International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.1, 2015

RESEARCH ARTICLE

ISSN: 2321-7758

ASSESMENT OF PHYSICOCHEMICAL QUALITY OF FOOD WASTE WATER OF RAIPUR AREA

N.V.RAVI SHEKHAR[1*] & Dr. SUPRIYA BISWAS[2]

[1*]Research Scholar Shri Shankaracharya Technical Campus, Bhilai (C.G), Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G)

[2] Prof & Head, Shri Shankaracharya Technical Campus, Bhilai (C.G), Shri Shankaracharya Technical Campus, Junwani Bhilai (C.G)

Article Received: 18/02/2015 | Article Revised on:24/02/2015 | Article Accepted on:28/02/2015

N.V.RAVI SHEKHAR

ABSTRACT

: Food waste water samples were collected from Tatibandh and Telibandha Area in Raipur. Samples were collected between the periods of Jan 2014-Dec 2014 to determine the following parameters, pH, temperature, turbidity, chemical oxygen demand (COD, Biological oxygen demand (BOD), dissolved oxygen (DO), conductivity, total dissolved solid (TDS), total suspended solid (TSS), sulphate, nitrate, nitrite and phosphate. Levels of pH, conductivity, temperature, nitrate, nitrite, sulphate and phosphate, TSS, TDS, DO, BOD and COD were higher than the limits. The high concentration of metals in the food waste samples suggests that the waste water used for irrigation and farming of nearby areas is considerably polluted and thus unfit for agricultural purposes. Thus, the food waste water around the Raipur area (Tatibandh) area is significantly polluted. Waste waters from household, bakeries, diaries, canteens and commercial food waste should be properly disposed and or recycled. The objective of this research is to determine the levels of some physicochemical parameters in water and extent of pollutants present in it. The results show that the water is generally unfit for irrigation as the physicochemical parameters reveal higher values than the WHO guidelines as well as local municipal authorities.

KEY WORDS: Food waste, Physicochemical, Pollutant, Waste water, Surfactants.

INTRODUCTION

One of the most critical problems of developing cities is improper management of huge amount of wastes generated by various sources such as bakeries, hotels, canteens, confectioneries. Industries & commercial sites are the major sources of pollution in all environments. Based on the type of industry and source, various levels of pollutants can be discharged into the environment directly or indirectly through public sewer lines and dumping reservoirs which are directly connected from hotels and other commercial wastes. Wastewater samples were collected from the Raipur city situated in state of Chhattisgarh. Samples were collected between the periods of Jan 2014 to Dec 2014 to determine the following parameters, pH, temperature, turbidity, chemical oxygen demand (COD), Biological oxygen demand (BOD), dissolved oxygen (DO), conductivity, total dissolved solid (TDS), total suspended solid (TSS), sulphate, nitrate, nitrite and

phosphate. In addition, heavy metals (copper, nickel, cadmium, lead and Zinc) also were determined. Levels of pH, conductivity, temperature, nitrate, nitrite, sulphate, and phosphate, TSS, TDS, DO, BOD and COD were higher than the maximum permissible limits. The remarkable concentration of the metals in the waste water was higher than limits set by local municipal authorities and various other organizations. The high concentration of metals in the food waste samples suggests that the wastewater used for the irrigation and farming of these nearby areas can be categorized as polluted and thus unfit for agricultural purposes. Thus, the food waste water around the Raipur city is considerably polluted. Domestic and commercial food waste should be properly disposed and or recycled. Authorized agencies should make continuous effort to control, regulate, monitor and create awareness amongst people on indiscriminate waste disposal from domestic and commercial within the concerned area. The increasing global concern on the environment demands that wastes should be properly managed in order to minimize and possibly eliminate their potential harm to public health and the environment.

NATURE AND CHARACTERISTICS OF EFFLUENTS

Food wastes are generated by many hotels, canteens, bakeries and various commercial sources, as a result of used foods or washing of utensils where food is left out. Depending on the waste and source, the waste waters contain suspended solids, both biodegradable and non biodegradable organics: oils and fats; heavy metals and dissolved inorganic; acids, bases and coloring compounds. Food wastes excreted from commercial sources such as hotels and restaurants contains high content of oils and greases. Although, the physicochemical analysis of the effluents indicate that some of the hotels and restaurants conform to the recommended guidelines of various authorities, however exceptions occur in the total dissolved solids (TDS) and Nitrate (NO_{3-}) contents. It is observed that the pH analysis of effluents from food waste tends to be normally very acidic.

