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"Effluent Treatment Plant" A Case Study

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Abstract

Chocolate industry is among the most polluting of the food industries in regard to its large water consumption. Chocolate is one of the major industries causing water pollution. Considering the increased milk demand, the Chocolate industry in India is expected to grow rapidly and have the waste generation and related environmental problems are also assumed increased importance. Poorly treated wastewater with high level of pollutants caused by poor design, operation or treatment systems creates major environmental problems when discharged to the surface land or water. Various operations in a Chocolate industry may include pasteurization, cream, cheese, milk powder etc. Considering the above stated implications an attempt has been made in the present project to evaluate one of the Effluent Treatment Plant (ETP) for Chocolate waste. Samples are collected from three points; Collection tank (CT), outflow of Anaerobic Contact Filter (ACF) and Secondary clarifier (SC) to evaluate the performance of Effluent Treatment Plant. Parameters analyzed for evaluation of performance of Effluent Treatment Plant are pH, COD, and BOD at 20^0C The, COD and BOD removal efficiency of Effluent Treatment Plant were 98.7 and 99.4 respectively. Hence it is pH is also perform of 29.3% increase.

Keywords– *Chocolate industry, Effluent treatment, Performance evaluation, Removal efficiency, Wastewater characteristics.*

1. Introduction

The quality of water is of vital concern for mankind since it is directly linked with human welfare. It is a matter of history that fecal pollution of drinking water caused waterborne disease which wiped out entire populations of cities. At present, the menace of waterborne disease and epidemics still looms large on the horizons of developing countries. Polluted water is the culprit in all such cases. The major sources of water pollution are domestic waste from urban and rural areas, and industrial wastes which are discharged into natural water bodies. Generally Speaking, water pollution is a state of deviation from the pure condition, where by its normal function and properties are affected. It has been mentioned before that knowledge of aquatic environmental chemistry is the key to the understanding of water pollution and its control. Water pollution can be best considered in the perspective of possible pollutant cycles through the environment. Advanced wastewater treatment technologies are essential for the treatment of industrial wastewater to protect public health and to meet water quality criteria for the aquatic environment and for water recycling and reuse (Agyemang, 2010).The effluent treatment plant is designed and engineered based on primary treatment and secondary treatment. Primary treatment consists of physical and chemical purification where as secondary consists of Biological carried out into two stages i.e. Anaerobic or Aerobic. The anaerobic process takes place is there like Hydrolysis (H_2O), acidogenesis & Methanogenesis. The Micro-organism responsible for methane production is classified as archaea the principal genera includes the rods (Methanobacterium, Methanobacillus) and spheres (Methanococcur, Methanothrix).The entire anaerobic process takes place in absence of oxygen and it removes majority of organic contaminants' from the influent.The anaerobic process is also called on activated sludge process in which treatment process takes place in presence of oxygen, which is supplied from ambient for metabolism activities of bacteria. These bacteria stipulates remaining organic load from the waste water and make its quality conforming to norms. Discharge of untreated effluent wastewaters into water bodies may put at risk riparian communities that depend on these waters for domestic and personal use (Tchobanologous et al., 2003).

2. Material and Methodology:

The experiment was conducted in Cadbury Industry, Malanpur Madhya Pradesh. The existing effluent treatment plant facilities consist of following tanks and equipments:

2.1. Primary Treatment:
2.2. Secondary Treatment:
2.3. Treatment Water Collection Sump

2.1. Primary Treatment:

2.1.1. Grit Trap And Bar Screen Chamber:

The combined influent passes through the grit trap and bar screen to retain fibrous particles of 10 mm size and above. The grit particles fall into the scum portion of the chamber and settles down to clean at an interval of one week. The bar screen and grit trap is having provision of one working and one standby enabling cleaning operation without interrupting influent flow.

