Performance Evaluation Of ETP Of Lifeline Feeds Pvt. Ltd., Chikamagalur, Karnataka, India

Kiran B.M [1] Srikantaswamy.S[2] Avani Rajesh Macwan[3] Binu John[4] Sneha S[5]
[1,3,4,5] Department of Environmental Engineering [2] Department of Studies in Environmental Science
[1,3,4,5]Adichuchanagiri Institute of Technology, Chikamagalur, Karnataka, INDIA
[2]Manasagangotri, Mysore, Karnataka, INDIA

Abstract--- Performance study of the existing wastewater treatment plant of the Lifeline Feeds Pvt.Ltd and the treatability study of the wastewater were conducted from Feb 10th to April 21st, wastewater samples were collected for the present study from 6 predetermined stations. These samples were analyzed for water quality parameters.

For the characterization of the incoming wastewater to the existing treatment plant, influent samples were collected from the existing treatment plant. The study revealed that approximately 100KL/day of wastewater is entering into the treatment plant every day and its pH is maintained in the beginning only. Its average composition for BOD, COD, TDS, TSS and Cl was found to be 320.69mg/L,790.48mg/L,1169.72mg/L,807.33mg/L,242.16 mg/L respectively, it has been reduced to 31.4mg/L, 145.576mg/L, 421.366mg/L,86.99mg/L, and 194.67mg/L respectively.

The maximum reduction 98.78% was observed in COD followed by BOD, TSS, TDS and then Cl which is 93.48%, 92.27%, 83.73%, 34.38% respectively. Above reduction indicates that removal efficiency ranges between 34.38 % to 98.78 % which is quite high.

I. INTRODUCTION

Indian poultry sector has been growing at around 8-10% annually over the last decade with broiler meat volumes growing at more than 10% while egg at 5-6% driven by increased domestic consumption. The production capacity has responded with increased integration and large scale implementation of contract poultry farming. Farmers in India have moved from rearing country birds in the past to rearing hybrids which ensure faster growth of chicks, higher eggs per bird, increased hatchability, low mortality rates, excellent feed conversion and consequently sustainable profits to the poultry farmers. The industry has been supported by indigenous advancements in genetic capabilities, veterinary health, poultry feed, poultry equipment, and poultry processing sectors.

The productivity gains of poultry industry are reflected in relatively lower price increases in poultry meat over last five years compared to other meat products - Poultry WPI (wholesale price index) has grown at 12% year to year over 2008-2013 as against 21% for overall meat products basket – providing an affordable alternative for meeting protein requirements in Indian diet.

Domestic poultry meat production (broiler - carcass weight) is estimated to have increased from less than 1.0 million tons in 2000 to 3.4 million tons in 2012with per capita consumption increasing from 0.8 kg to 2.8 kg per annum during same period. Egg production is estimated to have increased from 30 billion egg since 2000 to 66 billion eggs in 2012 with per capita egg consumption increasing from 28 to 55 eggs during that period. The healthy growth in poultry output over last decade makes India one of the fastest growing major world market in the segment with future growth potential remaining strong on back of wide gap against global per capital consumption norms and favorable socio-economic factors.

The efforts of key integrators in poultry industry to control supply through measures like 'hatching holidays' initiated towards fag end of 2012 has resulted in improved realizations in 2013 and industry is expected to register much better profitability compared to last calendar year. The continued industry wide co-ordination will be critical to maintain sustainable margins in the business considering increased production costs and seasonal volatility associated with the poultry products though long term solution lies in developing processed chicken industry with value added offerings to protect against regional and seasonal variations in prices. As the poultry industry growth is indigenous, so is the increasing need for best treatment technologies of the waste released by this industry.

The performance efficiency of a treatment plant depends not only on proper design and construction but also on good operation and maintenance. Performance evaluation of existing treatment plant is required to assess the existing effluent quality and/or to meet higher treatment requirements and, to know about the treatment plant whether it is possible to handle higher hydraulic and organic loadings. Performance appraisal practice of existing treatment plant units is effective in generation of additional data which also can be used in the improvement in the design procedures to be followed for design of these units. Existing facilities can be made to handle higher hydraulic and organic loads by process modifications, where as meeting higher treatment requirements usually requires significant expansion and/or modification of existing facilities.

