Waste Water Quality Analysis and Design of Waste Stabilization Pond of Shiats

Saad Asghar Moeeni, J. Lordwin Girish Kumar

Abstract- The purpose of this study was to access the waste water quality of SHIATS and to provide suitable treatment option in the form of waste-stabilization ponds. Two sites were selected for waste water quality analysis. Assessment was carried from March to June. The analysis were done at laboratory using standard Method. Parameter selected for the assessment were pH, turbidity, Electrical conductivity, Dissolved oxygen and Biological oxygen demand (BOD) at all the sampling sites all the parameter were at the pollutants exceeding the pollution limits. The value of pH, Turbidity, EC, DO and BOD ranges from 6.05 to 6.85, 6.55 NTU to 13.00 NTU, 0.008 to 2.00, 12mg/l to 22mg/l, 6.00 to 9.00 mg/l and total area required for waste stabilization ponds were 799.4 m^2.

Keywords: Parameter, pH, Turbidity, Electrical Conductivity, Dissolve oxygen, Biological oxygen demand, waste stabilization pond.

I. INTRODUCTION

Water is a common chemical substance that is essential for the survival of all known forms of life. In typical usage, water refers only to its liquid form or state, but the substance also has a solid state, ice, and a gaseous state, water vapor or steam. Other water is trapped in ice caps, glaciers, aquifers, or in lakes, sometimes providing fresh water for life on land. Water quality is the physical chemical and biological characteristics of water in relationship to a set of standards. The primary uses considered for such characterization are parameters which relate to drinking water, safety of human contact, and for health of ecosystems. Wastewater is any water that has been adversely affected in quality by anthropogenic influence. It comprises liquid waste discharged by domestic residences, commercial properties, industry, and/or agriculture and can encompass a wide range potential contaminants and concentrations.

Waste Stabilization Ponds

A WSP is a relatively shallow body of wastewater contained in an earthen man-made basin into which wastewater flows and from which, after certain retention time (time which takes the effluent to flow from the inlet to the outlet) a well-treated effluent is discharged.

Advantages of Waste Stabilization Ponds

Waste stabilization ponds (WSP) are shallow man-made basins into which wastewater flows and from which, after a retention time of several days (rather than several hours in conventional treatment processes), a well-treated effluent is discharged.

Manuscript Received on December 2014.

Saad Asghar Moeeni, Department of Soil Water Land Engineering and Management, Vaugh School of Agricultural Engineering and Technology, SHIATS, Allahabad, India.

J. Lordwin Girish Kumar, Department of Soil Water Land Engineering and Management, Vaugh School of Agricultural Engineering and Technology, SHIATS, Allahabad, India.

WSP systems comprise a series of ponds – anaerobic, facultative and several maturation. The advantages of WSP systems, which can be summarized as simplicity, low cost and high efficiency

II. MATERIAL AND METHODS

Water pollution study includes the estimation of physical and chemical parameters for which a size well equipped laboratory is needed. The number of parameters is to be determined depends upon the objective to be achieved.
Therefore some parameters are considered for their assessment. They are:

pH
Conductivity
Dissolved oxygen
Biological oxygen demand
Turbidity

Temperature

Impinging solar radiation and atmospheric temperature brings about spatial and temporal changes in temperature, setting up convection currents and thermal stratification. Temperature plays a very important role in wetland dynamism affecting the various parameters such as alkalinity, salinity, dissolved oxygen, electrical conductivity etc.

Electrical Conductivity

Conductivity (Specific conductance) is the numerical expression of the water's ability to conduct an electric current. It is measured in micro Siemens per cm and depends on the total concentration, mobility, valence and the temperature of the solution of ions. Electrolytes in a solution disassociate into positive (cat ions) and negative (anions) ions and impart conductivity. Most dissolved inorganic substances are in the ionized form in water and contribute to conductance.

Turbidity

Turbidity is an expression of optical property; wherein light is scattered by suspended particles present in the water (Tyndall effect) and is measured using a nephelometer. Suspended and colloidal matter; plankton and other microscopic organisms cause turbidity in water.

ph:

(a) The ph is determined by measuring the Eelctro Motive Force (E.M.F.) of a cell comprising an indicator electrode (an electrode responsive to hydrogen ions bunch as a glass electrode) immersed in the test solution and the reference electrode (usually a mercury/calomel electrode).