Principle of Working of Grit Chamber:-

Grit chamber should act as settling tank for the removed of inorganic solids which are heavier than organic effluent solids. Hence the velocity of flow should be right to permit the settlement of grit only but not the effluent solids. This velocity called "Differential Scouring Velocity". This limiting velocity should be always less than the souring velocity of grit particles. The velocity varies from 15-30 cm/sec depending on grit specific gravity and diameter. This same velocity is to be maintained for all fluctuation of flow for effective grit removal.

2.1.2 Skimming Tank:

The oil, grease and floating impurities are trapped into skimming tank by plug flow arrangement and slow movement of waste water allow all lighter components to float up and trapped between the two baffle walls and such trapped impurities which are mainly oil and grease is manually removed every day. There are one skimming tank in online working scum is removed by mechanical & physical working in sum digester. There are scum's digestion depend on ACF's clutter, HRT (Hydraulic Retention Time) is 100 days.

2.1.3 Equalization Tank:

The effluent coming from each unit of plant their own characters which are not uniform. But we are going to treat the combined effluent. So the effluent of each unit has to be will mixed so as to get on effluent with uniform characters this is main purpose of providing equalization tank. The waste water pH varies with respect to time and process discharge which is Equalization and Neutralization in this tank by adding calcium hydroxide solution and homogenized by operating floating operator of 5.0 HP Capacity. The supernated effluent coming to this unit from skimming tank, is well operated to maintained COD and to keep its pH constant lime is added time to time as per requirement to adjust the pH, the supernated effluents coming to equalization tank posses pH 7.5-9.0, BOD 100-300 mg/l, COD 200-500 mg/l, there are two equalization cum neutralization tank are working and one standby.

2.1.4 Waste Water Transfer Pump (Sump Tank):

The waste water up to equalization and neutralization tanks flows by gravity either through underground pipeline or through underground tanks. The neutralization and equalized waste water is transferred from underground tank by these transfer pumps into secondary treatment plant which is installed above the ground.

2.2. Secondary Treatment:

2.2.1. Anaerobic Contact Filter: (ACF)

There are 3 no. of anaerobic contact filters all are operating in parallel. The biological treatment place in ACF's in absence of oxygen and most of the organic load is stipulated by Micro-organism. This process of treatment is also called as Biomethanization which liberated biogas with a composition of 65% methane and 35% Carbon dioxide. Supply this gas in canteen for kitchen fuel. Anaerobic wastewater treatment is considered as the most cost-effective solution for organically polluted industrial waste streams Tan NCG, et al. (2001). The waste water transfer pump forces waste water from bottom of ACF and make it pass through blanket of anaerobic on palrings. While organic contaminant comes in contact with colonies of bacteria, most of organic substances are consumed by these bacteria and supernatant effluent flows out from top to the next stage. The sludge production is low, when compared to aerobic methods, due to the slow growth rates of anaerobic bacteria JB, et al. (1998). Total ACF's outlet flow obtained is 160 KL/ day. The excess bacteria are removed from bottom of digester occasionally in the form of sludge on to the sludge drying beds from drying and disposal as organic manure.

2.2.2. Aeration Tank:

The treatment of effluent with bacteria is known as biological treatment, Biological treatment is the most important stage in processing of industrial effluents because primary treatment 30-35% of BOD and 60% of suspended solids are removed the remaining pollutants load should be removed by biological methods. We use approximate 90KL of domestic in aeration tank.The principle objective in biological treatment is the Stabilization of its organic matter. The organic matter is broken down by bacterial action into simple substance that will not decompose further stabilization can be done either by aerobic bacteria. Decomposition rate is more rapid than is aerobic process generally we use cow dung is aerobic process. The three technologies evaluated were aerobic digestion utilizing mechanical thickening, membrane thickening, and gravity thickening (GMB Engineers, 2012).

