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Evaluation of the Efficiency of Surface Aerator in the Activated Sludge Process Treatment of Food Processing Effluent

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ABSTRACT: Food processing units is a diversified activity consists of processing of perishable items such as fruit and vegetables, meat and poultry etc. into a various products without the loss of nutritional properties. Liquid waste is generated more in the Food processing units by means of washing of raw materials, pulping, crushing and canning operations. Hence, it is necessary to treat the effluent from the food processing units and to find the suitable ways of reusing the treated effluent water like gardening and other cleaning purpose etc., The effluent coming from food processing units contains large quantity of organic and inorganic materials which gives adverse effect to the environmental system when it is discharged directly without proper treatment system. The level of physical, chemical and biological characters have to be analyzed and the treatment system needs to be designed accordingly with proper analysis and environmental control. All effluent and wastewater containing biodegradable constituents which can be treated biologically in which the dissolved and particulate biodegradable constituents have been oxidized into acceptable forms. Hence, the reduction of Bio-chemical Oxygen Demand (*BOD) and Chemical Oxygen Demand (**COD) are the predominant factors in the biological treatment methods. The biological treatment process that occurs in the presence of oxygen (Aerobic process) results the maximum reduction level of BOD and COD. Especially in the Activated Sludge Process (#ASP), the BOD removal is up to 80-95 percent and bacteria removal is up to 90-95%. The type of suitable aeration mechanism working with optimum efficiency plays vital role in the performance of biological treatment. Hence, the food processing effluent from the existing Effluent Treatment plant at CFTRI has been taken for analysis purpose in order to evaluate the efficiency and standardize the operation of aerator since the capacity of ETP of CFTRI is 120 m^3/ day which is almost equal the designed capacity of 100 m^3/ day for this project work. Moreover, the ETP of CFTRI had been designed based on the Activated Sludge treatment Process. The main characters like BOD, COD and pH have been analyzed for the following three main parameters during the project study

1. Temperature of the effluent at morning, noon and evening
2. RPM of the aerator
3. Immersible depth of impeller into the effluent in the aeration tank.

By analyzing the results of the above parameters, the characteristics of the effluent and efficiency of the surface aerators are evaluated.

KEYWORDS: Evaluation, Surface Aerator, activated Sludge, Food Processing Effluent

I. INTRODUCTION

Characteristics of Effluent And Importance of Treatment Of Effluent In the olden times, the waste waters from a community were not so much contaminated as they are today. The urbanization, industrial growth and the improved standards of living have increased the strength and quantity of municipal sewage in recent years to a point where dilution alone can no longer be relied upon to prevent the undesirable effects of pollution. In many cases, more advanced treatment of wastes is essential to prevent undue pollution. This is much more so, when the disposed sewage is likely to contain industrial wastes.

When untreated sewage is discharged into some river stream, floating solids present in the discharged sewage may be washed up on to the shore near the point of disposal, where they decompose and create unpleasant smells and odours. The large amount of organic matter present in the discharged sewage will also consume the dissolved oxygen from the river stream in getting oxidized, and may thus seriously decrease the dissolved oxygen of the river stream, causing fish kills and other undesirable effects. In addition to these effects, the discharged sewage will contaminate the river water with pathogenic bacteria. Hence, even though municipal sewage is 99.9 percent water, it requires treatment if nuisance is to be avoided. Food processing units are having diversified activities where water is being used abundantly by means of cleaning of raw materials, processing and their research activities. The effluent coming from the food processing units contains organic matters, oil, grease, minerals, metals and chemicals etc. Hence, it is absolutely necessary to analyze the various characteristics and behavior of effluent. The quality of effluent can be checked and analyzed by testing it physical, chemical and biological characteristics which are listed in Figure.1.

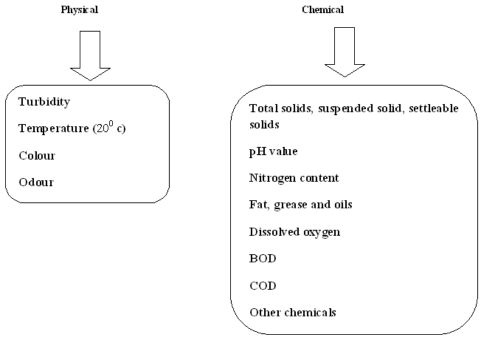

Figure.1. Characteristics of Effluent

The type of treatment required depends upon the character and quality of both effluent and source of disposal. The most important test of effluent is that for determining its Bio-chemical Oxygen Demand, popularly called BOD and Chemical Oxygen Demand popularly called COD . If sufficient oxygen is available in the effluent, the useful aerobic bacteria will flourish and cause the aerobic biological decomposition of waste, which will continue until oxidation is completed. The amount of oxygen consumed in this process is the BOD. The BOD affects the quality of water or effluent (See Figure. 2.) and Polluted water will continue to absorb oxygen for many months, and it is not practically possible to determine this ultimate oxygen demand. There are many different ways to treat effluent and treatment process level like preliminary treatment, primary treatment, secondary (Biological) treatment and final treatment are narrated in Table 1,2,3 & 4 .The pollution control board of State and Central Government has set the tolerance limits of discharged effluent to land and public sewers which are listed in Table.5 and Table.6. The discharge of effluent from all industrial sectors is being regularly monitored by the Pollution Control boards.