Biological Oxygen Demand

Reagents:

i. Manganese sulphate solution
ii. Alkali iodide azide
iii. N/40 sodium thiosulphate solution

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

iv. Concentrated sulphuric acid
v. Starch indicator

Procedure

Take the sample in two B.O.D. bottles. Keep one for incubation and other for determination of initial D.O. Add 2 ml of manganese sulphate solution dipping the end of the pipette below the water surface in the bottle. Add 2 ml of alkali iodide azide solution to the bottle in a similar manner. Add stopper carefully to exclude air bubbles and nix by precipitate settles, leaving clear solution above the manganese hydroxide floc, shake again. After 2 minutes setting remove the stopper and immediately add 2 ml concentrated H_2SO_4 by allowing acid run down the neck of bottle. Restopper and mix gentle inversion until dissolution is complete. Take 203 ml of solution from the bottle and add 1-2 ml starch indicator titrate it against 0.025. Sodium thiosulphate solution is taken in the burette. Note the volume of sodium thiosulphate solution used to an end where changes to blue colour. Similarly determine D.O. of incubated sample 20^0C for 5 days.

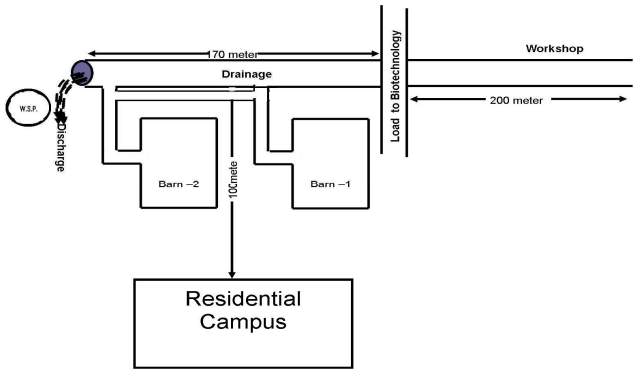
Dissolved Oxygen

Reagents:

i. Manganese sulphate solution
ii. Alkali iodide azide reagent
iii. N/40 sodium thiosulphate solution
iv. Concentrated H_2SO_4
v. Starch indicator

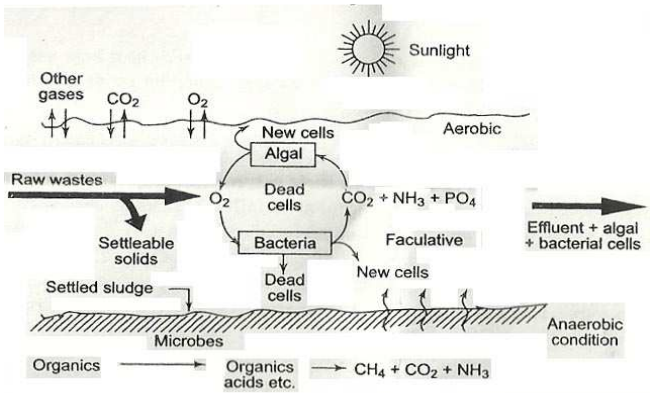
Procedure:

Take the 300 ml water sample in a B.O.D. bottle, Keep2 ml of manganese sulphate solution and dipping the end of the pipette below the water surface in the bottle. Add 2 ml of alkali iodide azide solution to the bottle in a same manner. Add stopper to carefully to exclude air bubles and mix by precipitate settles, leaving clear. Solution above the manganese hydroxide flock, shake again. After 2 minutes setting remove the stopper and immediately add 2 ml concentrated H_2SO_4 by allowing acid run down the neck of bottle restopper hand mix genetic inversion until dissolution is complete. Take 203 ml of solution from the bottle and add 1-2 ml starch indicator titrate it against 0.005 sodium thiosulphate solution taken in the burette. Note the volume of sodium thiosulphate solution used to an end where colour changes to blue.



Layout of drainage system of SHIATS

Aerobic waste stabilization ponds are shallow ponds of about 0.3m depth or less designed so as to maximize light penetration and the growth through photosynthetic action. Aerobic conditions are maintained throughout the depth of the pond at all times. Such ponds are useful where the ultimate harvesting of algae is desired, but their use in waste treatment has not been widespread.



