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Performance Evaluation of Effluent Treatment Plant for Rice Industry: a Case study of Aggarwal Agro industry Ambala, Haryana

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Abstract: ***The present study has been undertaken to evaluate performance efficiency of an Effluent Treatment Plant (ETP) of a rice mill located in Adhoya Distt. Ambala. An effluent treatment plant is operating on biological treatment method (Activated Sludge Process) with an average waste water inflow of 60 KLD has been considered for case study. Waste water samples were collected from the inlet, secondary tube settler outlet & final outlet of the effluent treatment plant and analyzed for the major water quality parameters, such as pH, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), and Total Suspended Solids (TSS). The effluent samples were collected on a weekly basis for a period of five months. The BOD, COD and TSS of the treated effluent reduced significantly, whereas very small reduction was observed in dissolved solids.***

Keywords: **Effluent treatment plant, Rice industry effluent, Activated sludge process, different parameter of *ETP***

I. INTRODUCTION

Among agro-industries, rice processing industry is the biggest industry in India. Moreover, it has the biggest area under rice cultivation. Almost all of the Rice mill effluent generation comes from parboiling of rice. It discharges processed waste water, particulate matter and solid wastes. Rice husk produces rice husk ash when burned as a fuel through boilers/furnaces which needs to be disposed properly. Poorly treated waste water with high levels of pollutants caused by poor design, operation or treatment systems creates major environmental problems when discharged to surface water or land. Such problems include: More growth of algae in water bodies as effluent is rich in nutrients. Eutrophication problem in tanks leads to low dissolved oxygen content and reduction in water quality. Due to color and turbidity of waste water, low penetration of sunlight into waterways affects the photosynthesis process. Pollution of inland surface water is a threat to natural ecosystem and lifestyle of people as well. Impact on public health due to soak waste water discharged into land and water bodies is another issue. Also land degradation and damage to pastures and crops due to low pH and Organic matter. Environmental degradation is an escalating problem owing to the continual expansion of industrial production and high-levels of consumption. A renewed dedication to a proven strategy to resolve this problem is needed. Cleaner Production is one such strategy, which can address this problem. It is a preventive environmental management strategy, which promotes eliminating waste before it is created to systematically reduce overall pollution generation, and improve efficiencies of resources use.[1]. The quality of such effluents can be determined by their physico-chemical and biological analysis. Monitoring of the environmental parameters of the effluents would allow having at any time, a precise idea on performance evaluation of the effluent treatment plant (ETP) and, if necessary, appropriate measures may be undertaken to achieve environmental compliance or to prevent the occurrence of critical pollution. Moreover, such information can also be utilized to establish methods for improved mill management and plant waste minimization strategies [2].

II. LITERATURE REVIEW

A major part of the total rice is converted into sella or parboiled rice, meaning partially boiled or partially cooking rice. It is economical as well as nutritious. Parboiling is a permilling process for paddy which originated in India [3]. Parboiled rice production generally requires a large amount of water for soaking of the paddy. After soaking, the water is drained out. This water if not properly treated could result in water pollution and odor nuisance to residents. Water pollution can be caused by high levels of organic matter present in wastewater [4]. This effluent has high BOD, COD and organic contents mainly in the form of starch, thus having the potential to damage and deteriorate the environment [5]. Therefore, it needs to be treated before disposal. The performance of treatment plan can be improved by adopting some suitable remedial measures.[6]Carried out the study

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on evaluating efficiency of the treatment plant by studying water samples, which were collected at different stages of treatment units. Parameters like BOD, COD, TSS and TDS were studied. Performance efficiency of each unit was calculated, which is the evidence that CETP has been working with the norms of MPCB and meeting the standard discharge limits. Hence, in the present study, an attempt has been made for performance evaluation of Effluent treatment plant (ETP) provided for the treatment of waste water generated by rice mill. Waste water sample were collected at different stages of treatment units and analyzed for the major water quality parameters, such as pH, TSS, TDS, BOD and COD. Performance, evaluation and operational aspects of effluent treatment plant and its treatability, results revealed that the treated effluent shows most of the parameters such as pH, TDS, TSS, BOD, COD, are within permissible limits of Central Pollution Control Board (CPCB).

