

PLANNING TREATMENT OF DAIRY WASTEWATER JOINING THE PARIYAT RIVER AT PANAGAR REGION, JABALPUR CITY (M. P.), INDIA

Aseem Jain¹, Prof. Dr. Shailza Verma², Prof. R.K Bhatia³

M.E .Environmental Engineering, Department of Civil Engineering, Jabalpur Engineering College, Jabalpur, MP, India¹

Assistant Professor, Department of Civil Engineering, Jabalpur Engineering College, Jabalpur, MP, India²

Associate Professor, Department of Civil Engineering, Jabalpur Engineering College, Jabalpur, MP, India³

Abstract: - Dairy industries have shown large growth in size and number in most countries of the world. These industries discharge wastewater having high organic pollutants, if discharged without proper treatment, severely pollute receiving water bodies. Large concentration of pollutants in terms of quantity and quality of liquid, solid and gaseous pollutant shows harmful effects on flora and fauna as well as on many areas on environment. According to the pollution board norms, every industry needs to follow land and stream wastewater discharge norms. Pariyat River is one of the most important tributary of Hiran River. Many dairy Industries situated near the banks of the Pariyat River and surrounding area directly releases the wastewater into the river water and affects the water quality of the river at Panagar region, Jabalpur. Due to this problem river water becomes objectionable and pollutes the water source in the vicinity of whole area. The local level pollution on the river bed, sewage waste, the agricultural runoff are causing untold damage to the river and seriously affecting the quality of life of the people who depend on the river. Therefore there is a need to provide necessary treatment before discharge into the environment. The present study proposes treatment of waste water produced from dairy farms those are located near the bank river Pariyat near Panagar region, Jabalpur.

Keywords: - Dairy farms, Wastewater Treatment plant, DO (dissolved oxygen), Sludge drying Beds

1. Introduction: - Dairy industry wastewaters are primarily generated from the cleaning and washing operations in the milk processing plants. It is calculated that about 2 % of the total milk processed is wasted into drains. Dairy wastewaters are characterized by high biological-oxygen demand (BOD) and chemical oxygen demand (COD) concentrations, and generally contain fats, nutrients, lactose, as well as detergents and sanitizing agents (Surtar et al.2015). Dairy effluents decompose rapidly and deplete the dissolved oxygen (DO) level of the receiving streams immediately resulting in anaerobic conditions and release of strong foul odors due to nuisance conditions. The receiving water becomes responsible for breeding place for flies and mosquitoes carrying malaria and other dangerous diseases like dengue fever, yellow fever, chicken guniya. It is calculated that every year 1.8 million people die due to suffering from waterborne diseases. A large part of these deaths can be indirectly attributed to improper sanitation.

Wastewater treatment is an important initiative method which has to be taken more seriously for the betterment of the society and our future. In wastewater treatment process, harmful contaminants are removed from wastewater as well as household sewage, to produce waste stream or solid waste suitable for discharge or reuse. It is also recorded that large concentration of dairy wastes are toxic to certain varieties of fish and algae. The casein precipitation from obtained generated waste which decomposes further into a highly odorous black sludge at certain dilutions the dairy waste is found to be toxic to fish also.

Dairy effluent contains large amount of soluble organics, suspended, solids and trace organics. They decrease DO, promote release of gases, cause taste and odor, impart color or turbidity and promote eutrophication. Due to the high pollution load of dairy wastewater, the milk-processing industries discharging untreated/partially treated wastewater cause serious environmental problems (Singh et al.2016). Moreover, the Indian government has applied very strict rules and regulations for the effluent discharge to protect the environment. Hence, appropriate treatment methods are necessary so as to meet the effluent discharge standards. The sewage waste of Pariyat village is directly discharge into this River. The people of village also use this river to wash their cloths, take bath, sanitation, discharge of cow dung by dairies etc. The cattle of the dairy owners also take bath in this River. After construction of Dairies in the surroundings and bank of Pariyat River, a major part of running water is being converted in to sludge. According to Tiwari (2015) Pariyat River has turned into dirty Nullah's in Panagar region, by discharge of heavy amount of cow dung and offending bunch of dairy owners, who disregarded environmental concerns.