Theory of Activated Sludge Process:-

Effluent flowing into the aeration tank from ACFs contains organic matter is serves as a food for microbe. Due to aeration in the tank, the active biomass metabolizes the organic waste by taking dissolved oxygen and release Co2 & produce new cells. Protozoa utilize some bacteria cells as their food and grow rapidly. Some of the bacterial cells die due to endogenous respiration the recycling of sludge helps in the initial build up of high concentration of the active micro-organism in the mixed liquor which accelerator BOD removed. Once the required constriction of Micro-organisum in the mixed liquor has been reacted its further increase is prevented by regulating the quality of sludge recycled and washing the exase sludge from the system. Activated sludge, which consists of stirred and aerated flocculated suspension of a mixed bacterial population that comes into contact with wastewater, is the most commonly used process in aerobic treatment. G.-P. Sheng et al. (2008). There are two aeration tanks both are operating in parallel and each is fitted with 10 HP surface aerator, the biological treatment takes place in these tanks in presence of oxygen which is continuously supplied by means of surface aerators. The balance organic contaminants are removed in this stage through bacteria which are maintained in defined percentage in terms of mixed liquor suspended solids (MLSS). The mechanical agitation through surface aerator mixes waste water vigorously with MLSS which in turn stipulates organic substance and purifies water. The treated effluent flowing out from aeration tanks contains MLSS which is recycled back into aeration system through secondary clarifier system.

2.2.3 Secondary Clarifier:-

This tank is provided to maintain mixed liquor suspended solids (MLSS) of the effluents. The secondary clarifier plays an important role in achieving the strict efficiency standards of WWTPs. The design and operation of the secondary clarifier are commonly based on solid flux theory N. Raggul and R. Saraswathi (2013). The MLSS along with effluent from aeration tank is received into a central well of secondary clarifier from where it is allowed to move down and subsequently moved up with a very slow velocity. In the process of downward and upward movement MLSS is settled down and clear supernatant effluent is obtained at final treatment effluent at the outlet of clarifier whereas bottom thick slurry which is mostly containing MLSS is transferred back into aeration tank through a slurry transfer pump to maintain desired level of concentration and excess sludge is disposed on to sludge drying beds for sum drying, dewatering and final disposal as organic manure.

2.2.4 Sludge Drying Beds:

Sludge is byproducts of all effluents treatment with the help of effluents treatment plant from effluent the purified water is recycled in sump tank and by products sludge is used as manure after drying derived sludge is very useful for agriculture process because of its high fertility. There are sixteen sludge drying beds in the effluent treatment plant. Which is removed time to time from the sludge from beds and it's used as manure.

2.3 Treated Water Collection Tank:

The treated effluent from secondary clarifier is collected into a underground sump of holding capacity 567 M^3. This tank is fitted 2 nos. of centrifugal transfer pump with one working and one standby arrangement to pump out treated effluent for gardening and lawn developments.

3. Result & Discussion

Industrial polluted water is very harmful for every living organism and environment. Treatment plant controls the germination of effects and disease on this industrial area and no effects in local people. The effluent treatment plant is delivering treated effluent quality well within the norms as laid by pollution control board. This process is healthy for environment. The pH, COD and BOD is analysed in (Table 1). SG chamber is removed heavy particles from effluents and control the clogging process in pipelines. There are skimming tank is a good removal for oil, grease, fat and other floating impurities and implement the effluent quality from this process. pH is low after anaerobic treatment because three process are involve for treatment in anaerobic contact filter there are- Hydrolysis, Acidification and Gasification.