III. MATERIALS AND METHODS

The physico chemical analysis was done to understand the performance evaluation of the ETPs. The study was conducted at a rice mill ETP namely Aggarwal agro industry at Adhoya in district Ambala, Haryana, India. For understanding the performance evaluation of ETP. The duration of study was from July 2014toNovember 2014.The samples were collected at a regular time interval of one week. Samples were collected every Sunday and were tested every Monday. Three samples were collected from rice mill effluent treatment plant; that is one from raw water sample of the ETP inlet, one from secondary clarifier outlet and one from treated water sample of ETP outlet. They were analyzed by comparing the concentrations as per Indian standards method. Activated sludge process was adopted as the system of treatment for the present study.

Method of sampling and testing (physical and chemical) for Waste Water

- IS 3025(PART 1) 1987 –SAMPLING.
- IS 3025(PART 11) 1983, (R-2002)– pH VALUE.
- IS 3025(PART 44) 1993, (R-2009)–B.O.D.
- IS 3025(PART 58), (R-2006) –C.O.D.
- IS 3025(PART 16) 1984, (R-2006)–T.D.S.
- IS 3025(PART 17) 1984, (R-2012)- T.S.S.

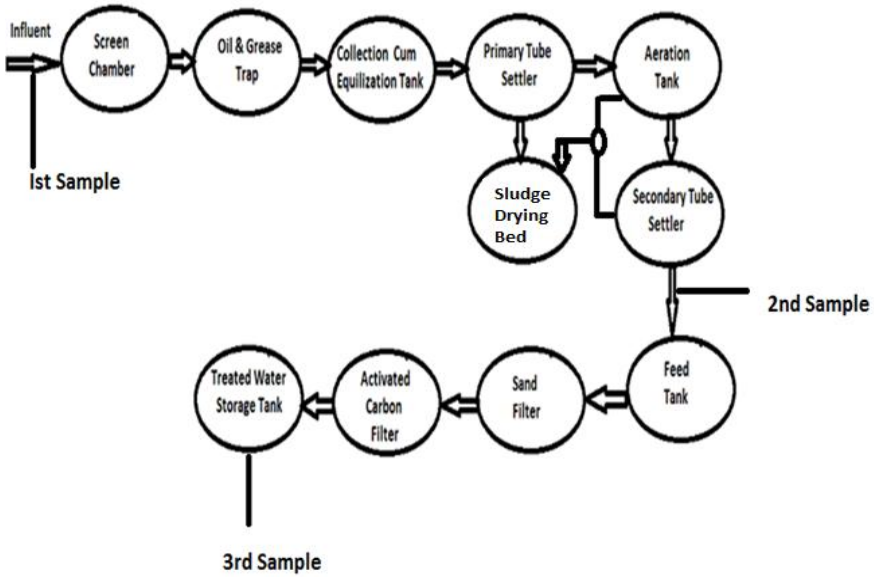

Fig. 1. Flow diagram of effluent treatment plantof Aggarwal Agro industry Ambala

BRIEF PROCESS DESCRIPTION

Primary Treatment

The Effluent will first pass through the Screen Chamber followed by oil and grease trap and then will be collected in the Effluent Collection Cum Equalization tank. From Effluent Collection Cum Equalization tank, the effluent will be transfer to the primary tube settler tank for the settling of sludge. The primary treated water will then enter into the Aeration tank for biological treatment.

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Secondary (Biological) Treatment

The aeration tank based on aerobic attached growth process oxidizes the organic matter in effluent to CO_2 and H_2O by the aeration principle. The aeration tank is fitted with no of air diffusers of suitable capacity to provide necessary dissolved oxygen mixed to the effluent. Biological media is provided in the tank to increase the surface area for the attachment of bacteria and hence reduces the size of the tank. Twin-Lobe Blowers for oxidation provides the aeration. The biological system has to be operated continuously for at least 20 hours and there by constant feed of Effluent water is required.