In the secondary (Biological) treatment, the fine suspended and dissolved organic matters are being removed. The reduction level of BOD and COD are very high in the activated sludge process of the biological treatment system where aeration process plays vital role in the Activated Sludge Process (ASP)

Hence, providing suitable aeration mechanism working with optimum efficiency will results the high reduction of BOD and COD.

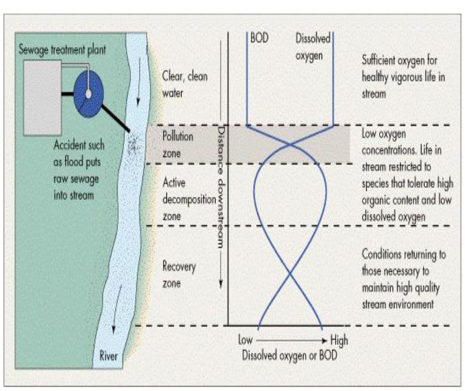

Figure.2 BOD Effects On Water Quality

1.1 EFFLUENT TREATMENT LEVELS

Table.1. Preliminary Treatment

Process	Unit	BOD removal in %	Total Suspended Solids (TSS) in %
Floating material	Screens	5-10	2-20
Heavy settileable inorganic solids	Grid chambers	10-20	20-40
Fats , oil and grease	Skimmin g tanks	20-30	20-40

Table.2. Primary Treatment

Process	Unit	BOD removal in %	Total Suspended Solids (TSS) in %
Large suspended organic matter	Plain sedimentation tank	30-35	60-65

Table.3. Secondary (Biological) Treatment

Process	Unit	BOD removal in %	(TSS) in %
Fine suspended and dissolved organic matter	Chemical flocculation and sedimentation	50-85	70-90
	ASP- Aeration tank and secondary settling tank	75-95	85-90

Table.4 Final or Tertiary Treatment

Process	Unit	BOD removal in %	(TSS) in %
Pathogens and very fine organic matter	chlorinator	100	100

1. 2 ACTIVATED SLUDGE PROCESS (ASP)

The activated sludge process provides an excellent method of treating either raw sewage or more generally the settled sewage. The sewage effluent from primary sedimentation tank, which is, thus normally utilized in this process, is mixed with 20 to 30 percent of own volume of activated sludge, which contains a large concentration of highly active aerobic micro-organisms. The mixture enters an aeration tank, where the micro-organisms (coated around the sludge solids) and the sewage, are intimately mixed together, with a large quantity of air for about 4 to 8 hours. Under these conditions, the moving organisms will oxidize the organic matter and the suspended and colloidal matters tend to coagulate and form a precipitate, which settles down readily in the secondary setting tank. The settled sludge (containing micro organisms) called activated sludge, is then recycled to the head of the aeration tank to be mixed again with the sewage being treated. New activated sludge is continuously being produced by this process, and a portion of it being utilized and sent back to the aeration tank, whereas the excess portion is disposed of properly along with the sludge collected during primary treatment after digestion.

The effluent obtained from a properly operating activated sludge plant is of high quality, usually having a lower BOD than that of trickling filter. BOD removal is up to 80-95 percent, and bacteria removal is up to 90-5 percent. Moreover, land are required is also quite less.

1.1.5 TOLERANCE LIMITS OF DISCHARGED EFFLUENTS

Table.5 Standards for the Discharge of Effluents into Public Sewers

SL. No.	Parameters	* KSPCB Standards (U/S 25 of Water Act 1974)
1	Suspended Solids (mg/L)	Max: 100
2	pH	5.5 – 9.0
3	Oil and Grease (mg/L)	Max: 20
4	Ammoniacal Nitrogen (mg/L)	Max: 50
5	BOD (mg/L)	Max: 350
6	COD (mg/L)	---
7	Chloride, mg/L	Max: 350
8	Sulphates, mg/L	Max: 1000
9	Dissolved Solids, mg/L	Max: 2100
10	Cyanide (mg/L)	Max: 0.20
11	Fluoride (mg/L)	Max: 1.5
12	Phenolics compounds (mg/L)	Max: 5.0
13	Organochlorine & Organophosphorus Pesticides, ppb	Absent
14	Arsenic (mg/L)	Max: 0.20
15	Mercury (mg/L)	Max: 0.01
16	Lead (mg/L)	Max: 1.0
17	Cadmium (mg/L)	Max: 1.0
8	Chromium (mg/L)	Max: 2.0
19	Copper (mg/L)	Max: 3.0
20	Zinc (mg/L)	Max: 1.5
SL. No.	Parameters	* KSPCB Standards (U/S 25 of Water Act 1974)
21	Selenium (mg/L)	Max: 0.05
22	Nickel (mg/L)	Max: 3.0
23	Iron (mg/L)	Max: 3.0
24	Residual sodium carbonate, (mg/L)	Max: 5.0
25	Sodium absorption ratio (m.eqs/L)	---
26	"Percent Sodium" (m.eqs/L)	Max: 60