2. Materials and Methods:-

2.1 Study area:-

Pariyat River is a main tributary of Hiran River which is situated Imaliya (kandrakheda) near Panagar region in the district of Jabalpur. This river merges into the Hiran river at Ganiyari gaon in an adverse condition as per pollution is concern due to presence of number of dairies near the river bank. There are approximate 200 numbers of dairy farms are present most of them are situated near the bank of the river. The study area selected for the present study is Pariyat village Imaliya near Panagar region Jabalpur (M.P.). The Latitude and Longitude of Paiyat River is $23^{\circ}15'27''\text{N}$ and $79^{\circ}58'30''\text{E}$ respectively. Water samples were collected from the eight different sampling locations at an approximate distance of 200m in the Pariyat River, Panagar region in Jabalpur city. Figure-1 shows all the site of samples collection at Pariyat River at Panagar region. First sampling point (S1) is located below the railway bridge and last Sampling point (S8) is near roadway bridge.

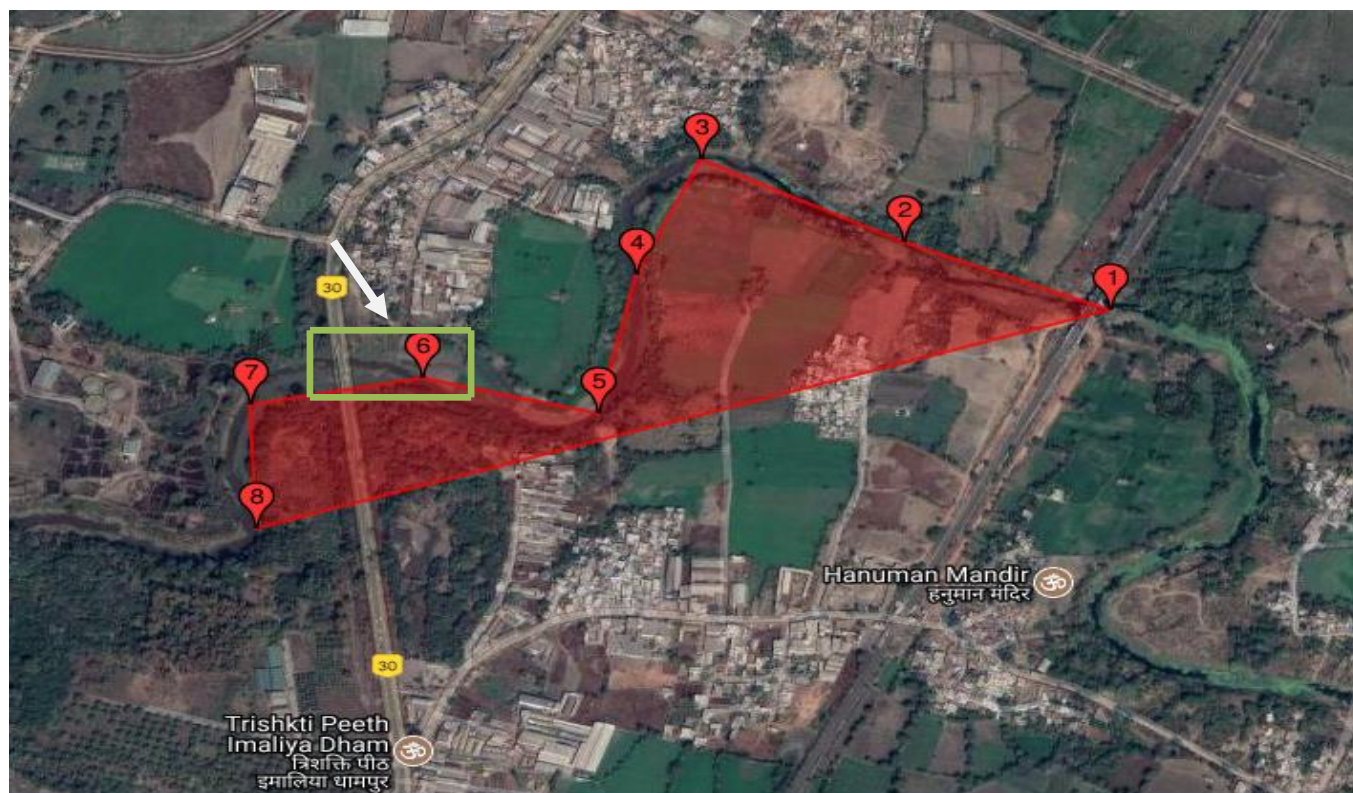


Fig.1 All sampling location of Pariyat River at Panagar region, Jabalpur

2.2 Impacts of Water Pollution:-

Dairy waste water caused depletion of DO by occurring chemical reaction. There is no normal pH that applies to all Fishes because fish originate in surface water bodies such as ponds, rivers, lakes, oceans that have different pH levels. But sudden change of pH can be harmful or even fatal to fishes and aquatic living organisms. In the dry season the DO level becomes very low and the river becomes very toxic. Those people are living near the river which is polluted by various germs and micro-organisms are severely suffering from various diseases like cholera, diarrhea, dysentery etc, often. Silt may cover the leaves of aquatic plants and increase the turbidity of water, as a result, sunlight cannot reach to the leaves of the plants and photosynthesis reaction is hampered. Hence, plants cannot produce oxygen and food for their survival condition. Consequently, ecosystem is hampered. Another study done by Jain et al. (2018) that All parameters are within the range at sampling point 1 & sampling point 2 (Fig.1) , so the quality of water is classified as 'A'. After the discharge of domestic as well as dairy waste affect the quality of river water at sampling point 3, 4, 5, 6, 7 and 8 (Fig.1) class of water is A which is a drinking water source without conventional treatment but after disinfection but due to continuous discharge of dairy waste water the class of water becomes E (at point 8) which not fit for drinking purpose. River water becomes highly polluted due to the dairy waste water disposal around the area which is responsible to change the water quality into adverse condition.

2.3 Dairy Wastewater Treatment:-