The secondary tube settler, which designed on low overflow rate, is provided after the aeration tank to enable the separation of solids. A steep slope is provided in the secondary settling tank. A part of the sludge is recirculated to the aeration tank in order to maintain MLSS levels and a part is drained to the sludge drying beds. Acclimatized Bacterial Culture will be added into the Aeration tank.

Tertiary Treatment

The Clarifier water collected from the collection launder of the secondary clarifier is collected in Filter feed tank and is pumped to the tertiary treatment. It is necessary to pass the effluent further through tertiary treatment comprises of filtration with Pressure sand Filter and Activated carbon Filter for removal of micro-suspensions, colures and odors.

Sludge Treatment

The Sludge generated from the secondary treatment will be send to Sludge Drying Beds. The Sludge will be dried in natural heat of the sun light. The dried sludge will be used as manure.

Table 1: General Standards for Discharge of Environmental Pollutants (Ref: according to CPCB) [7]

S.No.	Parameters	Land for Irrigation
1.	Suspended Solids mg/l	200
2.	pH value	5.5 to 9.0
3.	BOD (3 days at 27 C), mg/l	100
4.	COD, mg/l	250
5.	Dissolved Solids mg/l	2100

IV. RESULT AND DISCUSSION

Reference [8] shows the performance efficiency of a sewage treatment plant operating on biological treatment method (Activated Sludge Process) with an average inflow of 23 MLD for different parameters, such as biological oxygen demand (BOD), Chemical oxygen demand (COD), Total suspended solids (TSS) and Total dissolved solids (TDS).The pH directly affect the performance of a secondary treatment process.[9] because the existence of most biological life is dependent upon narrow and critical rang of pH. For evaluating the performance of ETP, the accurate idea of the compositions of effluents is very important. The evaluation of performance efficiency of the plant was undertaken in terms of effluent quality. This is so because industrial effluents contain various pollutants that may alter the quality of the receiving water and the environment at large. Data taken during 5 months of this study are presented. Results of weekly analysis of pH, biological oxygen demand (BOD), Chemical oxygen demand (COD), Total dissolved solids (TDS) and Total suspended solids (TSS) of Inlet, Secondary tube settler and final outlet Samples are summarized in table 2.

Table 2: Physico-chemical Parameter of Wastewater

DATE	SAMPLE	PARAMETERS				
		pH	BOD	COD	TDS	TSS
06.07.14	1	6.9	750	2091	3402	692
	2	8.0	131	292	2628	109

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	3	7.1	118	263	1820	96
13.07.14	1	6.6	726	2009	3384	651
	2	7.8	117	286	2528	104
	3	7.8	106	258	2072	89
20.07.14	1	6.7	705	1982	2419	785
	2	7.6	108	276	2091	128
	3	7.6	95	242	1654	116
27.07.14	1	7.9	718	2015	2774	615
	2	8.1	125	282	1612	107
	3	8.5	104	257	1540	94
03.08.14	1	6.7	687	1945	2848	679
	2	7.8	120	279	2028	121
	3	7.4	101	251	1456	112
10.08.14	1	7.5	736	1998	4242	702
	2	7.7	115	276	2980	116
	3	7.7	97	238	2055	104
17.08.14	1	6.8	672	1886	3095	591
	2	7.6	101	254	2491	98
	3	7.2	89	221	1826	83
24.08.14	1	6.7	736	1991	3591	674
	2	7.4	126	276	1540	122
	3	7.5	109	259	1149	107
31.08.14	1	7.2	706	1935	3281	865
	2	7.6	122	261	2415	118
	3	7.7	105	236	1908	101
07.09.14	1	8.3	672	1874	2745	624
	2	8.8	113	262	1965	125
	3	8.8	98	234	1543	106
14.09.14	1	6.7	651	1857	2850	649
	2	6.8	115	264	1810	101
	3	6.8	99	239	1317	91
21.09.14	1	6.6	681	1898	2255	551
	2	6.3	96	253	2096	95
	3	6.5	83	219	1540	82
28.09.14	1	6.7	747	1831	3154	487
	2	6.6	110	231	2467	89
	3	6.8	97	204	1959	70
05.10.14	1	6.5	667	1815	3794	592
	2	7.1	95	225	2650	95
	3	6.8	82	196	1854	80
12.10.14	1	6.8	638	1951	3148	648
	2	7.1	112	272	2540	98
	3	7.4	102	245	1744	82
19.10.14	1	7.0	664	1817	2850	851
	2	7.4	102	241	2146	132
	3	7.0	91	210	1659	118
26.10.14	1	6.3	619	1784	3544	581