One of the primary considerations in evaluating an existing effluent treatment plant is in the area of plant operation and control. A major tool required for proper process control is frequent and accurate sampling and laboratory analysis. Poor conditions of sewerage system, improper design of the plant and organizational problems are important factors that cause treatment plant not to meet the effluent standards Overloading due to increase in production and water use, discharge of additional trade effluents are other reasons of recent times for the poor performance of effluent treatment plants. The treatment efficiency may be badly affected if the system is hydraulically under loaded.

II. CHARACTERISTICS

The desired qualities of water depend on the purpose for which it is to be used. These water qualities are measured by a number of parameters which include biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), oil and grease, nitrate, phosphate and pH. The term wastewater (WW), is defined as the spent or used water of a community or industry which contains dissolved and suspended matter, and about 99% of which is liquid while the remaining 1% is solid waste. The composition of WW depends on the source of generation. Poultry slaughter houses produce substantial amounts of WW containing high amounts of biodegradable organic matter, suspended and colloidal matter such as fats, proteins and Cellulose. The WW is generated from various operations such as chicken cutting, scalding de-feathering, eviscerating, chilling, packaging and plant cleanup. Slaughter house WW has a complex composition and is very harmful to the environment. It has high organic concentration compared to domestic WW. After the initial screening of coarse solids, slaughter house WW is mainly composed of diluted blood, fat, and SS. It may also contain some manure while pathogens, including salmonella and shigella bacterial, parasite eggs and anaerobic cysts may also be present. WW must be treated before it is either discharged onto water courses or open field in order to reduce its potential environmental hazards. Where there is a need for it to be reused, the treatment becomes even more essential.

The clean water act prohibits the discharge of toxic pollutants in large amounts into water courses or open lands. The biological method of treatment involves the use of bio-organisms either in the presence (aerobic) or otherwise (anaerobic) of oxygen to reduce the pathogenic loads. The chemical method involves the use of chemicals in different forms and means in the treatment of the WW. The choice of an appropriate biological treatment system is influenced by a number of factors, including WW load and the need to minimize odors. The removal efficiencies of the various WW components depend on the method used and amounts of SS that can be removed in the primary treatment phase. Sand filtration system has been reported to achieve over 95%removal of BOD and COD investigated the use of the coagulation/ flocculation process to remove organic matter from slaughter house WW by adding aluminum salts and polymer compounds. The COD removal efficiency was reported to be in the range of 45-75%.

SOURCES	**WASTE**
Stock yard	Manure
Killing floor	Blood
Dehairing	Hair dirt
Insides removal	Paunch manure liquor
Rendering	Stick or press liquor
Carcass dressing	Flesh,grease,blood,manure
Parameters Characteristic	
Quantity	2000 m^3/day
Total solids	4000 to 5000 mg/L
BOD	4000 mg/L
COD	8000 mg/L
pH	6 to 7

Table 1: Parameters and characteristics

III. MATERIALS AND METHODOLOGY

A. Description of study area

The Lifeline feeds Pvt. Ltd. advanced processing plant is located on four and half acres in Amble village in Gowdanahalli, Chikmagalurdistrict, Karnataka state. The Chikmagalur district with a geoGRAPHical area of 7201 Sq.km lies partly in malnad tract and partly in the transition and maiden area. The perspective plan for industrial development of Chikmagalur district has been designed with the main objective of facilitating planners, prospective investors, financial institutions, Govt. organizations and the public to take fruitful decision on promoting / starting industries based on the resources available and demand. It helps planners to assess the infrastructure requirements of various sectors, so that the industrialization of the district takes place on a faster pace. There are two industrial estates in the area vicinity, one at Chikmagalur and the other is at Birur of Kadur Taluk. The district's only industrial area is located at Amble village about 7 km. from Chikmagalur town.

