

CLASSIFICATION

2.1 TYPES OF PONDS BY LOCATION:

Ponds can be classified based upon their location in the waste-water treatment process and on what type of waste they receive.

Whether wastewater is being treated in a pond or in another type of treatment facility, it follows the same general path. First, the water passes through a series of **pretreatment** processes including screening and shredding the sewage. Next, the wastewater receives **primary treatment** which allows some of the solid matter to settle out. From primary treatment, the wastewater moves to **secondary treatment** where biological processes convert the remaining organic matter into a form which is easier to remove from the wastewater. Treatment may stop after secondary treatment or may continue with **tertiary treatment,** which reduces the nutrient content of wastewater to prevent algae blooms in the body of water into which the effluent will be released.

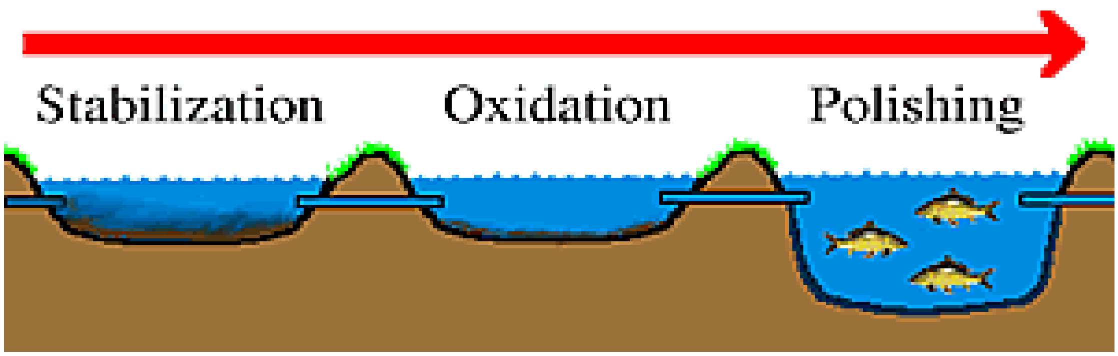

Fig 2.1: Ponds classified upon their location

The raw sewage stabilization pond, which we explored in depth in the last section, is a primary treatment pond. After water has been treated in a raw sewage stabilization pond or in some other type of primary treatment facility, the water can move on to an oxidation pond, which is a type of secondary treatment. Finally, a polishing pond is a type of tertiary treatment.

These three types of ponds can be used in a series, as shown in the picture above. Alternatively, they may be used in conjunction with primary, secondary, and tertiary treatment in a wastewater treatment plant. The wastewater may receive primary treatment in the treatment plant then receive secondary treatment in an oxidation pond. Or the wastewater may receive primary and secondary treatment in a treatment plant and tertiary treatment in a polishing pond.

➢ RAW SEWAGE STABILIZATION POND:

The **raw sewage stabilization pond** is the most common type of pond. It is a primary treatment facility which receives wastewater which has had no prior treatment (except screening or shredding).

Like any other primary treatment facility, the purpose of the raw sewage stabilization pond is to settle out most of the solids in the water. In addition, aerobic, facultative, and anaerobic decomposition of organic matter begins in this pond. Oxygen is provided by diffusion from the surface of the pond and from photosynthesis by the algae in the pond. All of these processes occur over the minimum 45 day detention time during which the water stays in the stabilization pond.

The stabilization pond consists of an influent structure, berms or walls surrounding the pond, and an effluent structure designed to permit selection of the best quality effluent. The normal operating depth of the pond is 3 to 5 feet.

The raw sewage stabilization pond is designed to receive no more than 50 pounds of BOD_5 per day per acre. The **biochemical oxygen demand,** or **BOD_5,** is the amount of organic matter which can be biologically oxidized in 5 days at 20°C in the dark. This is a way of measuring how much organic matter is in the water.

The quality of the water discharged from a stabilization pond will depend on the time of year. During the summer, the pond removes most of the BOD 5 but not very much of the suspended solids. In contrast, during winter months, the pond will have poor BOD_5 removal but excellent suspended solids removal. In either case, the water is usually transferred from the raw sewage stabilization pond to some type of secondary treatment facility.

➢ POLISHING POND:

These ponds, also known as finishing ponds, receive water flowing from the oxidation pond or from some other secondary treatment systems. Here, additional BOD_5, solids, fecal coliform, and some nutrients are removed from the water.

Polishing ponds have a much shorter detention time than stabilization ponds since they rely entirely on biological processes and no settling occurs here. Water remains in polishing ponds for only 1 to 3 days. A greater detention time may result in an increased concentration of suspended solids in the effluent.

In addition, polishing ponds are typically deeper than the other types of ponds, usually operating at a depth of 5 to 10 feet.

2.2 TYPES OF PONDS BY PROCESSES:

These are usually classified according to the biological activity that takes place in the ponds as:

➢ AEROBIC POND:

The aerobic ponds (also known as algae ponds) are designed to maintain completely aerobic conditions. In these ponds oxygen is supplied by natural surface aeration and **by** algal photosynthesis. The ponds are kept shallow with depth less than 0.5 m to 1.2 m.Shallower depths will encourage growth of rooted

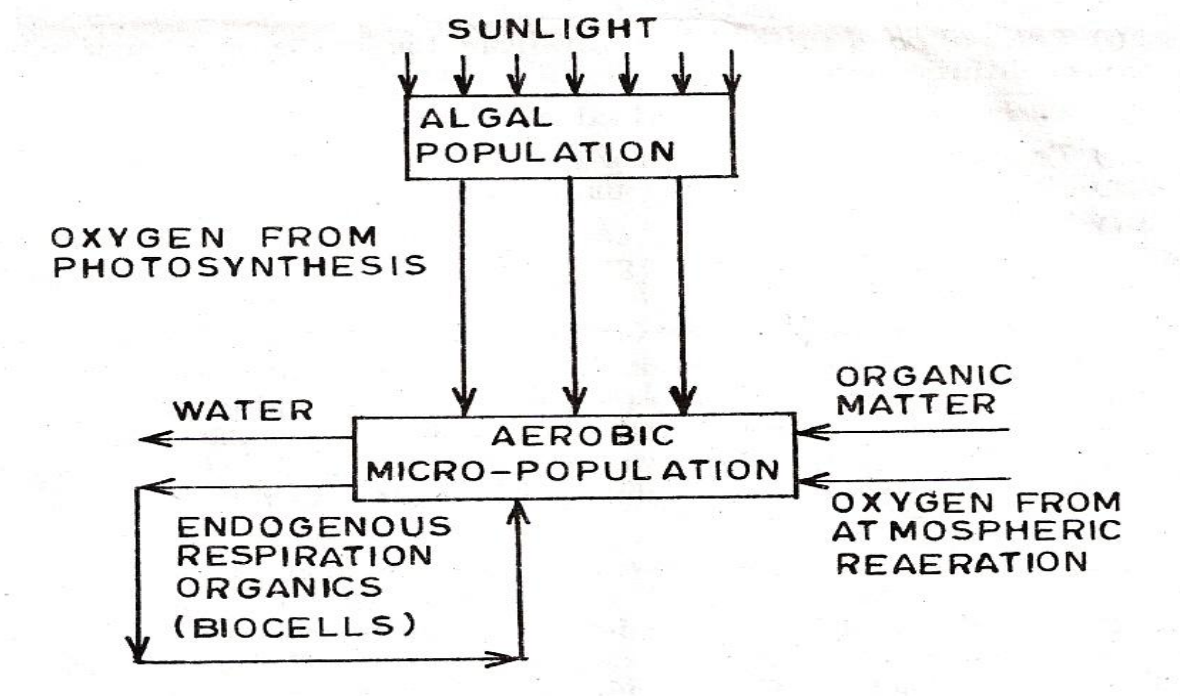

Fig 2.2: Algal-bacterial interaction in an aerobic pond

aquatic plants while greater depth may interface with mixing and oxygen transfer from the surface. Very shallow depth of aerobic pond (depth 0.15 to 0.45 m) is used for the treatment of irrigation return water or any other industrial sewage where the aim is the removal of nitrogen by algal growth. However, for the treatment of domestic sewage the depth is kept between 1 to 1.2 m. The length to width ratio of the pond depends on the geometry of the land but should not exceed 3:1. This tends to prevent short circuiting. The influent and effluent structures are so located that entire pond volume is utilized. The contents of the pond are stirred occasionally to prevent anaerobic conditions in the settled sludge. Except for the algal population, the microbiological population present in these ponds is similar to that in activated sludge system. The daily flow of sewage containing organic material matter by oxidizing it. During the process of oxidation, ammonia, carbon dioxide and other substances are liberated which are used by the algal population for their growth to produce more algal cells. The algal population in the presence of sunlight liberates free oxygen which is again used by the aerobic population to decompose the organic matter present in the sewage. The action taking place in these ponds is known as bacterial-algal symbiosis, and it is the symbiotic relation between bacteria and algae leads to the stabilization of the organic matter present in the sewage. The algal-bacterial interaction in an aerobic pond is shown in the Figure.