TABLE.6. STANDARDS FOR THE DISCHARGE OF EFFLUENTS INTO LAND FOR IRRIGATION

SL. No.	Parameters	*KSPCB Standards (U/S 25 of Water Act 1974)
1.	Colour	Colourless
2	Suspended Solids (mg/L)	Max: 30.0
3	pH	6.50 – 8.50
4	Oil and Grease (mg/L)	Max: 10.0
5	Ammoniacal Nitrogen (mg/L)	Max: 50.0
6	BOD (mg/L)	Max: 20.0
7	COD (mg/L)	Max: 250.0
8.	Dissolved phosphate	Max :5.0

Source: Karnataka Pollution Control Board (KSPCB)

But, however, is this process, a rather close degree of control is necessary in operation to ensure

1. That an ample supply of oxygen is present
2. That there is intimate and continuous mixing of the sewage and activated sludge and
3. That the ratio of the volume of activated sludge added to the volume of sewage being treated is kept practically constant.

1 .3 SURFACE AERATION

For efficient surface aeration, high- and low-speed floating aerators provide pumping action that transfers oxygen by breaking up the wastewater into the form of dispersion of bubbles. The large surface area of the bubbles allows oxygen transfer to the wastewater from the atmosphere. At the same time, the oxygen-enriched water is circulated and mixed, resulting in effective oxygen delivery in the entire bulk of the wastewater body. High- and low-speed surface aerators offer excellent oxygen transfer and low operating costs. They are able to handle environmental extremes such as high temperatures. Another alternative for surface aeration is the use of horizontally mounted aeration discs or rotors. These disc or rotor aerators can be used in oxidation ditches known as looped, “race track” reactor configurations. They provide stable operation with resulting high-quality effluent. The aerators are above water for easy maintenance and are energy efficient. Other multichannel processes use a concentric arrangement of looped reactors, which is particularly energy efficient and designed to achieve total nitrogen removal through simultaneous nitrification/de nitrification. Disc and rotor surface aerators offer good BOD and COD removal efficiencies, and are very easy to replace if necessary. Reactors in a vertical-loop configuration are also available for surface aeration. They are essentially oxidation ditches flipped on their sides. Upper and lower compartments separated by a horizontal baffle run the length of the tank. Surface-mounted discs or rotors provide mixing and deliver oxygen. Typically, two or more basins make up the system. The first basin operates as an aerated anoxic reactor and the second basin is operated under aerobic conditions. These types of reactors also have high BOD/COD removal efficiency

1. 4 SECONDARY (BIOLOGICAL) TREATMENT

Aeration Tank

The equalized effluent from the Equalization Tank is pumped to aeration tank where aerial oxygen is mixed with water by means of floating aerator system (see Fig: 1 . 2)

To understand the system, the following terms must be understood:-

Mixed Liquor Suspended Solids (MLSS)

The suspended solids concentration is the Aeration tank is referred as Mixes Liquor SS. It is an index of the mass of active microorganisms in the Aeration tank. As illustrated before MLSS in aeration tank indicates the presence of both active and dead bacterial cells. The level of MLSS that has to be maintained depends upon the desirability of treated water quality. MLSS level of 3500-5000 mg/ Lit would be optimum in an extended type aeration tank.

Return Activated Sludge (RAS)

The purpose of the return of activated sludge to Aeration tank from Sludge Sump is to maintain a sufficient concentration of activated sludge in the tank so that required degree of treatment can be obtained in the limited time interval.

Food to Microbes ratio (F/M):-

It is the ratio between amounts of Organic material available to microbial population. In other words it is the ratio between BOD in kgs and MLSS in kgs. A proper F/M can be achieved by increasing or decreasing the rate of Return Activated Sludge (RAS) from Secondary Clarifier. Optimum F/M for an Extended Aeration type ASP is 0.1-0.15.

Function of Aeration Tank:

The main function of an Aeration tank in a activated sludge process are:

To maintain the dissolved oxygen concentration in the Effluent by suitable aerators

To maintain sufficient MLSS regulating return activated sludge from secondary Clarifier.

II. Project Objectives

2.1 AIM

To find out the optimum efficiency of surface aerator at different process conditions in the activated sludge process treatment of effluent coming from Food Processing Units.

2.2 OBJECTIVES

To evaluate the efficiency of surface aerator for biological treatment in the food processing effluent, especially the reduction of BOD and COD.

To analyze the effluent characteristics at different conditions of surface aerator in the Activated Sludge Process.

To analyze the treatment efficiency of surface aerator at different conditions and to standardize the operation of surface aerator in the aeration tank.