As the dairy waste contains a lot of organic impurities such as suspended solids, turbidity, BOD, COD etc. so treatment requires preliminary treatment, Primary treatment, secondary treatment and tertiary treatment. In primary treatment floating and settleable solids such as suspended solids and organic matter are removed. Secondary treatment it removes and reduces the concentration of organic and inorganic compounds. In tertiary treatment final cleaning process is done which improves the wastewater quality before reuse, recycled or discharged to the environment. It covers the mechanisms and processes used to treat wastewater that is produced as a by-product of dairy industries and activities. After treatment, the treated industrial wastewater may be further reused or released to surface water or to a sanitary sewer in the environment. Most industries produce some wastewater although current trends in the developed world have been to minimize such production or recycle such wastewater within the production process. So many industries remain dependent on processes that produce wastewaters.

2.4 Wastewater Treatment Plant:-

The treatment of contaminated water can be done with the wastewater treatment plant, it is an effluent treatment plant that cleans the effluents from the industry, polluted water from rivers, lakes etc so that it can be recycled for further use according to their quality. In this way, water is recycled and conserved. Wastewater Treatment Plants are used to purify water and remove any toxic and non toxic materials or chemicals from it. These plants are used by all waste water producing industries for environment protection.

It is required to clean industry effluent and recycle it for further use, reduce the usage of fresh/potable water in Industries, cut expenditure on water procurement, meet the Standards for emission or discharge of environmental pollutants from various Industries set by the Government and safeguard environment against pollution and contributes in sustainable development.

2.5 Treatment Levels & Mechanisms of Wastewater Treatment plant:-

The treatment of waste water contains Preliminary treatment followed by Primary, Secondary and Tertiary (or advanced) treatment (Fig.2) The raw sewage will be collected in a collection sump and pumped to mechanical bar screen chamber for removal of large floating matter followed by grit removal in Grit Chamber. The raw sewage will then be collected in an equalization tank/ Collection Tank for homogenization of hydraulic load. The tank contents will be kept in suspension by means of coarse bubble aeration through pipe grid. The equalization tank, with air flow indicator for continuous monitoring of air supply to the tank in order to avoid septic conditions, will be covered from top (RCC) to avoid nuisance. The equalized effluent will then be pumped to two Fluidized Aerobic Bio Reactors (FAB) in series where BOD/COD reduction can be achieved by virtue of aerobic microbial activities. The essential oxygen will be supplied through coarse air bubble diffusers in it. The clear supernatant will gravitate to the chlorine contact tank where sodium hypochlorite will be dosed for disinfection of treated water prior to disposal. The dried sludge will then be disposed off suitably as manure. The schematics process of wastewater treatment plant is shown in Figure -2. All working units of waste water treatment plant are described below in details.

1. Screen Chamber:-Raw sewage shall flow into the inlet screen chamber by gravity. It removes large solids particles and floating matter. The remaining sewage is sent to the skimming tank where it is allowed to undergo skimming action Oil & Grease are removed.