Oxygen transfer in an aerobic pond depends on the following factors.

(i) Ratio of pond surface area to volume. Larger the ratio better will be the oxygen diffusion into the pond.
(ii) Turbulence. Generally provided by the wave action.
(iii) Temperature of pond. Greater solubility of oxygen in water and hence greater diffusion rate at lower temperature.
(iv) Bacterial oxygen uptake rate. The faster the micro-population consumes the dissolved oxygen, the greater will be the rate at which oxygen is replenished.

The composition of biological cell mass is approximated by the formula $C_{120}H_{180}O_{45}N_{15}KP$. According to this empirical formula, the basic requirement of bacterial cell growth is nitrogen(N), potassium(K) and phosphorous(P), and hence sufficient quantities of these should be available in the sewage, and if not, they should be added to the sewage to assure biological oxidation. A good rule of thumb to follow is to maintain a BOD/N/K/P ratio in the pond influent of 100/5/1/1.

In addition to the nutrient levels required, temperature and pH also influence the successful operation of aerobic ponds. Since the depth of aerobic ponds is less and its surface area is quite large, liquid temperature approximates the ambient temperature. Hence the expected BOD removal efficiency, which is 80 to 95 per cent under normal conditions, decrease during winter months. Further if pH is a problem, neutralization and equalization may be necessary prior to aerobic ponding.

For aerobic ponds the organic loading may be taken as 150 to 200 kg BOD_5 per hectare per day during cold weather, which may be increased considerably during summer. Further the detention period should be about 7 days for proper development of algae.

➢ ANAEROBIC POND:

In anaerobic ponds the entire depth is in anaerobic condition except an extremely thin top layer. The anaerobic micro-organisms do not require the presence of dissolved oxygen in the water in order to function. Their requirement is met from the oxygen chemically contained in the organic materials. The anaerobic decomposition takes place in two separate but interrelated steps:

Step 1: Decomposition of dissolved organic waste, by acid-producing bacteria, to organic acids such as acetic, propionic and butyric acids, and

Step 2: Further decomposition of these acids to the end products viz., methane, carbon dioxide and water, by methane-producing bacteria. This is depicted in Fig.

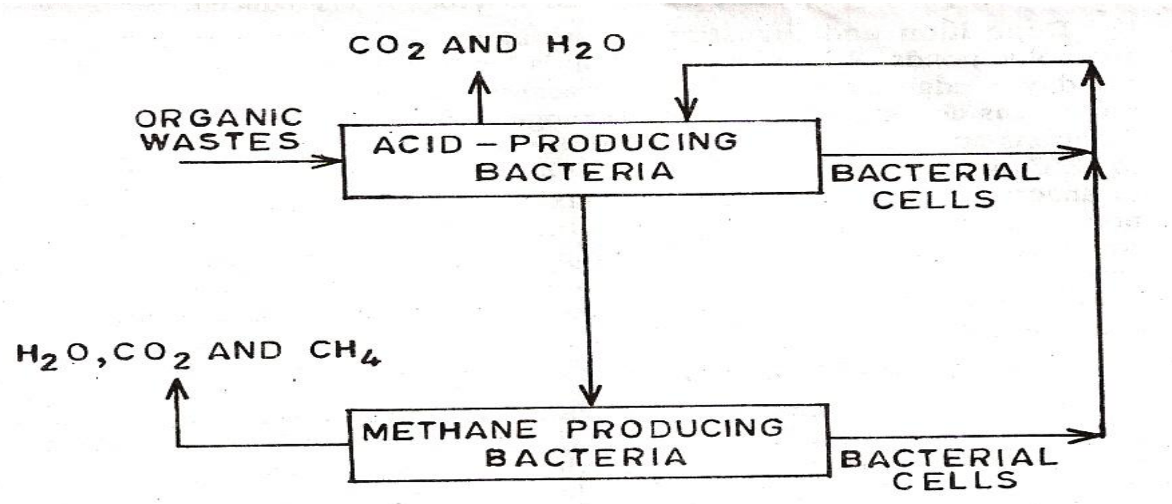

Fig 2.3: Anaerobic degradation process

Effective operation of anaerobic ponds requires a balance between step 1 and step 2, because the methane producing bacteria are sensitive to the concentration of volatile acids. A portion of the waste material is used by the anaerobic biosystem as source of energy and in the synthesis of new bacterial cells. Sludge or solids buildup is therefore much less in the anaerobic system. The contents of the anaerobic pond are black in colour which is an effective indication that the pond is functioning properly.

The anaerobic process is usually accompanied by obnoxious odours and the effluent is only partially purified. The obnoxious odours are as a result of the reduction of sulphate compounds to hydrogen sulphide (H_2S) gas by the acid producing bacteria. At high concentration H_2S attacks painted surface and is deleterious if inhaled for an extended period. The long term solution of this problem is to limit the concentration of sulphate in the influent.

Anaerobic ponds require much less surface area than the aerobic ponds. These ponds are constructed with a relatively greater depth, ranging from 2.5 to 5 m, to conserve heat and minimize land area requirement. The efficient length to width ratio for these ponds is 2:1. The levees of anaerobic ponds are similar to thos of aerobic/facultative ponds, both in geometry as well as in construction. For these ponds the organic loading in summer may be taken as 1000 to 3000 kg BOD_5 per hectare per day with BOD removal of 65 to 85 %, and in winter it may be taken as 400 to 1000 kg BOD_5 per hectare per day with BOD removal of 50 to 65%. The detention period for these ponds may range from 5 to 50 days. For anaerobic ponds, less surface area is required because the organic loading is about 10 times more than for aerobic ponds. Further the depth of the pond being more the surface area required is reduced.

Deposition and digestion of sewage solids is the main function of anaerobic ponds. With suspended solids loading of about 1000 kg per hectare per day, sludge may be allowed to accumulate for 10 years or more before removal is necessary. The ideal pH range is 6.6 to 7.6. The anaerobic process functions optimally over two temperature ranges: the mesophylic range of 29^0 to 38^0 C, and the thermophilic range of 49^0 to 57^0C. The greater depth provided in anaerobic ponds thus helps in maximizing heat retention. The anaerobic ponds are used mainly for pretreatment of strong industrial wastes and sometimes for the treatment of municipal sewage. These ponds may also be used in series with facultative ponds for complete treatment of sewage. The anaerobic ponds usually have an odour problem and these ponds are not commonly used in sewage treatment.

➢ FACULTATIVE POND:

In facultative ponds the stabilization of sewage is brought about by a combination of aerobic, anaerobic and facultative bacteria. The facultative ponds function aerobically at the surface while anaerobic conditions prevail at the bottom. Hence these ponds combine the features of both aerobic and anaerobic ponds. The depths of facultative ponds range from 1 to 1.5m. As shown in the Fig. three zones exist in a facultative pond: (1) an aerobic zone at the top where aerobic bacteria and algae exist in a symbiotic relationship,(2) an aerobic zone at the bottom in which accumulated solids are actively decomposed by anaerobic bacteria; and (3) a facultative zone in between the aerobic and anaerobic zones, that is partly aerobic and partly anaerobic, in which decomposition of organic matter is carried out by facultative bacteria. The action in the aerobic zone is similar to the one found in the aerobic ponds giving rise to bacterial-algal-symbiosis. Further the top aerobic layer acts as a good check against odour evolution from the pond. The pond depth inhibits mixing; hence organic solids which settle remain on the bottom and are subjected to anaerobic decomposition. The treatment effected by this type of ponds is comparable to that of conventional secondary treatment processes such as trickling filters, activated sludge process , etc., both in regard to BOD and bacterial removal. Hence facultative ponds are best suited and most commonly used for treatment of sewage.