Fig. 1: Chikmagalur district map with taluks

IV. ETP PROCESS DESCRIPTION

A. Neutralization tank

Neutralization is a common practice in wastewater treatment and waste stabilization. If a waste stream is found to be hazardous because of corrosivity, neutralization is the primary treatment used. Moreover, neutralization is used as a pretreatment systembefore a variety of biological, chemical, and physical treatment processes. Since manychemical treatment processes, such as metal precipitation, coagulation, phosphorus precipitation, and water softening are pH dependent, the pH of these processes is adjustedto achieve maximum process efficiency. Furthermore, the pH of the effluent wastewater from different industrial activities also requires adjustment prior to its discharge intoreceiving water bodies. When these two wastewater streams are combined, the pH is “neutralized” and approaches 7. If the resulting pH of the combined liquids is not within the acceptable range for discharge, an additional amount of either acid or base must be added to shift the pH into the acceptable range generally, the chemicals used to adjust the wastewater are alum and lime.

V. CLARIFIERS

Settling tanks built with mechanical means for continuous removal of solids being deposited by sedimentation. A clarifier is generally used to remove solid particulates or suspended solids from liquid for clarification and (or) thickening. Concentrated impurities, discharged from the bottom of the tank are known as sludge, while the particles that float to the surface of the liquid are called scum. The clarifiers have four sections to provide efficient solids / liquid separation: The inlet section to provide a smooth transition from the high inlet piping velocities to the low settling zone velocity; the settling zone to provide a low upward liquid velocity; a transition to the high velocity of the outlet overflow; and the sludge zone to collect, compact and remove the settled solids. Mechanical failures to any of the internals, such as holes in the center well wall or plugged overflow weirs, will adversely affect the solids removal efficiencies.

VI. AERATION TANK

Oxygen must be provided in wastewater treatment plants to satisfy several different demands. These include the biological degradation of organic materials and oxidation of ammonia and other inorganic materials. Aeration is the process by which oxygen is transferred to the liquid. Themain purposes are to supply the oxygen required and provide enough mixing to keep solids in suspension. Aeration can also be accomplished by forcing water into the air. A pump is situated at the lower level of the water body and connected to a hose. This hose is positioned at the surface of the water or connected to an ornamental fountain. When the pump is activated, the water from the bottom is forced up through the hose and into the air. The exchange of gases and oxygen takes place in the air before the water falls back into the pond.The solids are returned to the influent of the aeration tank (return activated sludge).

VII. SAND FILTERS

Water purification for treating raw water to produce a potable product. They are typically 1 to 2 meters deep, can be rectangular or cylindrical in cross section and are used primarily to treat surface water. Slow sand filters differ from all other filters used to treat drinking water in that they work by using a complex biological film that grows naturally on the surface of the sand. The sand itself does not perform any filtration function but simply acts as a substrate.

VIII. CARBON FILTER

Activated carbon is the main higher material is made, such as wood, coal, shell, bone, oil residue, etc. And coconut shell is the most commonly used raw material, under the same conditions, coconut shell activated activity, quality and other characteristics are the best, because it has the biggest specific surface. According to the activated carbon adsorption characteristics of activated carbon are mainly used to remove contaminants, discoloring, and filtered liquid. Activated carbon filter operation is through the carbon bed to finish.

IX. METHODOLOGY

In order to start examinations, a literature review was made by studying books, journals and various reports .A thorough study of existing Effluent Treatment Plant (ETP) was done for a period of 60days.

During the study phase of various treatment units, removal efficiencies of following parameters were determined.

1. Chemical oxygen demand(COD)
2. Biochemical oxygen demand(BOD)
3. pH
4. Total dissolved solids(TDS)
5. Total suspended solids(TSS)
6. Chlorides

Samples were collected at inlets and outlets of each unit weekly for a period of 3 months by the method of grab sampling. The samples were taken to AIT Chikmagalur, Department of Environmental Engineering analysis laboratory. The analytical procedures for examining and monitoring the above parameters were adopted from the procedure outline in the standard methods. Water used in all the experiments was laboratory distilled water (6.8-7.1) unless specified.

X. RESULTS AND DISCUSSIONS

Samples were collected from six points. Sampling points are waste water [P-1], Equalization Tank [P-2], Clarifier [P-3], Aeration Tank [P-4], Secondary clarifier [P-5] and Carbon filter [P-6] to evaluate the performance of Effluent Treatment Plant. Results have been summarized and discussed in the following sections.