2. 2 FEASIBILITY STUDY

2. 2. 1 Economic feasibility:

Providing surface aerators in the aeration mechanism consume high electric power in a day since the motor has to be operated continuously up to the designed detention period. The number of hours of aerator operation may be curtailed and standardized by doing the analysis of effluent based on the above mentioned project parameters for low range of raw effluent characteristics of BOD, COD and TSS are similar to that of the raw effluent of CFTRI.

By standardizing the aerator operation for the required limited period of time at a particular temperature in a day, we can save the energy and money for the daily operation cost of ETP at CFTRI. By analyzing the outcome of the results and standardizing the aerator operation in the ETP of CFTRI, we may able to bring down the daily operation costs.

2. 2. 2 Operational feasibility:

The daily operation of aerator is one of the predominant factors in the extended aeration process. The standardizing the operation of aerator for its optimum efficiency resulted the reduction of manpower, Time management and utilize the manpower in productive manner by engaging other activities. Hence it is more feasible to standardize the aerator operation based on the Temperature of the effluent, RPM and Immersible depth of the impeller of the surface aerator into the effluent in the aeration tank.

2 . 2 . 3 Technical feasibility:

Aeration process in the activated sludge process of biological treatment of effluent mainly depend on the type of aeration mechanism, percentage of activate sludge and microorganism present in the activated sludge, transformation of dissolved oxygen through the aeration system and type of impeller blade in the aerator.

Hence the reduction of BOD and COD in the biological treatment process involved more technical parameters of the extended aeration process where we can standardize the operation of aeration mechanism for high BOD and COD control.

III. Evaluation Of Surface Aerator

3 . 1 Biochemical Oxygen Demand (BOD)

The most widely used parameter of organic pollution applied to both wastewater and surface water is the 5-day BOD(BOD_5). This determination involves the measurement of the dissolved oxygen used by microorganisms in the biochemical oxidation of organic matter. Despite the widespread use of the BOD test, it has a number of limitations, It is hoped that, through the continued efforts of workers in the field, one of the other measures of organic content, or perhaps a new measure, will ultimately be used in its place. Why, then, if the test suffers from serious limitations, if further space devoted to it in this text? The reason is that BOD test results are now used

- To determine the approximate quantity of oxygen that will be required to biologically stabilize the organic matter present
- To determine the size of waste treatment facilities
- To measure the efficiency of some treatment processes, and
- To determine compliance with wastewater discharge permits. Because it is likely that the BOD test will continue to be used for some time, it is important to know the details of the test and its limitations.

3 . 2 Chemical Oxygen Demand (Cod)

The chemical oxygen demand is widely used as a means of measuring the organic strength of domestic and industrial wastes. The COD test allows measurement of a waste in terms of the total quantity of oxygen required for oxidation to carbon dioxide and water in accordance with the equation ;

COHNS + 0 2 + Nutrients 3 CO2 + NH3 + C5H202 + other end products

It is based upon the fact that all organic compounds, with few exceptions, can be oxidised by the action of strong oxidising agents under acid conditions.

During the determination of COD, organic matter is converted to carbon dioxide and water regardless of the biological assimilability of the substances. For example, glucose and lignin are both oxidised completely. As a result, COD values are greater than BOD values and may be much greater when significant amounts of biologically resistant organic matter is present. One of the chief limitations of the COD test is its inability to differentiate between biologically oxidisable and biologically inert organic matter. In addition, it does not provide any evidence of the rate at which biologically active material would be stabilised under conditions that exist in nature. (Clair NSawyer, 1994)

The major advantage of the COD test is the short time required to evaluation. The determination can be made in about 3 hours rather than the 5 days required for the determination of BOD. For this reason it can be used as a substitute for the BOD test in many instances. COD data can often be interpreted on terms of BOD values after sufficient experience has been accumulated to establish reliable correlation factors.

3 . 3 pH

The hydrogen –ion concentration is an important quality parameter of both natural waters and wastewaters. The usual means of expressing the hydrogen-ion concentration is as pH, which is defined as the negative logarithm of the hydrogen-ion concentration.

$$\mathrm{pH} = -\log_{10}[\mathrm{H}^+]$$

The concentration range suitable for the existence of most biological life is quite narrow and critical (typically 6 to 9). Wastewater with an extreme concentration of hydrogen ion is difficult to treat by biological means, and if the concentration is not altered before discharge, the wastewater effluent may alter the concentration in the natural waters. For treated effluents discharged to the environment the allowable pH range usually varies from 6.5 to 8.5

The hydrogen-ion concentration in water is connected closely with the extent to which water molecules dissociate. Water will dissociate into hydrogen and hydroxyl ions as follows:

$$\mathrm{H_2 0} \leftrightarrow \mathrm{H^+ + OH^-}$$

Applying the law of mass action [Eq. (2-7)] to Eq. (2-30) yields

$$\frac{[\mathrm{H^+}](\mathrm{OH^-})}{\mathrm{H_2 0}} = \mathrm{K}$$

Where the brackets indicate concentration of the constituents in moles per liter. Because the concentration f water in a dilute aqueous system is essentially constant, this concentration can be incorporated into the equilibrium constant K.