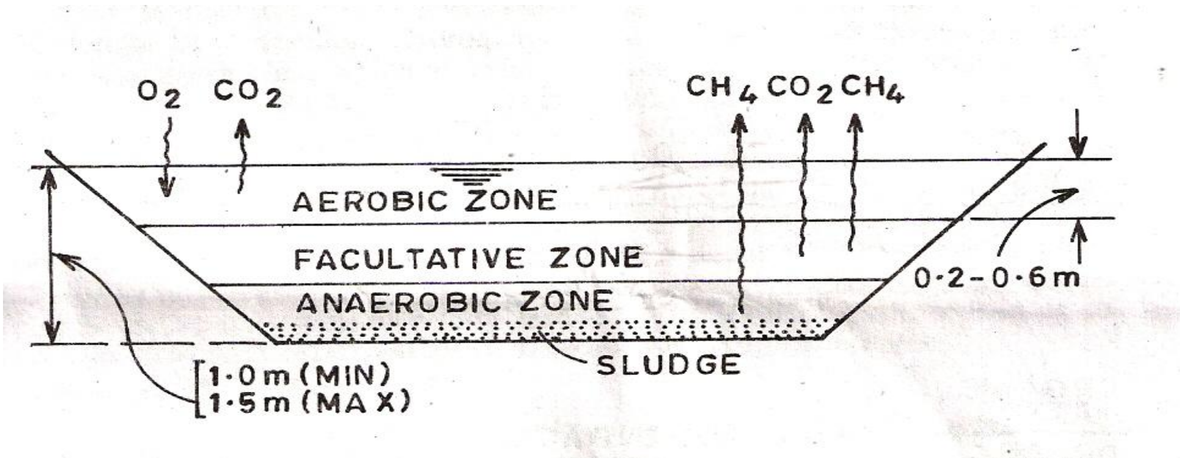

Fig 2.4: Zones of operation in a facultative pond

➢ MECHANISM:

In a facultative pond the influent organic matter is stabilized by methane fermentation in the bottom layers and partly by the bacterial oxidation in the top layers. In the liquid above the bottom sludge layer there is a zone known as facultative zone in which facultative bacteria oxidize the incoming organics as well as the products of anaerobic decomposition of the bottom anaerobic zone. When the sewage enters the pond, the suspended organic matter in the influent as well as the bioflocculated colloidal organic matter settles to the bottom of the pond. In the absence of dissolved oxygen at the bottom of the pond, the settled sludge undergoes anaerobic fermentation with the liberation of methane (CH_4) which represents a BOD removal from the system. For each kg of ultimate BOD stabilized or removed in this manner, 0.25 kg or 0.35 m^3 of methane is formed which escapes the pond in the form of bubbles. Another reaction which sometimes occurs in the anaerobic layers is conversion of hydrogen sulphide to sulphur by photosynthetic bacteria. If present in sufficient numbers they give a distinct pink hue to the pond appearance. In the liquid layers of the pond, algae begins to grow under favourable conditions. The algae utilize the carbon dioxide in the sewage for photosynthesis during day light hours, liberating oxygen which maintains aerobic conditions promote the oxidation of organic waste matter by aerobic bacteria. Thus it is seen that there is interdependence between algae and bacteria with the algae supplying oxygen required by the bacteria and bacteria making available the carbon dioxide required by the algae. This type of association between organisms is referred to as symbiosis, a relationship where two or more species live together for mutual benefits such that the association stimulates more vigorous growth of each species than if the growths were separate. Fig. shows the symbiotic relationship and functioning of a facultative pond. During the periods when the dissolved oxygen is less than saturation level, the surface water level is aerated through wind action. However, during the wind action both bacterial metabolism and algal synthesis are slowed by cold temperatures.

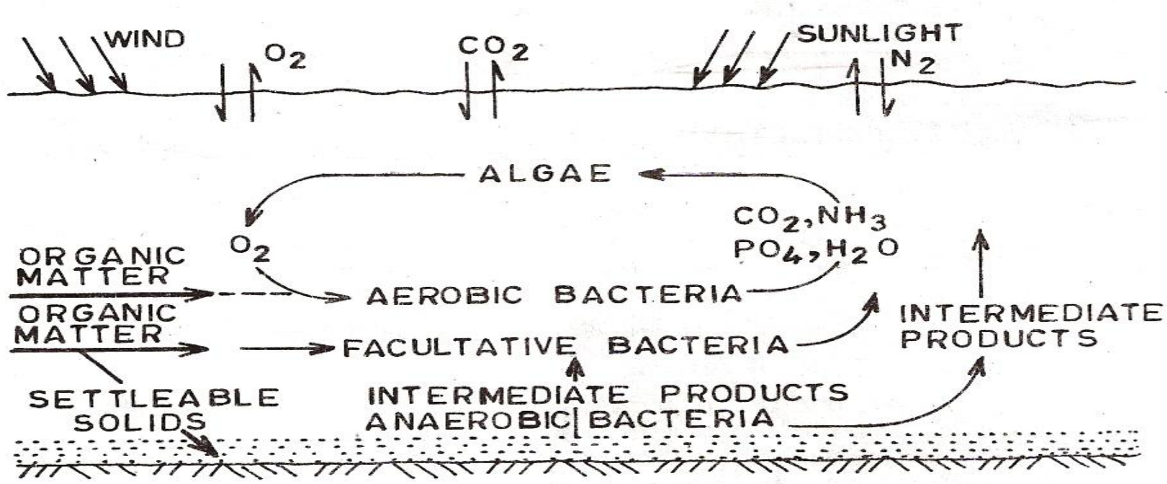

Fig 2.5: Symbiotic relationship and functioning of a facultative stabilization pond

Both the dissolved oxygen and pH of the pond are subjected to diurnal variation due to photosynthetic activity of algae which is related to incident solar radiation. A high dissolved oxygen concentration upto about 4 times the saturation value may be observed in the afternoon hours. Simultaneously, the pH value may reach a maximum of 9.0 or more due to the conversion of CO_2 to O_2. Towards the evening or in the night, when photosynthetic activity decreases or stops, there is a gradual decrease in both dissolved oxygen and pH .

In a facultative pond, the nuisance associated with anaerobic reaction is eliminating due to the presence of oxygen in the top layers. The foul smelling end products of anaerobic degradation which permeate to the top layers are oxidized in an aerobic environment. Furthermore, due to a high pH in top layers, compounds such as organic acids and H_2S which would otherwise volatise from the surface of the pond and cause odour problems are ionized and held back in solution.

In stabilization ponds the significant algae are green algae which include Chlorella, Scenedesumus, and Hydrodictyon, Chlamydomonas and Ankistrodesmus and blue - green algae which include Oscillatoria, Spirulina, Merismopedia and Anacystis. Chlorella, Scenedesumus and Hydrodictyon possess relatively high oxygen donation capacity per unit weight. Concentration of algae in a stabilization pond is usually in the range of 100 to 200 mg/l which gives the pond effluent a typical green colour. Floating blue-green algae mats may develop in ponds during summer months. They are undesirable since they restrict penetration of sunlight leading to reduction in depth of aerobic layer. They also encourage insect breeding.

CHAPTER 3

CONSTRUCTION DETAILS

It consists of a shallow pit dug below the ground, and surrounded on all four sides by high embankments or Levees. It is constructed in impervious soil such as clay.