Treatment of waste in a typical facultative pond

III. RESULTS AND DISCUSION

The present study "**Waste water quality analysis and design of waste stabilization pond of SHIATS**" was undertaken with reference to Laboratory of Chemistry Department, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad.

pH value:

pH value of two different location was found to be at non-significant level. For point-1- The lowest pH was found in the month of June (6.05). The highest pH was found in the month of May 6.85. For point-2 the lowest pH was found in the month of April 6.52 and highest pH was found in the month of June that is 6.85. These pH value when compared with W.H.O. value (6-7), was found that the waste water were below Neutral point.

Turbidity:

Turbidity value of two different locations was found to be at non-significant level. Turbidity value when compared with W.H.O. 5 NTU, it was found that for point-1, it was lowest in the month of May that is 6.55. NTU and highest in the month of April that is 8.9 NTU, for point-2 it was found that it was lowest in the month of April, June that is 10.00 NTU and highest in the month of March that is 13.00 NTU.

B.O.D.:

B.O.D value of two different locations was found to be at non-significant level. B.O.D. value when compared with W.H.O. value of 2 mg/l for waste water.

It was found that for point-1 it was lowest in the month of June that in 1.00 and highest in the month of April that is 3.00. For point-2 the lowest and the highest value was in the month of May- June that is 6.00 and 9.00.

Dissolve Oxygen -1

DO_1 value of two different locations was found to be at non-significant level. There DO value when compared with W.H.O. value (5-10) mg/l for waste water for Point -1. The lowest DO_1 was found in the month of March that is 14.00 mg/l and highest DO_1 was found in the month of May that is 18.00 mg/l. For Point -2 lowest was in the month of March that is 16.00 mg/l and highest in the month of April May that is 28.00 mg/l.

Dissolve Oxygen-2

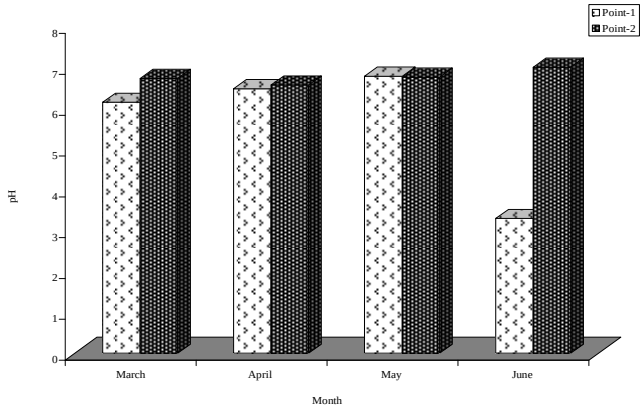
DO_2 value of two different locations was found to be at non-significant level. The DO_2 value when compared with

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

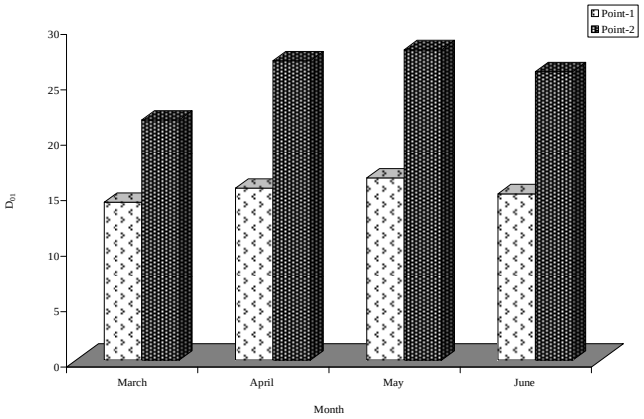
W.H.O. value of (5-10) mg/l for waste water it found for Point -1 that lowest DO_2 was found in the month of March that in 12.00 mg/l and highest DO_2 was found in the month of May that is 16.00 mg/l for Point 2 lowest DO_2 was found in the month of June that is 18.00 mg/l and highest DO_2 was found in the month of March and May that is 22.00 mg/l.