Table 2 Analyzed Parameter Values For The Month Of February

DATE	SAMPLING LOCATION	PARAMETERS				
February		BOD	COD	TDS	TSS	Cl
10/2/2014	1 Raw Influent	300	1080	1221	760	232.99
	2 Neutralization tank	286.8	756	1081	740	224.49
	3 Primary clarifier	256	400	983	600	211.494
	4 Aeration tank	237.2	172	880	540	208.44
	5 Secondary clarifier	94.9	244	721	60	201.494
	6 Carbon filter	30	228	740	60	200
17/2/2014						
	1 Raw Influent	298.4	1078	1233	761	230.49
	2 Neutralization tank	289.1	756.1	1013	735	226.49
	3 Primary clarifier	254.7	399.3	994.5	598.4	220.55
	4 Aeration tank	237.5	174.5	801.23	549.9	208.46
	5 Secondary clarifier	94.3	245	723	63.2	202.457
	6 Carbon filter	31.4	225.6	740	61.4	202.32
24/2/2014						

	1 Raw Influent	298.44	1079.3	1223.45	760	233.52
	2 Neutralization tank	289.99	756.3	1063.23	739	223.53
	3 Primary clarifier	253.57	400.11	995.5	600	209.33
	4 Aeration tank	231.56	173.3	799.25	544	207.56
	5 Secondary clarifier	93.45	245.35	743.68	61.12	202.494
	6 Carbon filter	30	229.9	739.3	61.5	202.33
March		BOD	COD	TDS	TSS	Cl
10/3/2014	1 Raw Influent	397.7	716	1040	660	204.22
	2 Neutralization tank	295.7	540	960	540	200.72
	3 Primary clarifier	247.7	464	880	430	198.72
	4 Aeration tank	235.7	44	760	340	198.21
	5 Secondary clarifier	94.7	8	580	240	193.71
	6 Carbon filter	25.7	8	320	120	189.207
17/3/2014						
	1 Raw Influent	398.4	715.6	1044	661	211.25
	2 Neutralization tank	298.2	543	968	541	204.79
	3 Primary clarifier	247.1	466	882	435	196.12
	4 Aeration tank	236.2	46	759	346	195.21
	5 Secondary clarifier	95.3	9	582	246	194
	6 Carbon filter	26.1	8.5	322	124	189.208
24/3/2014						
	1 Raw Influent	399.6	717	1045	662	202.3
	2 Neutralization tank	299.2	565	962	542	200.12
	3 Primary clarifier	297.5	467	835	434	198.72
	4 Aeration tank	237.3	76	758	346	195.2
	5 Secondary clarifier	945.2	8.68	583	243	188.2
	6 Carbon filter	26.2	8.2	325	126	188.05

TABLE 3: analysed parameter values for the month of march

April		BOD	COD	TDS	TSS	Cl
7/4/2014	1 Raw Influent	265.7	576	1240	1000	285.99
	2 Neutralization tank	259.7	532	1002	885	211.49
	3 Primary clarifier	187.7	516	970	720	204.49
	4 Aeration tank	106.7	324	840	600	199.49
	5 Secondary clarifier	43.7	212	680	160	191.49
	6 Carbon filter	37.7	200	200	80	187.49
14/4/2014						
	1 Raw Influent	264.2	577	1247	1002	286.88
	2 Neutralization tank	257.3	534	1007	883	212.43
	3 Primary clarifier	189.5	575	943	723	208.85
	4 Aeration tank	118.7	326	847	604	199.43
	5 Secondary clarifier	56.9	218	680	164	193.47
	6 Carbon filter	40	201	203	77	189.25
21/4/2014						
	1 Raw Influent	263.5	577	1200	1000	288.87
	2 Neutralization tank	259.5	534	1020	887	212.48
	3 Primary clarifier	185.3	575	943	723	208.85
	4 Aeration tank	108.4	326	847	604	199.43
	5 Secondary clarifier	43.5	218	688	163	192.50
	6 Carbon filter	35.5	201	203	75	188.25

TABLE 4: Analyzed parameter values for the month if April

Data presented in Table 4.1, 4.2, 4.3 shows monthly variation of BOD, COD, TDS, TSS, Cl at different sampling points.[P-1] sampling is a raw water sample that concentration is already high. That wastewater treated in [p-6] treatment unit i.e. Carbon filter, after that wastewater is discharged to the sewerage system or gardening purpose. Suspended solids in a wastewater removed up to 60 mg/L. COD in the raw effluent was found to be 1080 mg/L, which is reduced to 8 mg/L after secondary treatment.. BOD in raw effluent was found to be 399.6 mg/L which is reduced to 25.7 mg/L after secondary treatment. BOD is highly reduced after secondary treatment.