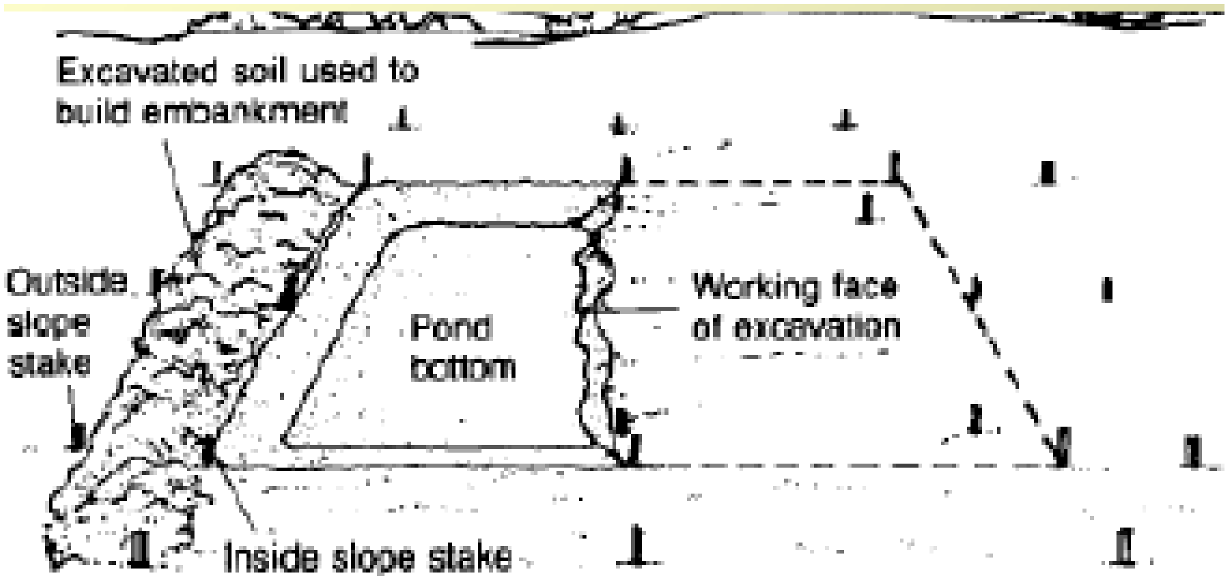

Fig 3.1(A): Construction details of an Oxidation Pond

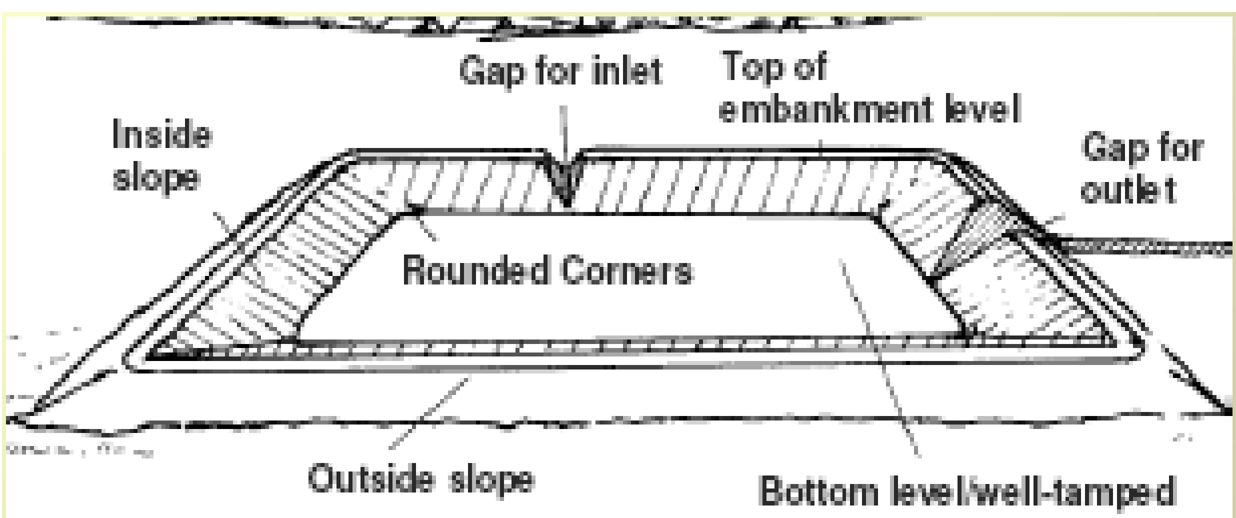

Fig 3.1(B): Construction details of an Oxidation Pond

However, if constructed in more permeable soil, it should be properly lined with impervious soil (clay) or with synthetic material. Embankments/Levees are constructed with 2:1 slope inside and 3:1 slope outside, with a top width of 2.5 to 3 m to form a roadway to provide accessibility. The side slopes are riprapped to prevent erosion from water and wind .A minimum free board of 0.6 m is provided.

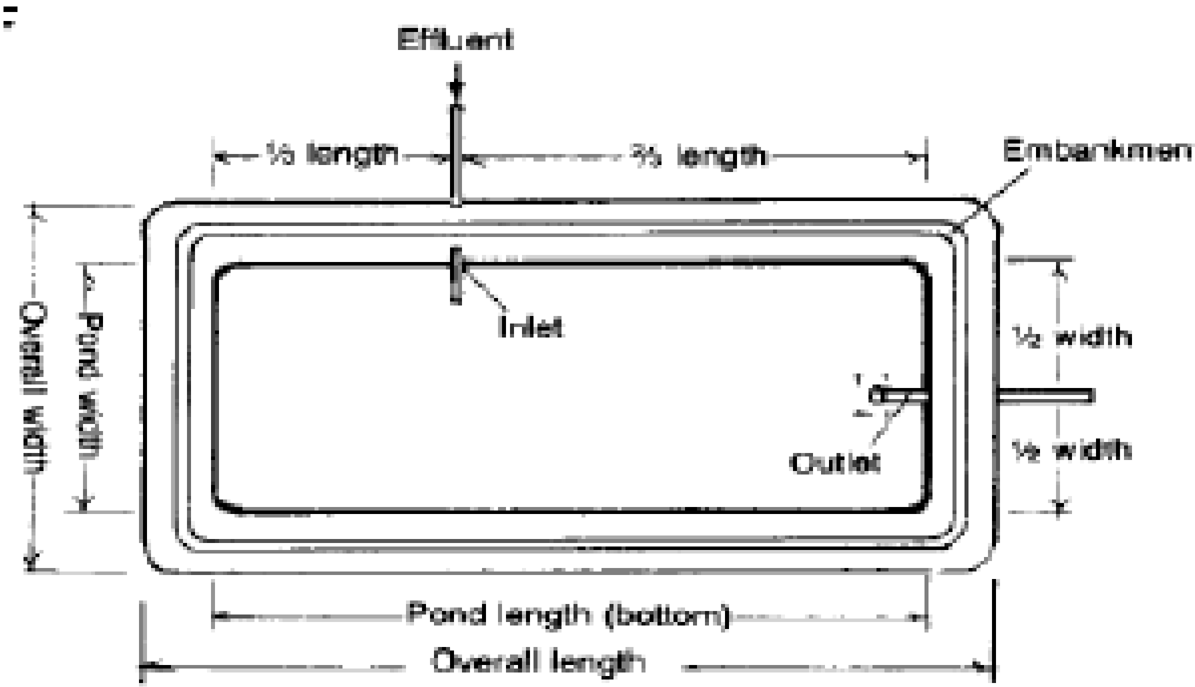

Fig 3.2(A): Inlet and Outlet of an Oxidation pond

Influent lines discharge near the centre of the pond and the effluent usually overflows in a corner on the windward side to minimize short circuiting. The overflow is generally a manhole or box structure with multiple valved draw off lines to offer flexible operation. In the absence of such a structure a simple but effective means of obtaining draw off is to install a sideways tee type discharge pipe.

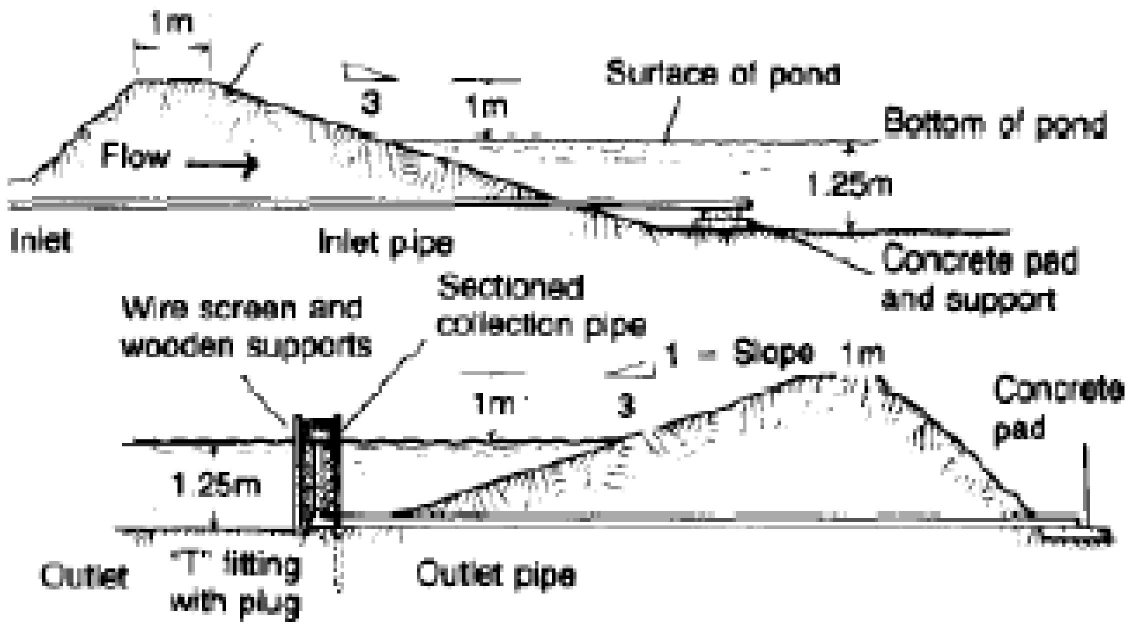

Fig 3.2(B): Inlet and Outlet of an Oxidation pond

CHAPTER 4

ADVANTAGES

AND

DISADVANTAGES

- **ADVANTAGES:**

The advantages of stabilization ponds are as indicated below:

- Lower initial cost, being only 10 to 30% of that of the conventional plant using activated sludge process or trickling filters.
- Lower operating and maintenance costs and no skilled supervision required at any stage of construction or operation.
- Quite flexible in operation. Treatment system is not significantly influenced by a leaky sewage system bringing storm water along with sewage, and do not get upset due to fluctuations in organic loading.
- Regulation of effluent discharge possible thus providing control of pollution during critical times of the year.