Electrical Conductivity

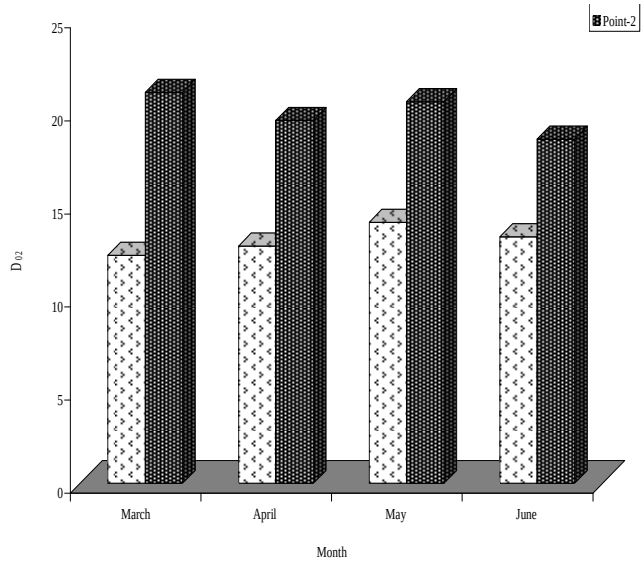
EC value of two location was found to be at non-significant level for Point -1 EC value was lowest in the month of June that is 0.008 and highest in the month of March April that is 1.08 for Point 2 it was lowest in the month of April that is 1.02 highest in the month of May that is 2.00



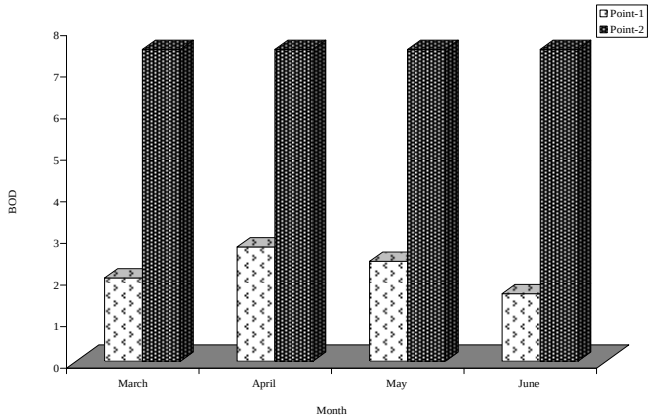
pH value of Point 1 & 2 from March to June



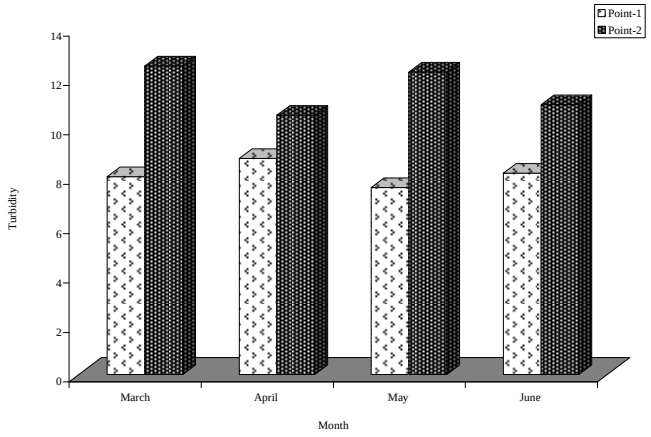
DO_1 value of Point 1 & 2 from March to June



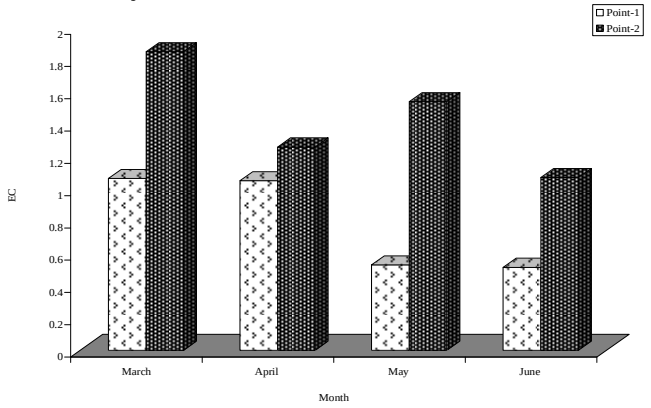
DO_2 value of Point 1 & 2 from March to June



BOD value of Point 1 & 2 from March to June



Turbidity value of Point 1 & 2 from March to June



EC value of Point 1 & 2 from March to June

Design parameter of waste stabilization pond

Wastewater Contribution Per Capita per Day (WWC) for a student population (Pe) 10,000.