IV. Materials And Methods

4 . 1 MATERIALS AND EQUIPMENTS

Materials:

1. Refluxing Flask
2. Blenders
3. Pipettes
4. Small Beakers
5. Condenser
6. Incubation bottles

Equipments:

1. Incubator
2. pH Meter
3. Thermometer
4. Light Intensity Meter
5. Motor Frequency convertor

4 . 2 STAGES INVOLVED FOR THE STUDY

Stage:I

Analyze the effluent characteristics at 3 different Temperature in a Day
(i) Morning (10.00am) (ii) Noon (12.30 pm)
(ii) (iii) Evening (6.00 pm)

Select the suitable Temperature where the high reduction percentage of BOD and COD

Stage :II

Analyze the effluent characteristics at 3 different speed (see Figure. 3 , 4 and 5). at the selected Temperature
(iii) RPM-1 (ii) RPM-2 (iii) RPM-3
Select the suitable RPM

Stage :III

Analyze the effluent characteristics at different immersible depth (see Figure. 6,7,8,9 & 10) of impeller of surface aerator into the effluent of at selected RPM and Temperature
(i) Depth-1 (ii) Depth-2
Select the suitable immersible Depth of impeller into the effluent.

From the aeration tank at CFTRI (see Figure.11) the effluent samples have been collected (Figure.12) for the evaluation of aerator of CFTRI

Figure. 3 Connection Of Motor Frequency Converter In The Motor Control Room

Figure.4 Impeller at 48 Rpm

Figure.5 Impeller At 96 Rpm

Figure.6 Determination Of Cod Of The Effluent Sample

Figure.7 Immersible Depth Of Impeller Into The Effluent (Stage-I)

Figure.8 Immersible Depth Of Impeller Into The Effluent (Stage-Ii)

Figure. 9 Immersible Depth Of Impeller Into The Effluent (Stage-Ii)

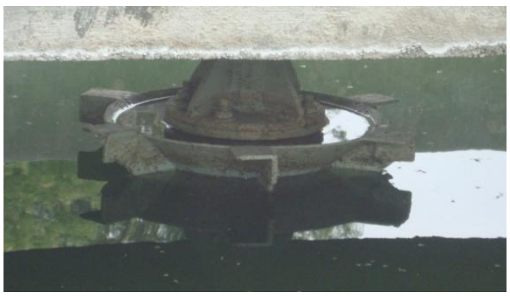

Figure. 10 Immersible Depth Of Impeller Into The Effluent (Stage-Ii)

Figure.11 Surface Aerators In The Aeration Tank At CFTRI

Figure.12 Collection of Effluent Sample For Analysis

4 . 3 Determination Of Bio-Chemical Oxygen Demand (Bod)

4 . 3. 1 BOD Test Procedures

5-Day BOD Test Principle:

The method consists of filling with sample, to overflowing, an airtight bottle of the specified size and incubating it at the specified temperature for 5 d. Dissolved oxygen is measured initially and after incubation, and the BOD is computed from the difference between initial and final DO. Because the initial DO is determined shortly after the dilution is made, all oxygen uptake occurring after this measurement is included in the BOD measurement.

Sampling and storage:

Samples for BOD analysis may degrade significantly during storage between collection and analysis, resulting in low BOD values. Minimize reduction of BOD by analyzing sample promptly or by cooling it to near-freezing temperature during storage. However, even at low temperature, keep holding time to a minimum. Warm chilled samples to 20 ± 3°C before analysis.

Grab samples

If analysis is begun within 2 h of collection, cold storage is unnecessary. If analysis is not started within 2 h of sample collection, keep sample at or below 4°C from the time of collection. Begin analysis within 6 h of collection; when this is not possible because the sampling site is distant from the laboratory, store at or below 4°C and report length and temperature of storage with the results. In no case start analysis more than 24 h after grab sample collection. When samples are to be used for regulatory purposes make every effort to deliver samples for analysis within 6 h of collection.

Composite samples

Keep samples at or below 4°C during compositing. Limit compositing period to 24 h. Use the same criteria as for storage of grab samples, starting the measurement of holding time from end of compositing period. State storage time and conditions as part of the results.

2. Apparatus

a. Incubation bottles
b. Air incubator or water bath,

3. Reagents:

Prepare reagents in advance but discard if there is any sign of precipitation or biological growth in the stock bottles. Commercial equivalents of these reagents are acceptable and different stock concentrations may be used if doses are adjusted proportionally.