- **DISADVANTAGES:**

The disadvantages of stabilization ponds are as indicated below:

- Requires extensive land area. Hence the method can be adopted in those areas where land costs are less.
- Assimilative capacity of certain industrial wastes is poor.
- There is nuisance due to mosquito breeding and bad odours. To avoid mosquito breeding the banks of the ponds should be kept clear of any grasses, bushes, etc. Similarly to avoid bad odours the ponds should be located sufficiently far from residential areas. Odours may also be kept under control by avoiding over-loading. However, when a pond gets over- loaded, the algae growth may be stimulated by adding sodium nitrate which is both a plant food and an oxidizing agent.
- If used in urban area, expansion of town and new developments may encroach upon the pond site.
- Effluent quality standards of 30 mg/l for suspended solids are not met.

Besides these, Ponds have many advantages and disadvantages compared to treatment in plants. Both have to deal with aeration of the water being treated, but in ponds, oxygen is transferred directly into the water across the surface area without the need for any equipment. A plant, in contrast, must install an aerator to add oxygen to the water.

The natural method of aeration used by a sewage pond takes much longer than an aerator does to add oxygen to the water. As a result, ponds treat sewage much more slowly than package plants do. The minimum detention time of a pond is 45 *days.* In contrast, a package plant has a two to four *hour* detention time. And, since ponds must hold the wastewater much longer than package plants do, the ponds must also have a much larger area to retain the sewage.

If the time and area are available, sewage ponds are very economical facilities to maintain. Package plants require frequent monitoring for various parameters such as ammonia and B.O.D. In contrast, ponds require only one visit per day to monitor pH and D.O.

CHAPTER 5

SITE DESCRIPTION

AND

SAMPLE COLLECTION

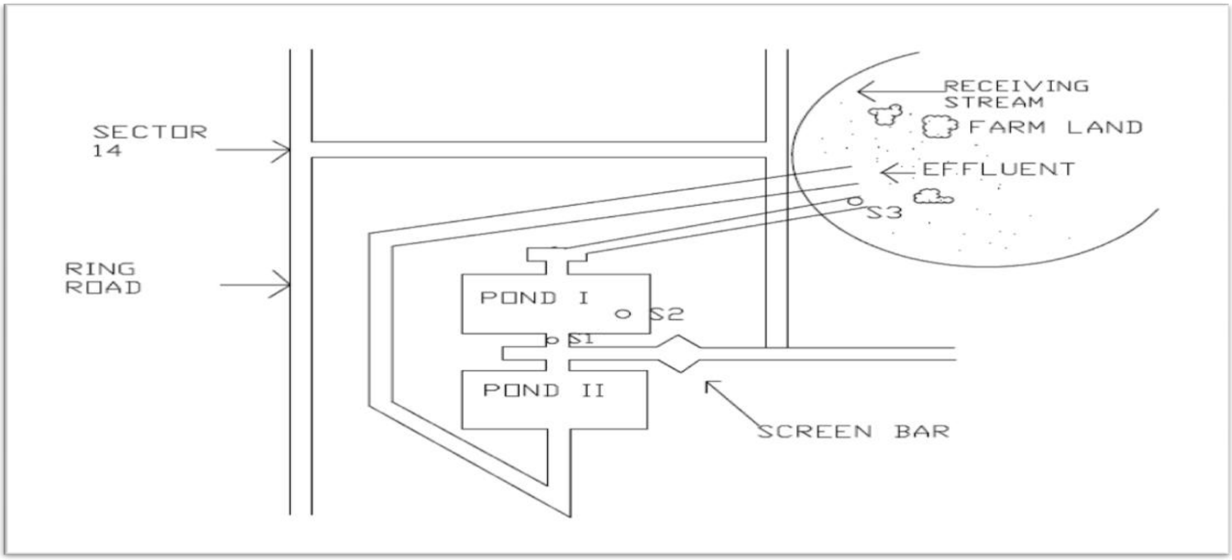

Fig 5.1: A sketch diagram of the study area

The Rourkela steel Plant has two oxidation Pond A & B lying side by side in which the whole domestic sewage of different sectors and industrial wastes of RSP are collected which is situated in sector-14 near Lakhsmi Market. Each of the ponds is 120x30x1.5m. A 10m wide dyke separates them. Only one pond receives influents at a time and wastewater and sludges are retained in the pond for about two weeks during which algae, bacteria and other organisms act on them. Wastes are conveyed to the ponds through sewers made of concrete pipes and there are manholes at some points along the channels to change the direction of the sewers.

Each of the ponds has a discharge channel through which effluents are discharged into a nearby receiving stream. This stream feeds Brahmani River directly.

➢ MATERIALS AND METHOD:

The influent (1^{st}) samples were collected at the inlet of the sewage treat oxidation pond, another (2^{nd}) samples were collected on the oxidation pond and 3^{rd} samples were collected at effluent discharge point from the oxidation pond before entry into the receiving stream. The qualities of influents and effluents were measured at these three points to determine the efficiency of the oxidation pond in removing those aforementioned parameters, from the influents.

Water samples were collected in plastic containers previously cleaned by washing in non-ionic detergent, rinsed with tap water and later soaked in 10% HNO_3 for 72 hr and finally rinsed with deionised water prior to usage.

During sampling, sample bottles were rinsed with sampled water several times and then filled to the brim. The samples were transported to the laboratory immediately and stored in the refrigerator at about 4^0C prior to analysis. The respective analyses were carried out immediately after sample collection.

CHAPTER 6

METHODOLOGY

AND

INSTRUMENTS

➢ DETERMINATION OF pH:

The pH was measured immediately after sample collection using a digital pH meter. Calibration of the electrode with 2 Buffer solutions of pH 4 and 7 was done prior to its use for pH measurement of the samples.

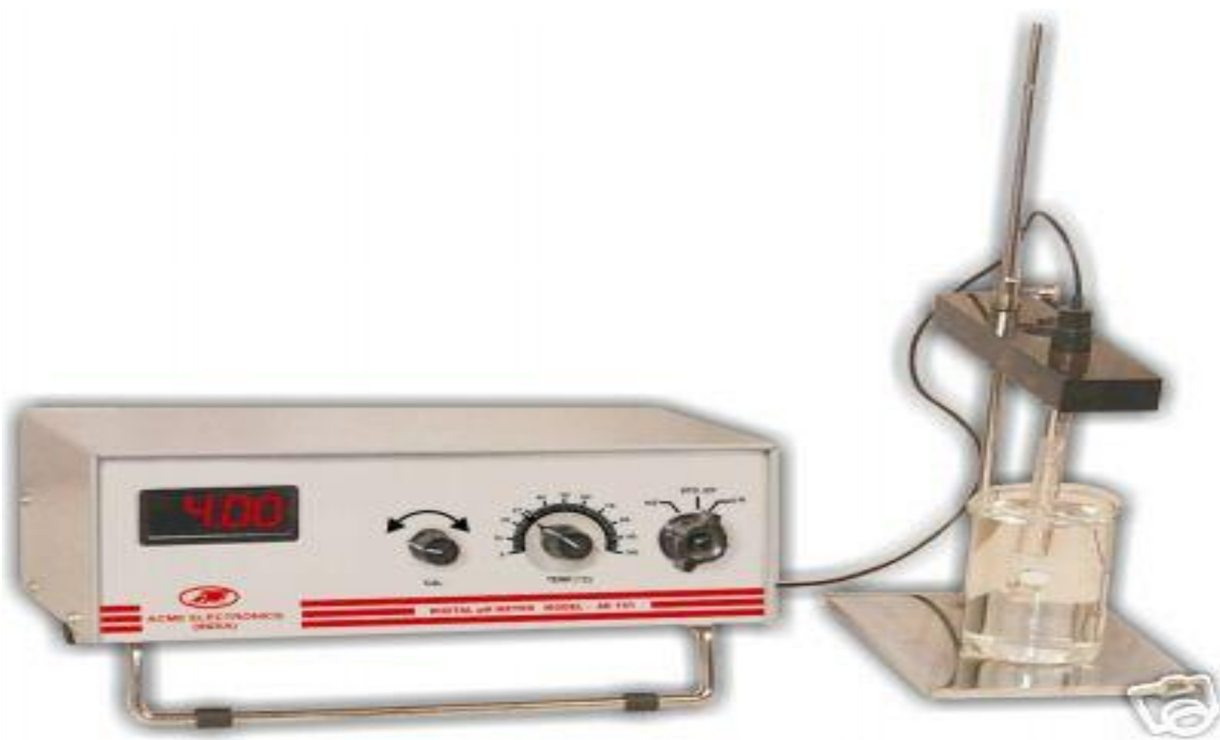

Fig6.1: Digital pH meter

➢ DETERMINATION OF BOD:

The BOD determination of the sample in mgL^{-1} was carried out using the standard methods. The dissolved oxygen content was determined before and after incubation. Sample incubation was for 5 days at 20^0C in BOD bottles and BOD_5 was calculated after the incubation period.