2. Collection Tank:-The collection tank accumulates the effluent water from the screening chamber, stores and then pumps it to the equalization tank. The equalization tank shall be designed to provide a minimum storage of 2 hours at peak flow while pumping. (Fig.2)

3. Aeration Tank:-An aeration system similar to the SAFF (Submerged Aerobic Fixed Film Reactor) tank shall be provided for mixing and aerating the sewage. The polypropylene media have been provided with a specific surface area of 350 – 520 m²/m³. This allows micro-organisms to get attached and biomass concentration can be increased to four folds as compared to Activated Sludge Process. This enables to consider higher Organic loading rates. The micro-organisms attached to media are kept in a fluid state thereby maintaining the CSTR (continuous Stirrer tank reactor) regimes as well as two tanks are provided in series making the plug – flow system.

4. Settling Tank:- Sewage after bio-oxidation shall enter the hopper bottom sedimentation tank where the sludge effectively settles to the tank bottom. The clear effluent shall weir into the Intermediate Tank for UV treatment. The activated sludge collected in the sludge tank shall be returned to the FAB (fluidized aerobic bio reactors) tank for further oxidation of the incoming organic matter. Excessive sludge shall be wasted in the sludge holding tank.

5. Clarifier Water Tank:-The purpose of sedimentation is to enhance the filtration process by removing particulates. In Sedimentation process suspended particles are removed from the water by means of gravity or separation. In the sedimentation process, the water passes through a relatively quiet velocity from it. In these conditions, the floc particles settle to the bottom of the basin, while “clear” water passes out of the basin over an effluent baffle or weir. (Fig.2)

6. Pre Filtration tank:-The flow from the each individual settling tank i.e., the supernatant liquid is let into the respective Pre-Filtration Tank, which has a minimum 1.5 hours holding capacity. This tank is provided to hold the treated effluent and give an even flow to the pressure sand filter.

(a) Pressure Sand Filter (PSF):- Vertical down flow type with graded/sand bed under drain plate with polysterene strains. Provide pressure sand filter of 980 mm diameter and 1200 mm sand as media layer, under drain pipe, laterals face piping etc for each stream.

(b) Activated Carbon Filter (ACF):- Provide Activated Carbon filter of 980 mm diameter with granular Activated carbon as media and 1200 mm sand as media layer, under drain pipe, laterals face piping etc for each stream. Chlorination is done for disinfection purpose which makes treated water safe.

7. Sludge Holding Tank:-Sludge holding tank has been provided with filter press for dewatering sludge. The filtrate drains off through the media, which is again let into equalization tank.

8. Sludge drying Beds:-Excessive sludge shall be stored in the sludge holding tank for final dewatering and disposal.

9. Final Treated Water Holding Tank:-It is always preferred to provide one final holding tank of minimum one day holding capacity, so that the treated effluents can be stored and used back flushing purposes.