Table 1: Annual effluent treatment analysis

	TOTAL	PH		COD (mg/l)		BOD (mg/l)	
DATE	FLOW (M^3/d)	UNTRE.	TRE.	UNTRE.	TRE.	UNTRE.	TRE.
Apr-10	251.7	6.0	7.6	8560.0	91.1	2800.0	17.0
May-10	260.0	6.4	7.9	8523.1	104.0	2900.0	19.0
Jun-10	262.0	5.9	7.7	8793.9	84.3	2860.0	1.0
Jul-10	261.0	6.1	7.8	8237.0	88.9	3075.0	16.2
Aug-10	262.0	5.8	7.7	8829.0	85.3	2800.0	18.0
Sep-10	261.0	6.0	8.0	8282.7	100.8	2158.0	16.2
Oct-10	259.0	5.8	7.7	8890.4	87.1	2675.0	18.7
Nov-10	259.0	6.0	.8.02	8436.9	126.8	2693.3	20.0
Dec-10	261.0	6.0	7.9	8206.4	229.6	3185.0	19.0
Jan-11	256.0	6.0	7.9	8508.6	123.1	3075.0	19.2
Feb-11	258.0	6.0	7.9	8266.7	113.3	2887.5	20.7
Mar-11	234.0	6.3	7.6	8717.0	95.1	2450.0	17.9
Average	257.06	6.02	7.79	8520.97	110.79	2796.57	16.89
Std.Dev.	8	0.17	0.15	243.84	40.10	283.21	5.20
Minimum	234	5.78	7.55	8206.40	84.31	2158.00	1.00
Maximum	262	6.36	8.00	8890.37	229.55	3185.00	20.70
% Reduction					**98.7**		**99.4**

When flow is high across flow pH will be low. If we do not proper closing of Urea and DAP in aeration tank there are not prepare healthy MLSS and treated water quality are not pure in this care. Aerobic action takes place when sufficient amount of free oxygen is available for the bacteria. Anaerobic bacteria grow in the absence of free oxygen

and release energy. They get energy from various compounds which are decomposed by these bacteria. The Decomposition takes place in a number of stages. The principal end products of decomposition of carbonaceous organic matter and nitrogenous matter are CO_2, CH_2 and organic acid, NH_3. The average value of COD and BOD is calculated in (fig.1), the value calculated from monthly data and daily analysis.

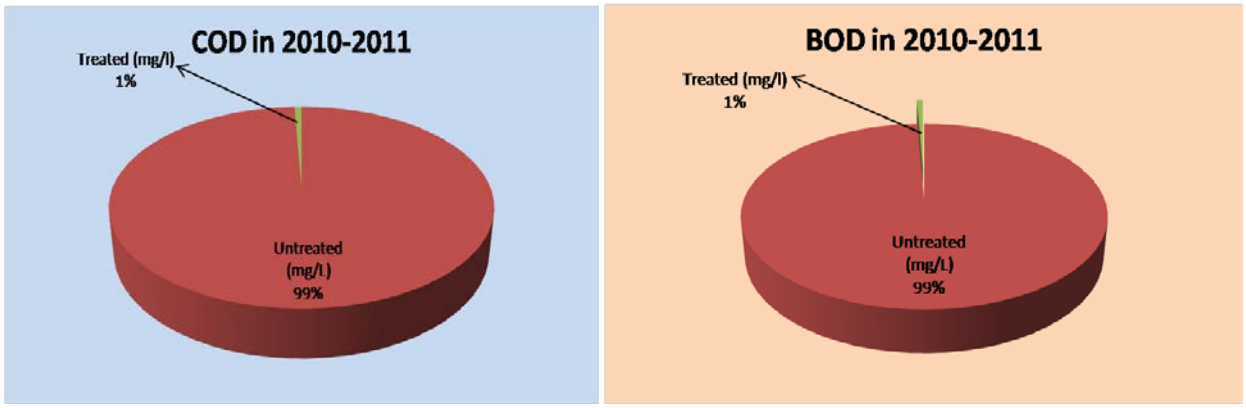

Fig. 1: Yearly COD and BOD Performance of Effluent Treatment Plant (2010-2011)

Percentage of COD reduction is depending on over all treatment units and healthy nature of anaerobic and aerobic bacteria. Treatment of effluent in secondary clarifier its depend on heavy concentration of MLSS. Treated effluent quality obtained turbid If-Low pH water and high percentage of mass dissolve with effluent. Though treated wastewater may not comply with drinking water standards, contacts with water carrying high pathogenic loads may potentially lead to the transmission of enteric infections (Kamala and Kanth Rao, 2002).

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