Fig 6.2: BOD bottles

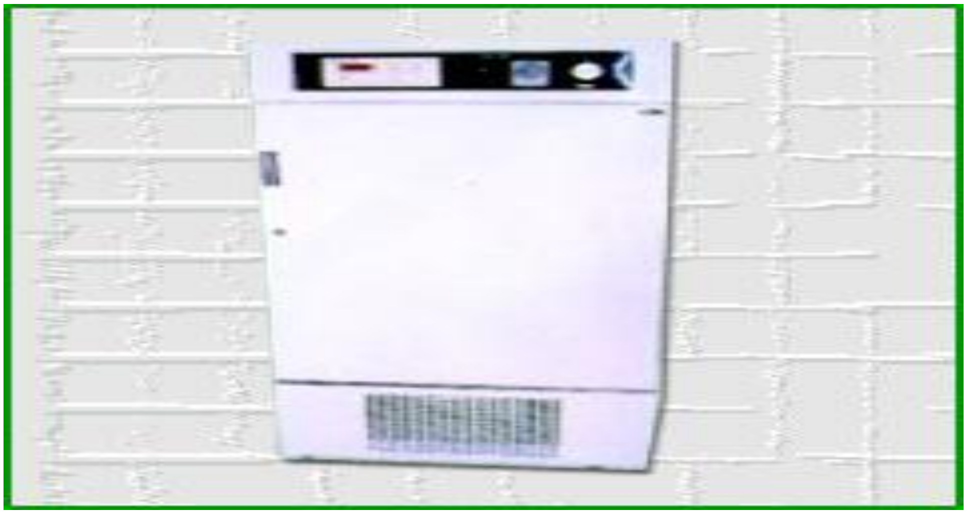

Fig 6.3: BOD incubator

➢ DETERMINATION OF DISSOLVED OXYGEN:

The dissolved oxygen content was determined before and after incubation. Sample incubation was for 5 days at 20^0C in BOD bottles and BOD_5 was calculated after the incubation period.

Fig 6.4: Device to measure dissolved oxygen

➢ DETERMINATION OF TURBIDITY:

The turbidity determination of the sample in mgL^{-1} was carried out using the Nephelometer (Turbidity meter).

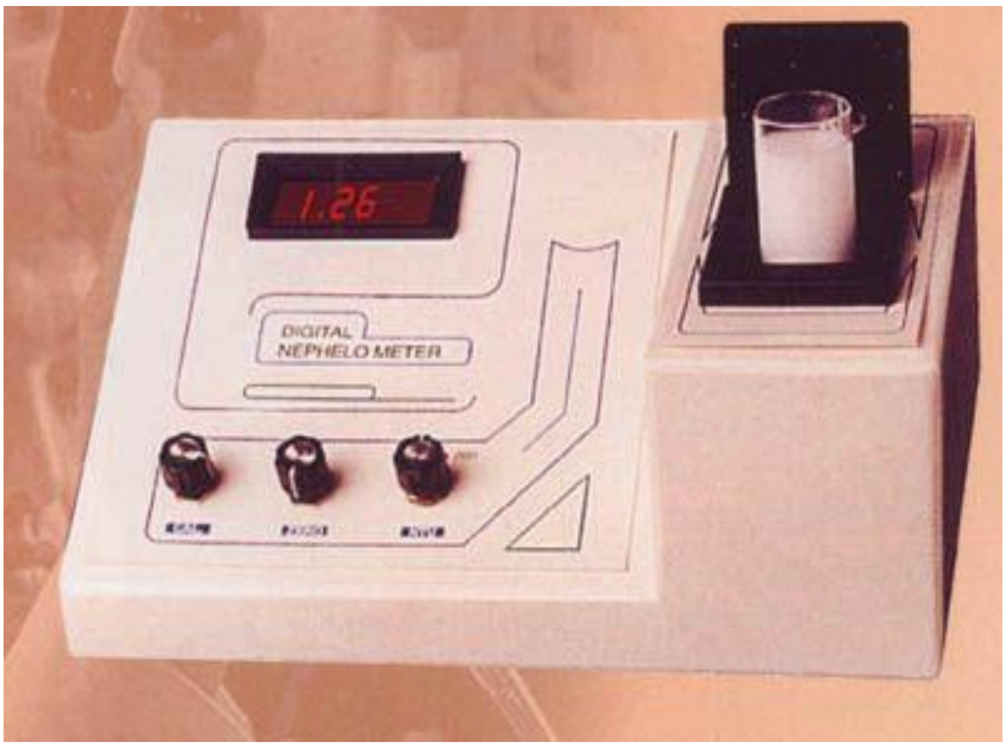

Fig 6.5: Nephelometer (Turbidity meter)

CHAPTER 7

RESULTS

AND

DISCUSSION

➢ DISSOLVED OXYGEN CALCULATION :

Samples	Nov. ,2008	Jan.,2009	Feb.,2009	Mar.,2009
Sample 1 (at the inlet)	3.26mgL^{-1}	3.46 mgL^{-1}	3.16 mgL^{-1}	2.2 mgL^{-1}
Sample 2 (on the pond)	3.68 mgL^{-1}	3.76 mgL^{-1}	3.28 mgL^{-1}	2.21 mgL^{-1}
Sample 3(at the effluent)	4.88 mgL^{-1}	4.93mgL^{-1}	4.16mgL^{-1}	2.85mgL^{-1}

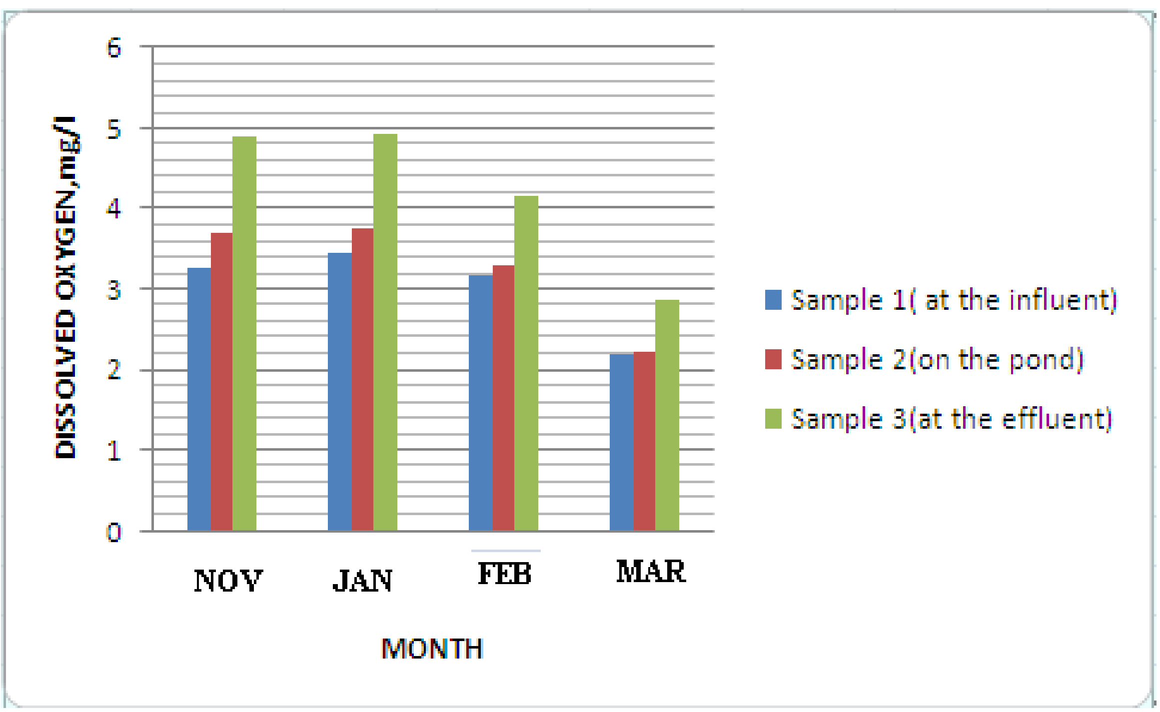

Fig 7.1: DO Analysis

➢ pH CALCULATION :