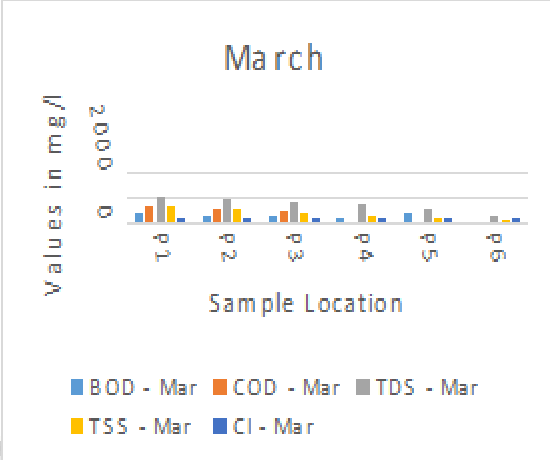

Fig. 2:

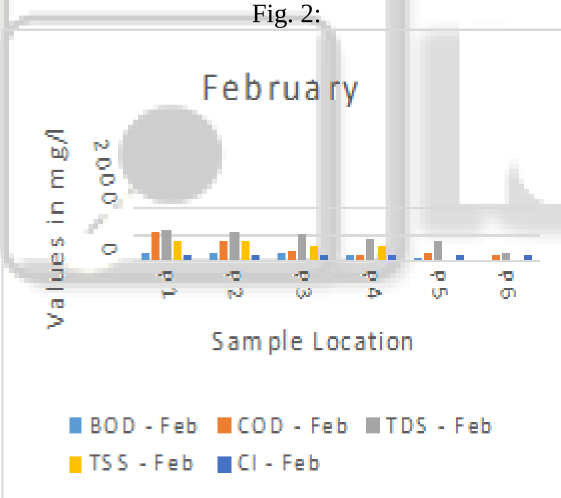

Fig. 3:

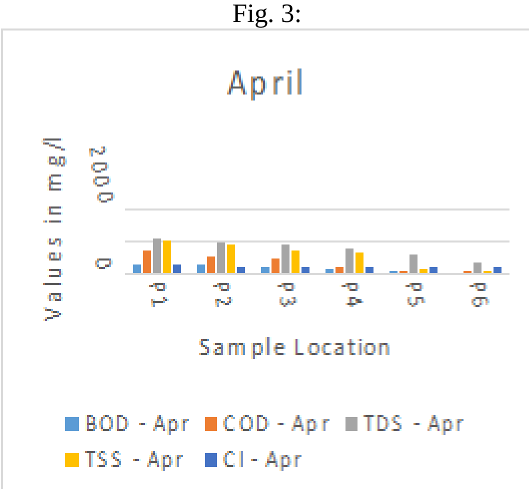

Fig. 4:

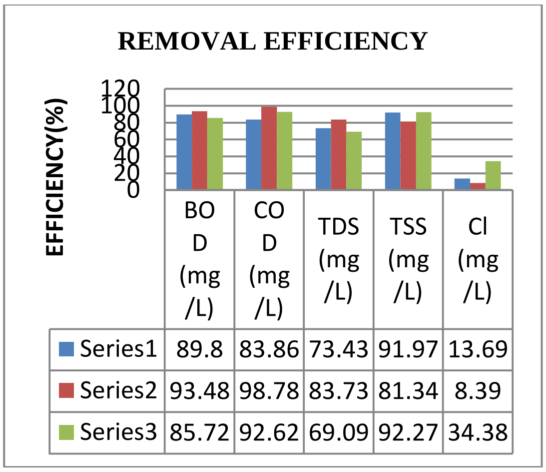

Fig. 5:

XI. DISCUSSIONS

As shown in TABLE 4.1, 4.2, 4.3 the range of TSS for February, March and April month at inlet of the treatment plant was found to be 760 mg/L to 1002 mg/L and at outlet of the treatment plant was found to be 60 mg/L to 126mg/L.The slightly low efficiency of TSS removal is due to excessive turbulence in the treatment unit ,therefore , the likelihood of entrapping suspended and colloidal solids is reduced. TABLE 4.1,4.2,4.3 shows the range of BOD at inlet of the treatment plant unit was found to be 263.5 mg/L to 399.6 mg/L and at outlet of treatment plant was found to be 25.7 mg/L to 40 mg/L.BOD removal efficiency was found to be between 84.85 % to 93.54 %.

XII. CONCLUSIONS

The BOD, COD, TDS, TSS, Cl removal efficiency of ETP was observed to be 93.48%, 98.78%, 92.27%, 83.37%, 34.38% respectively. It was observed that the plant working condition is satisfactory. At some times the readings was varying day by day either due to high or low flow rate. The Chloride removal percentage is less compared to other parameters. The treated water is being used for gardens and for construction activities. The treated water is not being reused.

REFERENCES

[1] Al-Mutairi, N., Hamoda, M. and Al-Ghusain, I. 2003. Performance based characterization of a contact stabilization process for slaughterhouse wastewater. Journal of Environmental Science and Health, 38, 2287–2300.
[2] AmeenSarairah and Ahmad Jamrah(2008), Characterization and Assessment of Treatability of Wastewater Generated in Amman Slaughterhouse ,Dirasat, Engineering Sciences, Volume 35, No. 2.
[3] Brian Harry Keipper, Athens,Georgia,2003Characterization of poultry processing operations, wastewater generation, and wastewater treatment using mail survey and nutrient discharge monitoring methods.
[4] Budiyono et al.,"Study on Treatment of Slaughterhouse Wastewaterby Electro-coagulation Technique",Internat. J. of Sci. and Eng. Vol. 1(1):25-28, July 2010,
[5] C.K. Chen et al.,(2003) "Treatment of slaughterhouse wastewater using an activated sludge/contact aeration process",Water Science and Technology Vol 47 No 12 pp 285–292.

[6] HoracioSaravia et al.(2005), "Economic Analysis of Recycling Chiller Water in Poultry Processing Plants Using Ultrafiltration Membrane Systems", Journal of Food Distribution Research 36(1).
[7] K. Sundara Kumar et al.,"Performance Evaluation of waste treatment plant"/ International Journal of Engineering Science and Technology Vol. 2(12), 2010, 7785-7796
[8] Manjunath, N. T., Mehrotra, I. and Mathur, R. P. 2000. Treatment of wastewater from slaughterhouse by DAF UASB system, Journal of Water Research, 34, 1930-1936.
[9] Masse, D. I. and Masse, L. 2000a. Treatment of slaughterhouse wastewater in anaerobic sequencing batch reactor. Journal of Canadian Agricultural Engineering, 42(3).
[10] Masse, D. I., and Masse, L. 2000b. Characterization of wastewater from hog slaughterhouse in eastern Canada and evaluation of their in-plant wastewater treatment system. Journal of Canadian Agricultural Engineering, 42, 139-146.
[11] Metcalf and Eddy (Tata McGraw-Hill),wastewater Engineering Treatment and Reuse(Fourth Edition)
[12] R. Rajakumar et al. "Treatment of poultry slaughterhouse wastewater in upflow anaerobic filter under low upflow velocity", Int. J. Environ. Sci. Tech., 8 (1), 149-158, Winter 2011 ,ISSN: 1735-1472 © IRSEN, CEERS, IAU
[13] Tony Pescatore, Steve Skelton and Jacquie Jacob" Processing chickens" University of Kentucky, College of Agriculture, Lexington.
[14] YahayaMijinyawa et al.,(2008), "Treatment efficiency and economic benefit of Zartech poultry slaughter house waste water treatment plant, Ibadan, Nigeria" Scientific Research and Essay Vol. 3 (6), pp. 219-223.