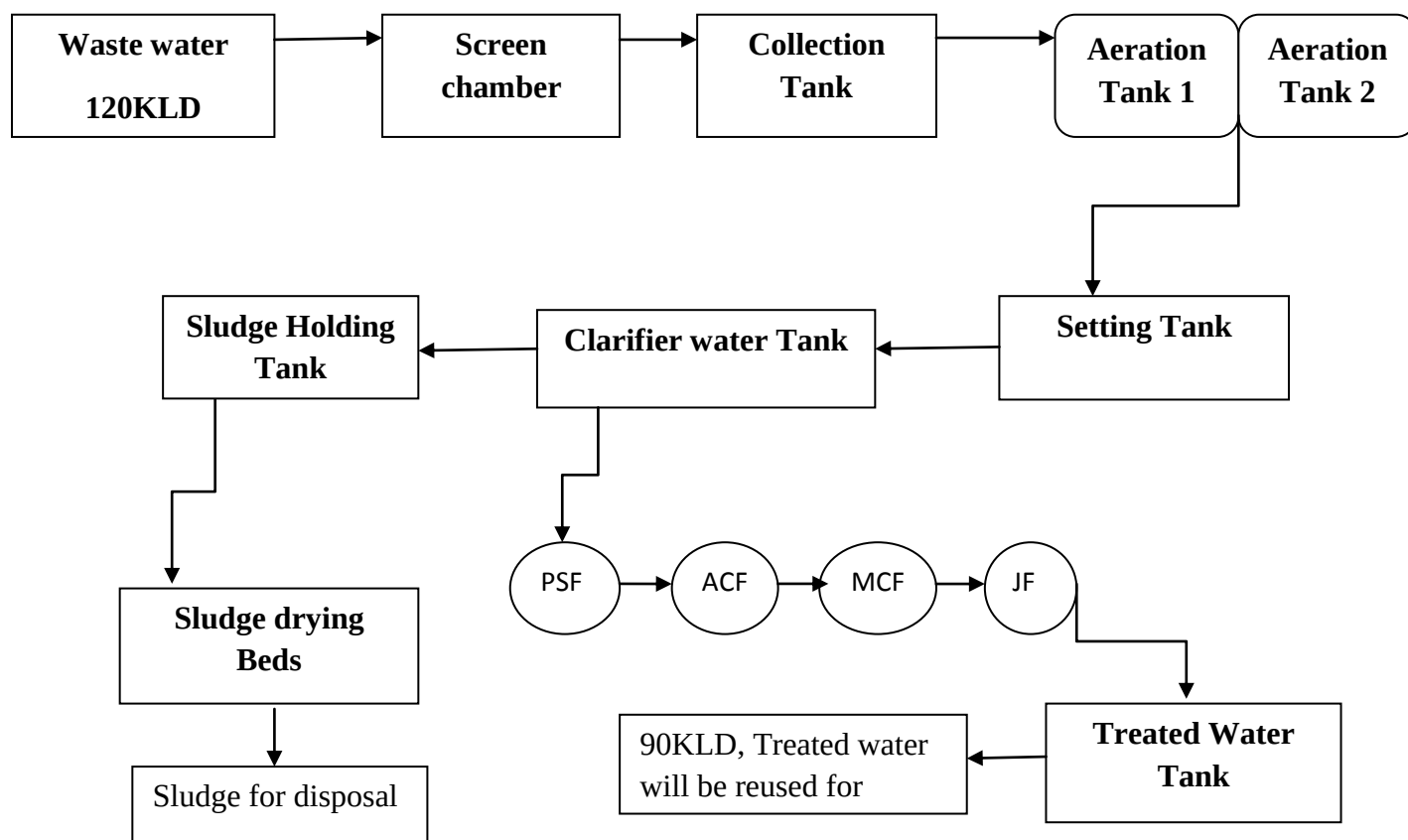


Figure:-2 Wastewater Treatment Plant Process Flow Chart

Table:-1 represents the various design parameters before and after the treatment of waste water as per Indian standard Guide for treatment and disposal of effluents of dairy industry in water body. Table:-2 represents the various sizes of treatment plant units with dimensions.

TABLE:-1 DESIGN PARAMETERS OF EFFLUENT TREATMENT PLANT:-

Parameter	Before Treatment	After Treatment
pH	6.5 – 8.0	6.5 – 7.5
TSS(mg/lit)	350	<100
BOD(mg/lit)	350	<30
COD(mg/lit)	450	<250
Oil & Grease(mg/lit)	20	<10

TABLE: -2 CIVIL UNITS OF 120 KLD WASTEWATER TREATMENT PLANT

S. No	Description	Size(LXB X H)	Quantity
1.	Screen Chamber	0.8m X 0.5m X 0.6m	1
2.	Collection Tank	2.1m X 3.65m X 4.6m	1
3.	Aeration Tank	3.5m X 3.65m X 4.6m	2
4.	Settling Tank	2.8m X 2.8m X 3m	1
5.	Clarifier Water Tank	1.8m X 2.4m X 3.8m	1
6.	Sludge Holding Tank	1.8m X 1.8m X 2.25m	1
7.	Sludge drying Beds	1.1m X 1.1m X 1.25m	2
8.	Treated water tank	5.05m X 4.05m X 2.5m	1

3. Result and Discussion

As the dairy waste contains a lot of organic impurities, it is necessary to develop a capable treatment plant for the disposal of wastewater. From the test results of a study done by Jain et al.(2018) it was found that the water quality of river become very poor , so the establishment of wastewater treatment plant definitely will maintain the water quality of river and also improves the living standard of this area. Rectangular Green box in Figure-1 shows the most suitable site for establishment of the treatment Plant .It will avoid the ill effect of discharged untreated effluent into the environment. The treated water can be reuse for washing and other uses. There is no supply of municipality water supply system so river water can be used to locality area for their daily needs. It will also produced large amount of manure which will help in organic farming and cultivation.

4. Conclusion

The milk-processing industries discharging large amount of untreated/partially treated wastewater which causes serious environmental problems. Pariyat River has turned into dirty Nullah's in Panagar region, by discharge of heavy amount of cow dung and offending bunch of dairy owners, who disregarded environmental concerns. The study proposes developing a treatment plant for the disposal of wastewater in the river near the bank of the Pariyat River. The quality of disposed wastewater must be monitored frequently to follow the CPCB (Central Pollution Control Board) Guidelines. This can be a safe and sustainable solution for the disposal of wastewater.

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