Samples	Nov. ,2008	Jan.,2009	Feb.,2009	Mar.,2009
Sample 1 (at the inlet)	7.39	7.41	7.53	7.74
Sample 2 (on the pond)	7.22	7.48	7.74	7.83
Sample 3(at the effluent)	7.38	7.75	7.92	8.1

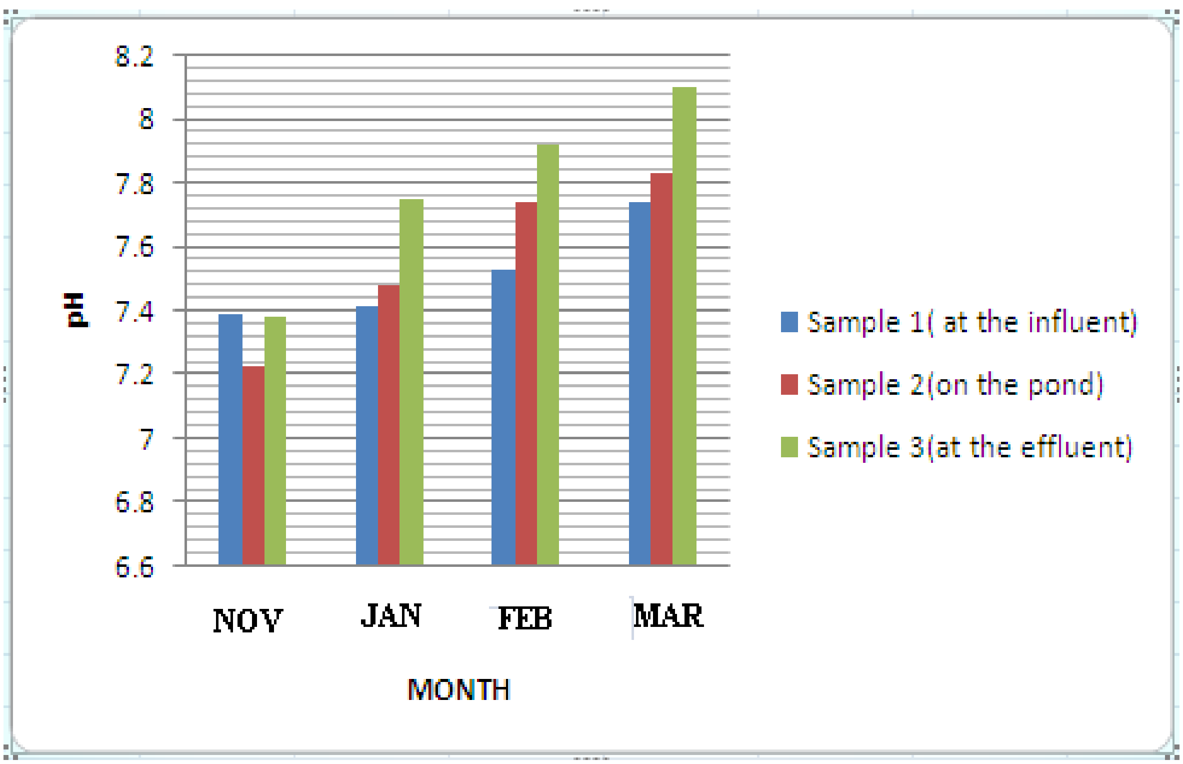

Fig 7.2: pH Analysis

➢ TURBIDITY CALCULATION:

Samples	Nov. ,2008	Jan.,2009	Feb.,2009	Mar.,2009
Sample 1 (at the inlet)	4.2 NTU	3.5 NTU	3.8 NTU	4.7 NTU
Sample 2 (on the pond)	2.94 NTU	2.87 NTU	2.99 NTU	3.41 NTU
Sample 3(at the effluent)	1.21 NTU	1.20 NTU	1.85 NTU	2.60 NTU

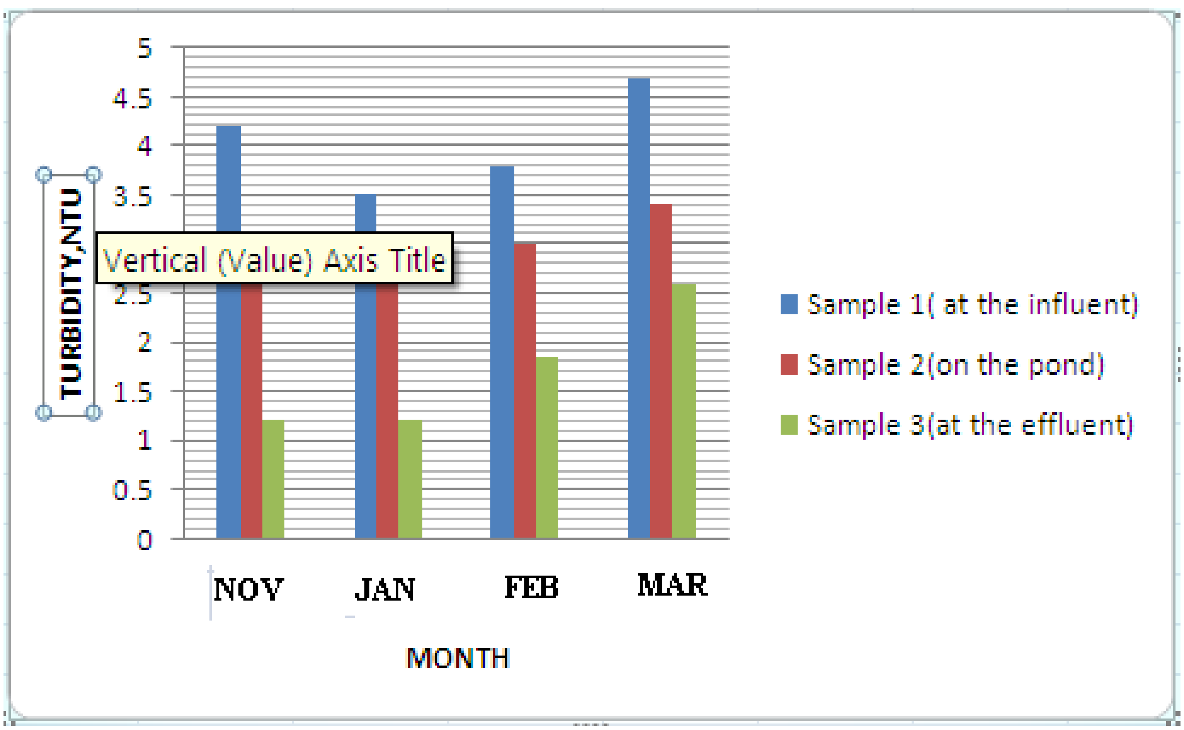

Fig 7.3: Turbidity Analysis

➢ BOD_5 CALCULATION:

Samples	Nov. ,2008	Jan.,2009	Feb.,2009	Mar.,2009
Sample 1 (at the inlet)	57.3 mg/l	81.2 mg/l	67.6 mg/l	63.5mg/l
Sample 2 (on the pond)	49.8 mg/l	67.4 mg/l	58.4mg/l	55.9mg/l
Sample 3(at the effluent)	29.1 mg/l	43.5 mg/l	39.5mg/l	35.7mg/l