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	2	7.0	92	236	2491	120
	3	6.9	81	208	1857	88
02.11.14	1	6.5	647	1834	3140	694
	2	6.1	110	259	2345	102
	3	6.3	97	226	1850	88
09.11.14	1	6.9	614	1736	2854	518
	2	6.5	89	218	2055	82
	3	6.3	79	187	1549	71
16.11.14	1	8.3	702	1826	2744	550
	2	8.3	108	255	1985	96
	3	8.1	95	230	1508	82
23.11.14	1	6.8	654	1816	2659	648
	2	6.4	106	254	1850	106
	3	6.3	92	227	1454	96

In table 2 samples 1, 2 and 3 for Inlet, Secondary Tube Settler Outlet and Final Outlet

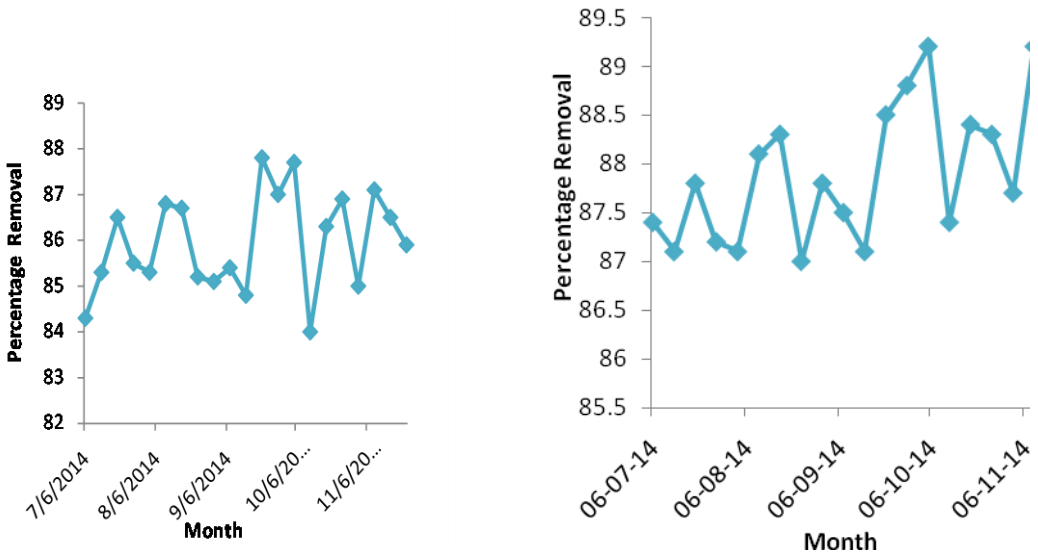

Fig. 1 Variation in percentage removal of BOD and COD

The maximum and minimum BOD removal efficiency of the ETP in the present study were 87.8% and 84.3% respectively. Reference [10] observed similar types of results for the BOD removal efficiency at 85.14%. The maximum and minimum COD removal efficiency of the ETP in the present study were 89.2% and 87.0% respectively. Similar types of results shows [11] for the COD removal efficiency at 96.0%. The maximum and minimum TDS removal efficiency of the ETP in the present study were 68.0% and 31.6 % respectively. Reference [12] also reported results for the TDS removal efficiency at 44.0 % in the similar study. The maximum and minimum TSS removal efficiency of the ETP in the present study were 88.3% and 83.0% respectively. It has been also studied the performance evaluation of brewery waste water treatment plant and found TSS removal efficiency of plant 93-98% [13].