MATERIALS AND METHOD

SAMPLING AREA AND SAMPLING POINT

Food waste water samples were collected from different renowned hotels and restaurants of Raipur area (Tatibandh and Telibandha) for the analysis of physicochemical parameters. Measurement points for the sampling were designated as H1 to H5. Wastewater samples were collected at the discharge point from Tatibandh designated as H5; 500metres away from it at Mahoba Bazaar (H4); and at 1000 meters towards Ring road No:2 (H3) and towards airport road (Telibandha) samples were taken from two different hotels designated as (H2) and (H1) respectively. Food waste water was sampled at these points.

SAMPLE COLLECTION

The wastewater samples were collected from the discharge unit of the hotels and restaurants designated from H1 to H5 in hard glass bottles which has been thoroughly washed with non ionic detergent rinsed with tap water and after some time soaked in 10% HNO_3. The samples were collected differently for multiple tests. The samples were labeled and transported to the laboratory, stored in the refrigerator at about 4°C prior to analysis. The wastewater sample used for DO and BOD determinations were collected directly into dark DO bottles and were added some drops of manganous sulphate solution to fix the dissolve oxygen. After collection it was stored at room temperature.

METHODS OF ANALYSIS

All samples were analyzed as described in the Standard Methods from the Guide Manual: Water and Waste water analysis CPCB and other reference sources. Where analysis was not immediately possible, they were preserved to inhibit biodegradation. All the reagents used for the analysis were of analytical grade and obtained from Merck and Qualigens Brand.

DETERMINATION OF PHYSICOCHEMICAL POLLUTANT PARAMETERS

All field meters and equipment were checked and calibrated according to the manufacturer's specifications. The pH meter was calibrated using buffers of pH 4.0, 7.0 and 10.0 & dissolved oxygen (DO) meter was calibrated prior to measurement with the appropriate traceable calibration solution (5%HCl) in accordance with the manufacturer's instruction. The spectrophotometers for anions determination were checked for malfunctioning by passing standard solutions of all the parameters to be measured; Blank samples (deionized water) were passed between every three measurements of

wastewater samples to check for any eventual contamination or abnormal response of equipment. The dependent variables analyzed were pH, temperature, dissolved oxygen, total dissolved solid, nitrate, sulphate, phosphate and heavy metals concentration. Standard methods were followed in determining the above variables. In-situ measurements for some of the parameters, pH and temperature (°C) were measured using pH Electrode. Dissolved oxygen was measured with DO meter. Conductivity /TDS meter was used to measure the conductivity and total dissolved solids of the water samples. The power key and the conductivity key of the conductivity/TDS meter were switched on, and the meter was also temperature adjusted; the instrument was calibrated with 0.001M KCl to give a value of 14.7µS/m at 25ºC. The probe was dipped below the surface of the wastewater and surface water. Time was allowed for the reading to be stabilized and reading was recorded. The key was then changed to TDS key and recorded. The probe was thoroughly rinsed with distilled water after each measurement. Levels of turbidity and total suspended solid of the wastewater samples were determined using standard procedures. The biological oxygen demand determination of the wastewater samples in mg/L was carried out using standard methods described in guide manual. The dissolved oxygen content was determined before and after incubation. Sample incubation was for 5 days at 20ºC in BOD bottle and Physicochemical Determination of Pollutants in food waste water was calculated after the incubation periods. Determination of chemical oxygen demand was carried out using Liebig condenser with 300 mm jacket.

DIGESTION OF WASTEWATER SAMPLES FOR HEAVY METALS DETERMINATION

The wastewater samples were digested as follows. The sample, 100cm3 was transferred into a beaker and acidified to methyl orange with 5ml concentrated HNO_3. The beaker with the content was placed on a hot plate and evaporated down to about 10ml. Transferred to conical flask of 125 mL and cooled. Add another 5ml concentrated HNO_3 and 10 mL of perchloric acid 70% was also added. The beaker was covered with watch glass and returned to the hot plate. The heating was continued, and then small portion of HNO3 was added until the solution appeared light colored and clear. The beaker wall and watch glass were washed with distilled water and the sample was filtered to remove any insoluble materials. The volume was adjusted to 100cm3 with distilled water (N. Manivasakam 2011). Determination of heavy metals in the wastewater samples was done using Spectrophotometer (S-920) as described in the manufacturer's instruction manual.