4. Procedure:

a. Preparation of dilution water: .
b. Dilution water storage
c. Glucose-glutamic acid check
d. Seeding
1) Seed source
2) Seed control
e. Sample pre treatment:
f. Dilution technique
g. Determination of initial DO
h. Dilution water blank
i. Incubation
j. Determination of final DO

5. Calculation

For each test bottle meeting the 2.0-mg/L minimum DO depletion and the 1.0-mg/L residual
DO, calculate BOD_5 as follows:
When dilution water is not seeded:

$$BOD_5,\ mg/L = \frac{D_1 - D_2}{P}$$

When dilution water is seeded:

$$BOD_5,\ mg/L = \frac{D_1 - D_2}{P}$$

where:
D_1 = DO of diluted sample immediately after preparation, mg/L,
D_2 = DO of diluted sample after 5 d incubation at 20°C, mg/L,
P = decimal volumetric fraction of sample used,
B_1 = DO of seed control before incubation, mg/L
B_2 = DO of seed control after incubation mg/L and
f = ratio of seed in diluted sample to seed in seed control = (% seed in diluted sample)/(% seed in seed control).
If seed material is added directly to sample or to seed control bottles:
f = (volume of seed in diluted sample)/(volume of seed in seed control)

4 . 4 DETERMINATION OF CHEMICAL OXYGEN DEMAND (COD)

$$\mathbf{COD\ (ppm)} = \frac{\textbf{Titre X N.Thiosulfate x 8000}}{\textbf{Volume of sample}}$$

4 . 5 DETERMINATION OF Ph

4 . 5 .1 Test Procedure Reagents

a. General preparation

Calibrate the electrode system against standard buffer solutions of known pH. Because buffer solutions may deteriorate as a result of mold growth or contamination, prepare fresh as needed for accurate work by weighing the amounts of chemicals specified in Table 4500-H^+:I, dissolving in distilled water at 25°C, and diluting to 1000 mL. This is particularly important for borate and carbonate buffers.

Boil and cool distilled water having a conductivity of less than 2 μmhos/cm. To 50 mL add 1 drop of saturated KCl solution suitable for reference electrode use. If the pH of this test solution is between 6.0 and 7.0, use it to prepare all standard solutions.

Dry KH_2PO_4 at 110 to 130°C for 2 h before weighing but do not heat unstable hydrated potassium tetroxalate above 60°C nor dry the other specified buffer salts.

Although ACS-grade chemicals generally are satisfactory for preparing buffer solutions, use certified materials available from the National Institute of Standards and Technology when the greatest accuracy is required. For routine analysis, use commercially available buffer tablets, powders, or solutions of tested quality. In preparing buffer solutions from solid salts, insure complete solution.

As a rule, select and prepare buffer solutions classed as primary standards in Table 4500-H^+:I; reserve secondary standards for extreme situations encountered in wastewater measurements. Consult Table 4500- H^+:II for accepted pH of standard buffer solutions at temperatures other than 25°C. In routine use, store buffer solutions and samples in polyethylene bottles. Replace buffer solutions every 4 weeks

Procedure

Instrument calibration

In each case follow manufacturer's instructions for pH meter and for storage and preparation of electrodes for use. Recommended solutions for short-term storage of electrodes vary with type of electrode and manufacturer, but generally have a conductivity greater than 4000 μmhos/cm. Tap water is a better substitute than distilled water, but pH 4 buffer is best for the single glass electrode and saturated KCl is preferred for a calomel and Ag/AgCl reference electrode. Saturated KCl is the preferred solution for a combination electrode. Keep electrodes wet by returning them to storage solution whenever pH meter is not in use. Before use, remove electrodes from storage solution, rinse, blot dry with a soft tissue, place in initial buffer solution, and set the isopotential point. Select a second buffer within 2 pH units of sample pH and bring sample and buffer to same temperature, which may be the room temperature, a fixed temperature such as 25°C, or the temperature of a fresh sample. Remove electrodes from first buffer, rinse thoroughly with distilled water, blot dry, and immerse in second buffer. Record temperature of measurement and adjust temperature dial on meter so that meter indicates pH value of buffer at test temperature (this is a slope adjustment).

Use the pH value listed in the tables for the buffer used at the test temperature. Remove electrodes from second buffer, rinse thoroughly with distilled water and dry electrodes as indicated above. Immerse in a third buffer below pH 10, approximately 3 pH units different from the second; the reading should be within 0.1 unit for the pH of the third buffer. If the meter response shows a difference greater than 0.1 pH unit from expected value, look for trouble with the electrodes or potentiometer.

The purpose of standardization is to adjust the response of the glass electrode to the instrument. When only occasional pH measurements are made standardize instrument before each measurement. When frequent measurements are made and the instrument is stable, standardize less frequently. If sample pH values vary widely, standardize for each sample with a buffer having a pH within 1 to 2 pH units of the sample.

Sample analysis

Establish equilibrium between electrodes and sample by stirring sample to insure homogeneity; stir gently to minimize carbon dioxide entrainment. For buffered samples or those of high ionic strength, condition electrodes after cleaning by dipping them into sample for 1 min. Blot dry, immerse in a fresh portion of the same sample, and read pH. With dilute, poorly buffered solutions, equilibrate electrodes by immersing in three or four successive portions of sample. Take a fresh sample to measure pH.

V. Results And Discussions

5.1 Analysis Of The Results

5 .1 .1 BOD Results and calculation

The results of the BOD values have been analyzed with regard to the following parameters and their effects are identified .