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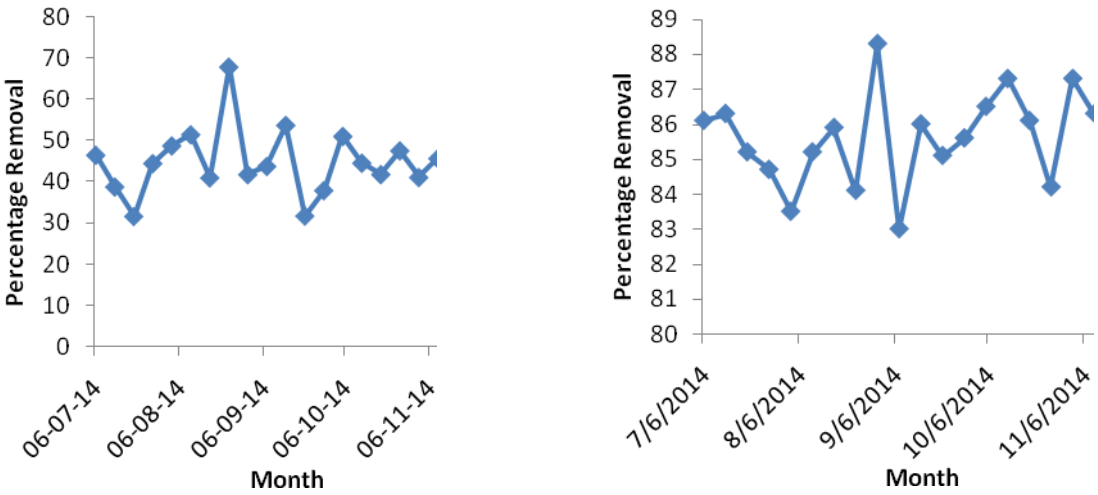

Fig.2 Variation in percentage removal of TDS andTSS

Comparison of results with Standards

Table.3 is showing maximum, minimum and averages values of parameters at the effluent of ETP during the study, percentage reduction after treatment and their comparison with standards. All values are in mg/l except pH.

Table 3: Rice Mill ETP (60 KLD) effluent values

S.No.	Parameters	Max.	Min.	Avg.	Percentage Removal	Limit (Land for Irrigation)
1	pH	8.8	6.3	7.3	-	5.5 to 9.0
2	BOD	118	79	96.2	85.9	100
3	COD	263	187	230.9	87.8	250
4	TDS	2072	1149	1681.6	44.85	2100
5	TSS	118	70	93.3	85.6	200

IV. CONCLUSION& RECOMMENDATION

Bases on the laboratory analysis and operating data of effluent treatment plant, it is concluded that

The maximum and minimum BOD at the inlet is 750 and 614 mg/l respectively. After the treatment maximum and minimum BOD at the outlet is 118 and 79 mg/l. The maximum and minimum COD at the inlet is 2091 and 1736 mg/l respectively. After the treatment maximum and minimum COD at the outlet is 263 and 187 mg/l. These values are above standards. There are several reasons for this, but the bottom line is usually lack of optimal treatment process. Main problem experienced by this factory with ETP are inadequate treatment due to incorrect dosing of chemicals required in the treatment process. The efficiency of this ETP can be increased by employing improved treatment methods like: In primary treatment, flash mixer and flocculation tank should be included and chemicals like ferrous sulphate, lime /alum and polyelectrolyte must be dosed in the tanks. In secondary treatment, MBBR reactor may be used instead of Aeration tank because the BOD removal efficiency of MBBR reactor is 80-90% which is greater than that of aeration tank. The overall total suspended solids removal efficiency is 85.6% which is of standard limit in discharging. The overall total dissolved solids removal efficiency is 44.8%. After the ETP treated water storage tank we have proposed a UF/RO treatment process following which the value of TDS will be less than 400 mg/l and this water will be used in the rice milling operation.

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