A moderate value of wastewater contribution per capita per day including infiltration losses for this study is,

WWC = 70 Liters/Capita/Day

BOD Contribution Per Capita per Day (BOD)

The values of BOD, usually, vary between 30 and 70 gm per person per day, depending on type of diet.

BOD = 40 gm/capita/day

Total Organic Load (B)

Total organic load can be calculated as,

B=Pe x (BOD) Eq=1

Putting the above given value of Pe and BOD, Total organic load B will be,

B-400 kg/day

Volumetric Loading (λv)

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.

The variation of permissible design value for λv is calculated according to latitude of India. This relationship can be expressed mathematically as:

$$\lambda v = 375\text{-}6.25L$$

Where L= Latitude, ^{o}N (range considered BOD loading on facultative ponds in India with latitude

Latitude (^{o}N)	Design BOD loading (kg/ ha day)
36	150
32	175
28	200
24	225
20	250
16	275
12	300
8	325

Source: Ministry of Urban Development in India.

Allahabad region latitude 25^{0}N

λv = 200 for Allahabad region

Design of Anaerobic Ponds

The volume of the anaerobic ponds (Va) in m^3 is compared by using the formula of Mara and Pearson (1987) i.e.

Va = (LiQ)/ λv

Eq. 4

Putting the values in Eq. – 4 Va will be

Va = 1998.5 m^3

The retention time is normally taken as two days and depth 2.5 meters. Desludging may be needed in 2 to 5 years therefore, two ponds, are often arranged in parallel to allow one to be taken out of service for desludging.

Detention time = Va/Q (Q=WWCxPe)
= 3 days

No. of ponds = 2

Volume of each pond = Va/2
= 999.25 m^3

Depth of each pond = 2.5 meters

Area of each Anaerobic pond will be = 399.7 m^2

BOD removed in anaerobic pond can be calculated from the following equation

% B.O.D. removal = 2T+20 = 72%

To be conservative = 55%

IV. CONCLUSION

Waste water quality of SHIATS is severely contaminated at two sites of sampling at point P_1 waste water is moderately polluted during the course of study. It can also be concluded that as the B.O.D. value is less. The waste stabilization pond is the best option for waste water treatment. People dependent on this water must be suffering from health hazards of waste water. Some strict and effective measure for the waste water quality of Sam Higginbottom Institute of Agriculture is urgently required.

REFERENCE

[1] **Allen and H.E. (1993).** The significance of trace metal speciation for water, sediment and soil quality criteria and standards. Proceeding of the Second European Conference on the Ecotoxicology. Ecotoxicology. Sloof, W.; de-Kruijf, H. 1-2, 23-46.

[2] **Bichi, M.H. and Anyata. (1999).** "Industrial Waste Pollution in the Kano River Basin", Environmental Management and Health , 10(2), pp. 112-116".

[3] **Ezeronye O,U., and Ubalua A,O., (2005).** Studies on the effect of abattior and industrial effluents on the heavy metals and microbial quality of Aba river in Nigeria. African Journal of Biotechnology Vol. 4 (3), pp. 266-272.

[4] **Howitt J, A., Baldwin D, S., Rees G, N., and Williams J, L., (2006).** Modelling blackwater: Predicting water quality during flooding of lowland river forests.

[5] **Miyamoto, S., Cruz and I. (1986).** Spatial variability and soil sampling for salinity and sodicity appraisal in surfaceirrigated orchards. Soil Sci. Soc. Am. J. 50.

[6] **Nawaz S, Ali S, M and Yasmin A. (2006).** Effect of industrial effluents on seed germination and early growth of Cicer arientum. J. Biosci., 6: 49-54.

Saad Asghar Moeeni, Lecturer, Department of Civil Engineering, Sachdeva Institute of Technology, Farah, Mathura.

J. Lordwin Girish Kumar, Associate Professor, Shiats Allahabad.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication Pvt. Ltd.