ELEMENTAL ANALYSIS OF DIGESTED SAMPLES

Determination of heavy metals (copper, nickel, cadmium, lead and zinc) was made directly on each final solution using Spectrophotometer. Flame emission spectrometer was used to determine sodium (Na), potassium (K) and Calcium (Ca).

DETERMINATION OF NITRATE, NITRITE, SULPHATE AND PHOSPHATE IN THE WASTEWATER SAMPLES

The concentration of nitrate, nitrite, sulphate and phosphate were determined using Portable Data Logging Spectrophotometer. The spectrophotometers were checked for malfunctioning by passing standard solutions of all the parameters to be measured; blank samples (deionized water) were passed between every three measurements of water samples to check for any eventual contamination or abnormal response of equipment. Nitrate as nitrogen was determined by the cadmium reduction metal method 8036[Standard methods, 1976. DWAF,1992]. The cadmium metal in the added reagent reduced all nitrate in the sample to nitrite; while sulphate was determined by using Sulfa Ver methods 8051 [Standard methods, 1976. DWAF,1992].

RESULTS AND DISCUSSION

Table 1.Concentration of Physicochemical Parameters in wastewater samples from major hotels in Raipur city

Parameters Sampling Points	H1	H2	H3	H4	H5
pH	7.92±1.32	8. 92±2.03	10.32±1.43	9.53±0.54	9.54±0.54
Temp (OC)	31.34±0.32	31.11±0.11	35.34±2.94	31.34±1.44	32.34±1.44

Turbidity (NTU)	35.33±2.13	33.23±2.32	41.22±3.10	32.34±2.01	32.34±2.01
COD (mg/l)	563.32±5.43	511.45±7.21	697.11±6.45	530.05±9.23	530.05±9.23
BOD (mg/l)	252.11±2.32	222.43±4.23	340.11±4.34	242.22±2.77	245.22±2.77
DO (mg/l)	7.42±0.76	6.21±0.23	8.40±0.56	6.55±0.49	6.56±0.49
TDS (mg/l)	2320.23±33.23	2210.21±22.3	2655.43±16.33	2456.22±18.90	2455.22±18.90
TSS (mg/l)	1236.12±12.45	1131.23±14.32	2672.22±17.32	2672.22±17.32	2673.22±17.32
Conductivity (µS cm^{-3})	1122.41±10.21	1020.17±14.32	1534.21±12.43	1477.32±14.32	1477.32±14.32
Sulphate (mg/l)	171.32±0.83	154.33±1.02	251.21±1.32	211.22±0.77	212.22±0.77
Nitrate (mg/l)	223.21±1.21	210.43±0.34	283.33±1.74	233.56±1.92	234.56±1.92
Phosphate (mg/l)	111.45±0.42	102.23±0.11	163.22±0.56	154.22±0.67	152.22±0.67

The levels of the physicochemical parameters are presented in Table 1. From the results of this study the levels of pH varied between 9.92±1.32 and 8.92±2.03 for point H1 and H2; 10.32±1.43 to 9.53±0.54 for point H3, H4 and for H5 9.54±0.54 in the wastewater respectively. Generally point N3 shows the highest concentration followed by H3, while point H2 shows the least concentration. The mean pH values recorded for all the sampling point were above the municipal authorities and WHO. pH tolerance limit of between 6.00 – 9.00 for wastewater to be discharged into sewage line with exception of point H2.

Temperature is basically important for its effect on other properties of wastewater. Average temperature of wastewater under investigation is 31.34±0.32ºC for H1; 31.11±0.11ºC for H2; 35.34±2.94ºC for H3; 31.34±1.44ºC for H4 and 32.34±1.44°C for H5. The results indicate that some reactions could be speeded up by the discharge of this wastewater into stream. It will also reduce solubility of oxygen and amplified odor due to anaerobic reaction (less oxygen). These values were higher than municipal authorities and WHO standard of 40 ºC for discharged of wastewater into stream. Similarly turbidity values were in the mean of 35.33±2.13NTU for H1; 33.23±2.32NTU for H2; 41.22±3.10NTU for H3; 33.34±2.01NTU for H4 and for H5 32.34±2.01NTU. The values obtained for turbidity in the entire sampling points under study were higher than prescribed standard of 5 NTU for discharged of wastewater into stream.