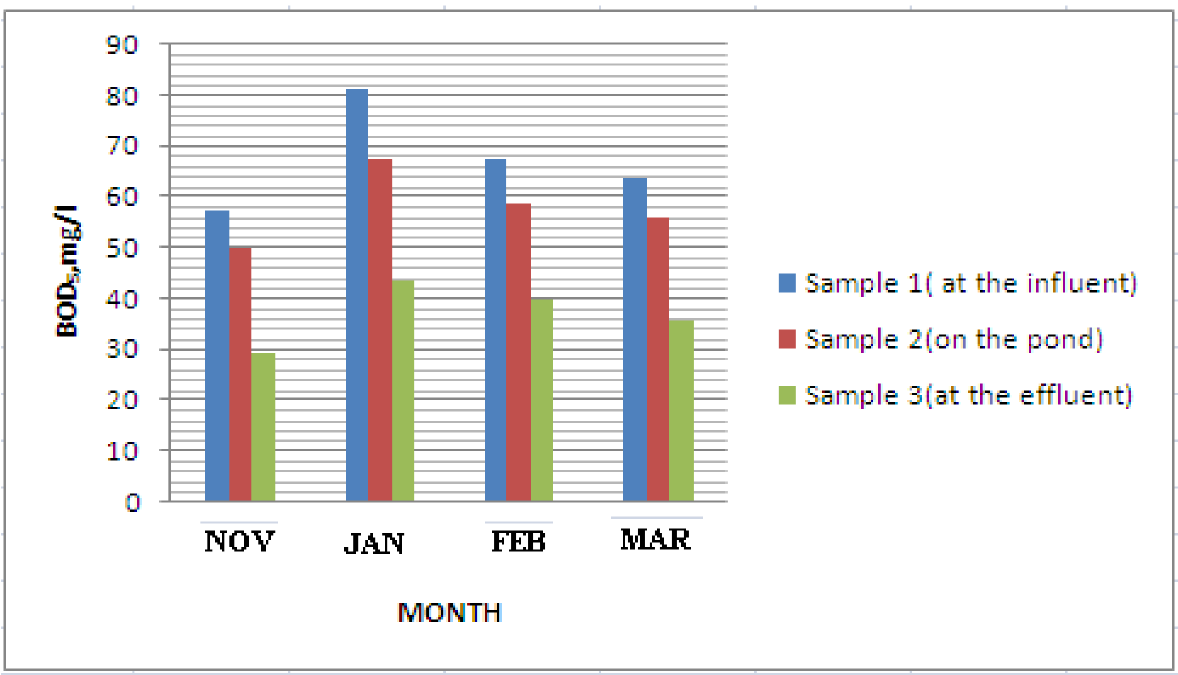

Fig 7.4: BOD_5 Analysis

➢ Determination of Total suspended solids :

Samples	Nov. ,2008	Jan.,2009	Feb.,2009	Mar.,2009
Sample 1 (at the inlet)	653.4 mg/l	478.5 mg/l	525.2 mg/l	548.4 mg/l
Sample 2 (on the pond)	457.3 mg/l	343.8 mg/l	398.4mg/l	423.5mg/l
Sample 3(at the effluent)	329.7 mg/l	213.1 mg/l	224.5mg/l	256.7 mg/l

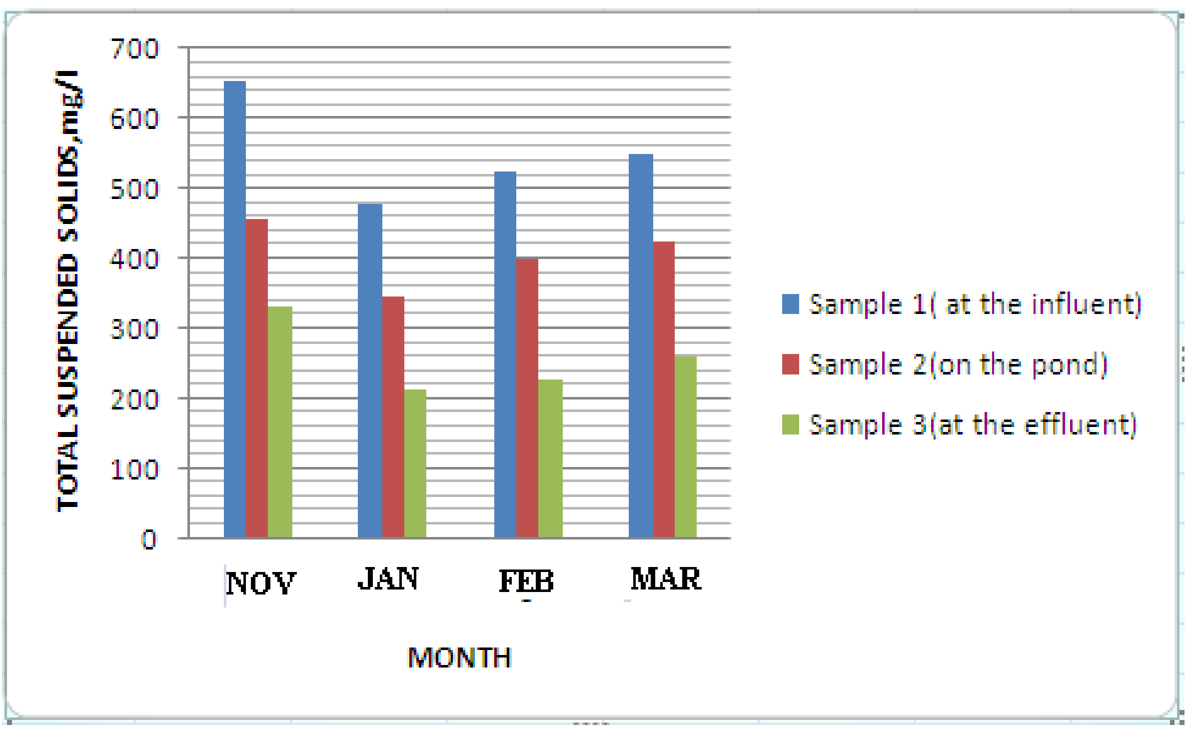

Fig 7.5: Total Suspended Solid Analysis

➢ DISCUSSIONS:

Total suspended solids are also a very important parameter to know the water quality of the pond. The more the suspended matter in water the more the light is screened out. During the present study, TSS showed certain seasonal variations. Its minimum values were recorded during winter months especially in January. However its maxima were recorded during monsoon season in both the ponds which might be due to rainfall and influx of dissolved contents. Its maximum value was observed in pond which might be due to pouring of domestic sewage.

pH indicates the concentration of hydrogen ions. During the present investigation, a very good pattern of pH change was noted. Its low value was noticed in winter and monsoon season and high value in summer. However, a range of 7.1 to 8.1 presented a clear cut identification of alkaline nature of pond water. The rise of pH in summer months due to an increased temperature that reduces the solubility of CO_2.

Dissolved oxygen is the most important factor in the assessment of water quality and reflects the physical and biological processes prevailing in the natural water. Most natural waters are saturated with oxygen. But they become oxygen deficient for oxygen sensitive aquatic life when large amounts of organic pollutants are added which require oxygen for microbial decomposition at a rate higher than that supplied by diffusion from air. The levels of dissolved oxygen in the pond water are perhaps of the greatest importance for the survival of the aquatic organisms. A minimum concentration of 5 mg/l of DO has been considered necessary to maintain fish of the water body. During the present investigation, both seasonal as well as spatial changes in oxygen content have been recorded. The general trend of changes in dissolved oxygen concentration during different seasons is directly or indirectly governed by fluctuations of temperature and biochemical oxygen demand. Higher values of DO content were in winter, the period during which the water temperature was the lowest. This might be due to the fact that the solubility of DO increases with the decrease in water temperature.

CHAPTER 8

CONCLUSION

- In this case study, an attempt has been made to assess the levels of some water quality parameters-pH, BOD_5, Turbidity, Dissolved solids and total solids suspended solids in the sewage treatment oxidation pond of Rourkela steel plant.

- Total suspended solids are also a very important parameter to know the water quality of the pond. The more the suspended matter in water the more the light is screened out. Its minimum values were recorded during winter months especially in January. However its maxima were recorded during monsoon season in both the ponds which might be due to rainfall and influx of dissolved contents. Its maximum value was observed in pond which might be due to pouring of domestic sewage.

- pH indicates the concentration of hydrogen ions. During the present investigation, a very good pattern of pH change was noted. Its low value was noticed in winter and monsoon season and high value in summer. However, a range of 7.1 to 8.1 presented a clear cut identification of alkaline nature of pond water. The rise of pH in summer months due to an increased temperature that reduces the solubility of CO_2.

- Dissolved oxygen is the most important factor in the assessment of water quality and reflects the physical and biological processes prevailing in the natural water. Most natural waters are saturated with oxygen. But they become oxygen deficient for oxygen sensitive aquatic life when large amounts of organic pollutants are added which require oxygen for microbial decomposition at a rate higher than that supplied by diffusion from air. The levels of dissolved oxygen in the pond water are perhaps of the greatest importance for the survival of the aquatic organisms. A minimum concentration of 5 mg/l of DO has been considered necessary to maintain fish of the water body. During the present investigation, both seasonal as well as spatial changes in oxygen content have been recorded. The general trend of changes in dissolved oxygen concentration during different seasons is directly or indirectly governed by fluctuations of temperature and biochemical oxygen demand. Higher values of DO content were in winter, the period during which the water temperature was the lowest. This might be due to the fact that the solubility of DO increases with the decrease in water temperature.

- The water obtained from effluent still contains bacteria and other micro-organisms, some of which may be pathogenic (disease producing). The water obtained directly from effluent is therefore not safe for drinking because it may result in spreading of various water borne diseases. As such in order to make the water obtained from effluent safe for drinking purposes, it is necessary to kill the disease producing bacteria and other micro-organisms present in it. So that, the disinfection process should be require.

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