Effect of temperature

The effluent samples have been taken in the aeration tank at morning, noon and evening time in order to analyze the character of BOD with regard to Temperature. On observing the results, there is no significant effect of BOD reduction since the variation in the temperature level at 3 different timings is very nominal. However, the BOD reduction has observed due to the process of aeration and the values have been listed in Table No.7

Table No.7 Effect Of Temperature On Bod

Parameter in PPM	Temperature		
	29°C (10.00am)	31°C (12.30pm)	28°C (6.00pm)
BOD	190	160	105

Effect of Impeller RPM

The values of BOD have been taken at the impeller rotation 48 RPM , 68 RPM and 96 RPM for 30 minutes aeration process and analyzed (See Table.8) . On reading of the values , it is noticed that the reduction of BOD level is significant for 45 minutes aeration process at 96 RPM of impeller rotation

Table No.8 Effect Of Impeller Rpm

Parameter in PPM	Impeller RPM		
	48	68	96
BOD	155	180	105

Effect of immersible depth of impeller into the effluent

The samples have been taken in the aeration tank at two different immersible depth of impeller into the effluent and values have been analyzed (See Table.9) . On observing the values, it is found that the reduction BOD level is more at the immersible depth of 10 cm.

Table. 9 Effect Of Immersible Depth Of Impeller Into The Effluent

Parameter in PPM	Immersible Depth of impeller in centimetre	
	10 cm	8 cm
BOD	30	105

5 . 3 . 2 COD Results and Calculation

The COD values have been analyzed based on the three parameters namely Temperature of effluent, impeller rotation and immersible depth of impeller into the effluent and their effects are identified

Effect of Temperature

The effluent samples have been taken in the aeration tank at morning, noon and evening time in order to analyze the character of COD with regard to Temperature. On observing the results, there is no significant effect of COD reduction since the variation in the temperature level at 3 different timings is very nominal. However, the COD reduction has observed due to the process of aeration and the values have been listed in Table .10

Table.10. Effect Of Temperature On Cod

Parameter in PPM	Temperature		
	29°C (10.00am)	31°C (12.30pm)	28°C (6.00pm)
COD	16	Not detectable	Not detectable

Effect of Impeller rotation

The COD values have been taken at three impeller rotation 48 RPM, 68 RPM and 96 RPM and analyzed. The values of COD with respect to the 48 RPM, 68 RPM and 96 RPM are (-) 16 , (-) 64 and (-) 72 respectively. Based on the results, it can be seen that there is a reduction in COD as the impeller rotation increases. But, the COD values (Table 11) are not in the detectable limits. However, it is observed that the reduction of COD level is in decreasing trend.

Table .11 Effect Of Impeller Rpm

Parameter in PPM	Impeller RPM		
	48	68	96
COD	16	Not detectable	Not detectable

Effect of immersible depth of impeller into the effluent

The samples have been taken in the aeration tank at two different immersible depth of impeller into the effluent and values have been analyzed (Table .12) . On observing the values, it can be seen that the reduction of COD level is more at the immersible depth of 10 cm

But, the COD values are not in the detectable limits. The COD values have been taken at two impeller rotation 68 RPM and 96 RPM and analyzed. The values of COD with respect to the 68 RPM and 96 RPM are (-) 24 , and (-) 48 respectively. However, it is observed that the reduction of COD level is in decreasing trend.

Table .12 Effect Of Immersible Depth Of Impeller Into The Effluent

Parameter in PPM	Immersible Depth of impeller in centimetre	
	10 CM	8CM
COD	Not detectable	Not detectable

5 .4 PH RESULTS AND CALCULATION

Since the variation in pH level of effluent samples itself are very less, it is not noticed accurately ensured that the significant reduction of BOD and COD with respect to the effect of temperature (Table No.13)., impeller rotation (Table.14) and immersible depth of impeller into the effluent (Table.15)

TABLE .13. EFFECT OF TEMPERATURE

Parameter	Temperature		
	10.00 AM	12.30 PM	6.00 PM
pH	7.09	6.82	7.37

TABLE.14 EFFECT OF IMPELLER RPM

Parameter	Impeller RPM		
	48	68	96
pH	7.63	7.8	7.37

TABLE .15 EFFECT OF IMMERSIBLE DEPTH OF IMPELLER INTO THE EFFLUENT

Parameter	Immersible Depth of impeller in centimetre	
	10 cm	8 cm
pH	7.09	7.25

5 .5 EFFLUENT CHARACTERS BASED ON TEMPERATURE

Effect of temperature

The effluent samples have been taken in the aeration tank at morning, noon and evening time in order to analyze the character of BOD with regard to Temperature. On observing the results, there is no significant effect of BOD and COD reduction since the variation in the temperature level at 3 different timings is very nominal. However, the reduction in the values of BOD and COD has observed due to the process of aeration and the values have been given Figure13.