The conductivity values were 1123.41±10.21 µScm^{-3} for H1; 1021.17±14.32 µScm^{-3} for H2; 1534.21±12.43 µScm^{-3} for H3; 1477.32±14.32 µScm^{-3} for H4 and 1477.32±14.32 µScm^{-3} for H5 refer (Table 1). Conductivity of water which is a useful indicator of its salinity or total salt content is high in the wastewater from the major hotels in Raipur. This result is not surprising, since wastewater from domestic sewage often contain high amounts of dissolved salts. The mean conductivity values for all the sampling point were higher than the municipal authorities and WHO guideline values of 1000µScm^{-3} for the discharge of wastewater through hotels into sewages

The total suspended solids (TSS) concentrations were 1236.12±12.45 for mg/L H1; 1131.23±14.32 mg/L for H2; 2672.22±17.32mg/l for H3; 2672.22±17.32 mg/L for H4 and for H5 2673.22±17.32 mg/L (Table 1). Literature classified wastewater TSS as follows: TSS less than 100 mg/L as weak, TSS greater than 100 mg/L but less than 220 mg/L as medium and TSS greater than 220 mg/L as strong wastewater. Results of the study show that food wastewater from the major hotels in Raipur can be classified as strong wastewater and cannot be discharged into stream.

The mean concentration of Total dissolved solid (TDS) in the Raipur city are presented in Table 1. The concentration of TDS is 2320.23±33.23 mg/L for H1; 2210.21±22.32 mg/L for H2; 2655.43±16.33 mg/L for H3; 2456.22±18.90 mg/L for H4 and for H5 2455.22±18.90 mg/L. These values obtained for TDS in all the sampling points were higher than WHO standard of 2000 mg/L for the discharged of wastewater into surface water.

The concentrations of nitrate, sulphate and phosphate in all the sampling points varied between 210.43±0.34 to 283.33±1.74 mg/L for nitrate;

154.33±1.02 to 251.21±1.32 mg/L for sulphate and 102.23±0.11 to 163.22±0.56 mg/L for phosphate respectively refer (Table 1). High concentration of nitrate, sulphate and phosphate were observed in point H3, while low concentrations were observed for point H2. The levels of nitrate exceeded the WHO limits of 45mg/L and Indian guideline of 0.23 mg/L. Nitrate concentration was above the limit while sulphate was below the WHO limit of 250 mg/l for the discharged of wastewater into sewage. The levels of phosphate in the entire sampling point were higher than the WHO limit of 5mg/l for the discharged of wastewater into river. The levels of nitrate may give rise to Methaemoglobinemia, also the levels of nitrate reported in this study in addition to phosphate levels can cause eutrophication and may pose a problem for other uses.

Dissolved oxygen (DO) values obtained for point H1 to H2 varied between 6.21±0.23 to 8.43±0.56 mg/L as observed in Table 1. The DO is a measure of the degree of pollution by organic matter, the destruction of organic substances as well as the self purification capacity of the water body. The Standard for sustaining aquatic life is stipulated at 5mg/l a concentration below this value adversely affects aquatic biological life, while concentration below 2mg/l may lead to death for most fishes (Chapman, 1997). The DO level at point H1 to H5 was above these levels.

An indication of organic oxygen demand content of wastewater can be obtained by measuring the amount of oxygen required for its stabilization either as BOD and COD. Biological Oxygen Demand (BOD) is the measure of the oxygen required by microorganisms while breaking down organic matter. While Chemical Oxygen Demand (COD) is the measure of amount of oxygen required by both potassium dichromate and concentrated sulphuric acid to breakdown both organic and Inorganic matters. BOD and COD concentrations of the wastewater were measured, as the two were of major concern. The wastewater has an average COD concentration of 512.45±7.21 to 698.11±6.45 mg/L for point H2 to H4 refer (Table 1). BOD concentration of the wastewater obtained for point H1 to H5 ranged between 222.43±4.23 to 340.11±4.34 mg/L respectively. The concentrations of BOD and COD in all the sampling point were higher than the WHO values of 50 mg/L and 1000mg/L for the discharged of wastewater into stream. High COD and BOD concentration observed in the wastewater might be due to the use of chemicals, which are organic or inorganic that are oxygen demand in nature.