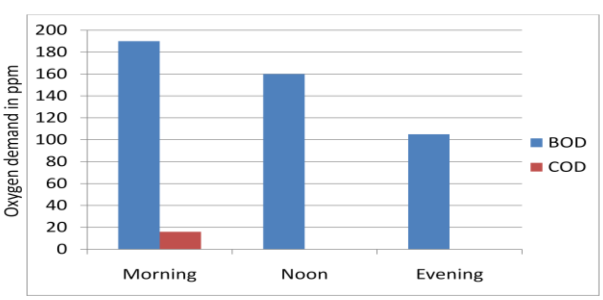

Figure.13. Effect of Temperature on BOD and Cod

5.6 Effluent Character Based On Impeller Rpm

5.6.1 Effect of Impeller RPM

The values of BOD have been taken at the impeller rotation 48 RPM , 68 RPM and 96 RPM for 30 minutes aeration process and analyzed (Figure.14) . On reading of the values , it is noticed that the reduction of BOD level is significant for 45 minutes aeration process at 96 RPM of impeller rotation

The COD values have been taken at three impeller rotation 48 RPM, 68 RPM and 96 RPM and analyzed. The values of COD with respect to the 48 RPM, 68 RPM and 96 RPM are (-) 16 , (-) 24 and (-) 48 respectively. Based on the results, it is found that there is a reduction in COD as the impeller rotation increases. But, the COD values are not in the deductable limits. However, it is observed that the increase in the reduction of COD level in negative value.

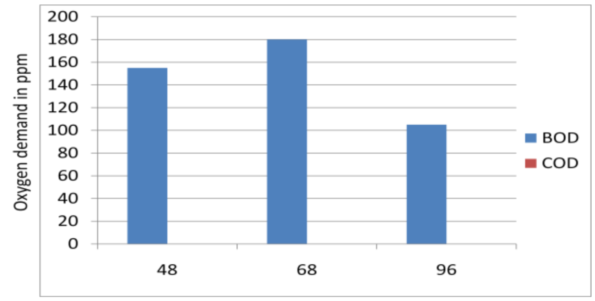

Figure.14 Effect of Impeller RPM on BOD And Cod

5.6.2 Effluent Character based on Immersible depth of Impeller into the effluent

Effect of immersible depth of impeller into the effluent

The samples have been taken in the aeration tank at two different immersible depth of impeller into the effluent and values have been analyzed (Figure.15) . On observing the values, it is found that the reduction BOD level is more at the immersible depth of 10 cm.

The BOD reduction level is not found significant at 8 cm immersible depth of impeller into the effluent through the aeration process took place for 45 minutes at higher impeller rotation (96 RPM)

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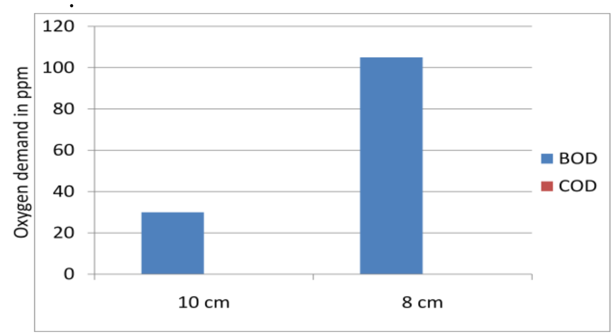

Figure.15 Effect of Immersible Depth Of Impeller On Bod And Cod

5 . 7 SCOPE FOR THE IMPROVEMENTS

There is ample scope for improvement to overcome to the following limitations are observed during the analysis for ensuring the accurate value of the characteristics of effluent. There may be a variation in the quantity of raw effluent coming from the equalization tank to aeration tank and the quantity of flow is not consistent. There may be a chance for variation in the raw effluent characteristics from time to time depending on the food material that is processed in the pilot plants. The incoming quantity of activated sludge from clarifier tank to aeration tank for recycling is not consistent and microorganism present in the activated sludge may vary from time to time and it is difficult to calculate accurately. The presence of chemicals in the raw effluent may oxidize the inorganic materials very fast than the expected time of aeration.

VI. CONCLUSION AND FUTURE SCOPE OF THE PROJECT

There is no significant effect of temperature on reduction in BOD and COD, since the variation in the temperature level at 3 different timings is very nominal. However, the reduction in the values of BOD and COD has observed due to the process of aeration. The effect of impeller rotation at three different speeds on reduction of BOD, it is observed that the reduction of BOD level is significant for 45 minutes aeration process at 96 RPM of impeller rotation. The effect of impeller rotation at three different speed on reduction of COD, the values of COD with respect to the 48 RPM, 68 RPM and 96 RPM are not in the deductable limits. However, it is observed that the increase in the reduction of COD level. Moreover the reduction in BOD and COD will depend on the incoming quality and quantity of raw effluent and activated sludge. The effect of immersible depth of impeller into the effluent is significant. On observing the values, the reduction in BOD level is more at the immersible depth of 10 cm. The oxygen transfer in the aeration tank by the surface aerators may be increased by changing the suitable design of impeller. For instance, pitched blade turbine (up flow) with six blades and a blade angle of 45° (pitch) will significantly increase the degree of surface aeration. The inflow of activated sludge quantity may be increased and the effluent characters can be analyzed by which the detention time of effluent in the aeration tank and operation hours of aerators may be reduced.

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