The results for elemental concentration in food wastewater samples from major hotels in Raipur city for different sampling points are shown. The composition of metals in the wastewater samples ranged from 2.87 to 5.22 mg/L for Mn; 4.57 to 7.45 mg/L Mg; 2.32 to 3.78 mg/L Cu; 1.00 to 3.58 mg/L Cd; 1.23 to 2.87 mg/L Pb; 2.34 to 5.23 mg/L Co; 14.56 to 21.45 mg/L Fe; 1.56 to 4.33 mg/L Cr; 11.65 to 18.45 mg/L Ni; 20.91 to 32.94 mg/L Na; 19.43 to 27.34 mg/L K and 9.56 to 16.93 mg/L Ca for point H1 to H5. From the result of these study the concentrations of all the parameters study are in the following order H1>H2<H3>H4>H5.This variation is due to the fact that point H1 is the discharged point from Airport road which is high crowded area hence consumption of food materials in hotels is more and decrease towards point H2 less crowded area. While the high values at point H3 is due to the discharged of food wastewater from densely crowded area in city which might increase the concentration of these parameters, and finally decreases toward point H5 due to sedimentation and dilution

CONCLUSION

From the data collected from this research, the physicochemical parameters monitored in point H1, H2, H3, H4 and H5 showed high levels of all the parameters. This must be as a result of the nature of waste water from the highly crowded area to least crowded area. Point H3 showed the highest concentration of the physicochemical parameter, while point H2 shows the lowest values. The concentration of heavy metals and some anions in all the food waste samples were higher than values set by local authorities and WHO, this high values are due to the used of untreated wastewater from the hotels and restaurants for the irrigation of these vegetables. Accordingly, wastewater from all the sampling points are polluted as it can be observed from the results obtained from the food waste water samples.

REFERENCES

[1]. Ademoroti CMA (1982). Recent Development in Research in Wastewater

Renovation in Nigeria. The Nigerian Engineers. J. Niger. Soc. Eng. 17(1): 31-36.

[2]. Ademoroti CMA (1994). Short term - BOD tests; Effl. Wat. Treat. J. 24(10): 373–377.

[3]. Ademoroti CMA (1996a). "Standard Method for Water and Effluents Analysis" Foludex Press Ltd. Ibadan. Nigeria.

[4]. Ademoroti CMA (1996b). Environmental Chemistry and Toxicology, Foludex Press Ltd. Ibadan Nigeria pp. 134-146.

[5]. AWWA, Standard Methods for the Examination of Water and Waste Water, (American Water Works Association, Washington, DC, 1990). Schutte, F , Handbook for the Operation of Water Treatment Works. (The Water Institute of Southern Africa,2006).

[6]. Chapman, D. (1997). Water Quality Assessment. A Guide to the use of Biota, Sediments and water in Environmental Monitoring. Second Edition. E& FN Spon, London. file: A//:\Hydrology and Water Quality of Lake Merced.htm.

[7]. DWAF (1992) Analytical Methods Manual, TR 151. Department of Water Affairs and Forestry, Pretoria. DAWF and WRC (1995)

[8]. South Africa Water Quality Guideline 1: Domestic water use (2nd edn) Department of Water Affairs and Forestry, Pretoria.

[9]. DWAF, (1996c) South Africa water quality Guidlines. 7: Aquatic Ecosystems (1st Edn) Deparment of water Affairs and forestry, Pretoria.

[10]. HACH, (1997). Water Analysis Handbook, 3rd edition, HACH Company, Loveland,Colorado, USA.

[11]. Sharma, R.K., Agrawal, M., and Marshall, F. (2007). Heavy metal contamination of soil and vegetables in suburban areas of Varanasi, India. Ecotoxicol. Environ. Safety. J. Doi 10.1016/jecenv

[12]. Schutte, F , Handbook for the Operation of Water Treatment Works. (The Water Institute of Southern Africa,2006).