Root Zone Technology As Tertiary Treatment To Dairy Industry Waste Water: A Review

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Abstract- *Rapid urbanization, industrialization and other human activities disturbed and affect quality of fresh water bodies. Dairy industry uses large amount of fresh water for processing and manufacturing of dairy products. Effluents from dairy industry causes the generation of organic compounds leaves impact on environment. Root Zone Cleaning system treats water naturally, which has low construction cost, low maintenance and economic design. RZTS interacts with bacteria, root zone plant, soil, and sun. RZTS effectively can use as secondary and tertiary treatment to dairy effluent By constructing wetland system waste water produced by Dairy Industry is used to determine the quality and extent of pollution by examining physical, chemical and organic parameters. By which the pH, suspended solids, TDS, and the significant reduction in the parameters were observed. This determines feasibility as tertiary treatment to the dairy effluent by comparing results to conventional treatment plant.*

Keywords- Root Zone; COD; BOD; colocasia esculanta; Dairy effluent.

I. INTRODUCTION

The dairy industry is one of the most important food industries among all the major source of waste water. The amount of Fresh water will depend on the process technology of milk processing.India has the largest livestock population in the world. The dairy industry is a well establish industry and India is known for “Operation flood” also referred as “White Revolution”. It generates between 3.739 and 11.217 million m3 of waste per year (i.e. 1 to 3 times the volume of milk processed)[3].The annual cost of treatment and disposal for the typical plant appears to be in the order of thousands of Rupees. It is becoming a major problem of deposal of dairy effluents with respect to the environmental aspects and society. Almost all the dairy factories are facing the problem of water treatment, disposal and utilization of the waste water. Disposal of waste water into rivers, land, fields and other aquatic bodies, without or with partial treatment, in crude tanks, will soon offer a serious problem to health and hygiene [5]. Natural Wetlands are defined as areas which are in undated or saturated with surface or groundwater, saline or fresh, which supports vegetation adapted for living in saturated soil conditions[1].

Root Zone Cleaning System is a self-cleaning biological filter which removes disease organisms, nutrients, organic loads and a range of other polluting compounds. The treatment of wastewater and breakdown of organic pollutants is done by passing the pollutants through a root-zone of plants. Organic pollutants are broken down as a food source for the various microorganisms that are present in the soil and plants. Other contaminants like heavy metals are fixed in humic acid and cation exchange bonds in the soil or mineral substrate in which these plants are rooted[6].There are two types of constructed wetland: free water surface constructed wetlands and sub-surface constructed wetlands. In free water surface constructed wetlands, waste water flows as a shallow water layer over a soil substrate. Sub-surface constructed wetlands may be either subsurface horizontal flow or sub-surface vertical flow. In sub-surface horizontal flow constructed wetlands, waste water flows horizontally through the substrate. In subsurface vertical flow constructed wetlands, waste water percolates through reed root zone then through filters of sand, charcoal and gravel. Constructed wetlands may be planted with a mixture of submerged, emergent and, in the case of free water surface constructed wetlands, floating vegetation [2].

II. OBJECTIVE OF THE RESEARCH.

1. Analyze and characterize the dairy industry waste water.
2. To investigate the feasibility of using Root Zone Technology System.
3. To compare the treatment efficiency of root zone system with conventional treatment plant.

III. MATERIALS

(1) Gravel: - 0.6mm size & it’s used remove the sediment, odor and smell of waste water.
(2) Coal: - To reduce the hardness of dairy effluent.

(3) Sand:- 0.3-0.5 mm size sand are used for RZTS, This size of sand promote movement of water and prevent clogging.
(4) Soil: - To growth of plant and remove the oil from dairy effluent.
(5) Colocasia Esculanta: - To kill bacteria by roots and getting oxygen from dairy waste water.

IV. PROCESS OF ROOT ZONE TECHNOLOGY

First, the very existence of root zone system creates space for the water to pass through. After, the root gets oxygen down into reed systems soil and gives region where aerobic bacteria grow. These organisms are necessary for the breakdown of many types of compounds in particular in the oxidation of ammonia to nitrate; this is the first step in the biological breakdown of nitro compound. Thirdly, the process of Nitrification takes place i.e. the plants themselves take up a certain amount of nutrient from the wastewater.

Reed beds can help to achieve a better standard of water quality through.

1. High level of bacterial and viral removal
2. Decreased biological oxygen demand and reduction of suspended solids.
3. Reduction of nitrogen concentrations and removal of metals[4].

The process involves the raw effluent (after removing grit or floating material) which is passed horizontally or vertically through a bed of soil having impervious bottom. The effluent passes through the root zone where roots are dense. Nearly 2,500 types of bacteria and 10,000 types of fungi, which stay around roots get oxygen from the weak membranes of the roots and aerobically oxidize the organic matter of the effluent. The characteristics of plants of absorbing oxygen through their leaves and passing it down to roots through their stems which are hollow, is utilized as a bio-pump. Anaerobic digestion also takes place away from the roots. The filtering action of the soil bed, the action with fungi etc. and chemical action with certain existing or added inorganic chemicals help in finally obtaining very clear and clean water. The system of plants regenerates itself as the old plants die and form useful humus. Hence the system becomes maintenance free and can run efficiently for several years[1].

V. ADVANTAGES OF ROOT ZONE TECHNOLOGY SYSTEM

1. It can be used as secondary or tertiary treatment with low cost of installation, zero energy consumption.
2. Low maintenance cost due to no equipment and machinery required.
3. Does not require skilled labor and supervision.
4. It has no problem with disposal and production of sludge.
5. It provides good aesthetics and greenery.
6. It gives natural habitat for birds and maintains the natural cycle of ecosystem.
7. Air pollution problems like Sewage Treatment Plant were neglected as no odor production.
8. It becomes a green Zone and it does not have mosquito problem.
9. RZTS provides ecofriendly solution to waste water treatment.
10. The reeds are not grazed by ruminants, insects can be prevented.
11. Salinity may not be a problem for a survival or operations of reed beds.
12. Both horizontal and vertical flow root zone system can be used at a time.

VI. DISADVANTAGES OF ROOT ZONE TECHNOLOGY SYSTEM

(1) Relatively area requirements for zone formation.
(2) No specific design and operating criteria.
(3) Biological and hydrological complexity and our lack of important process dynamics.
(4) Possible problems with pests.
(5) Steep topography, shallow soils and high water tables, susceptibility to severe flooding may limit the use of constructed wetlands.

1. By A. A. Raval1 and P. B. Desai (2015) presented that the current design criteria for wetland design are based on either empirical or first. The performance of Constructed Wetlands Treating Domestic Waste water can be judged on the basis of various parameters such as biochemical/chemical oxygen demand (BOD / COD), TSS, nitrogen, phosphorus and coli form removal. The BOD removal efficiency in India when reed beds used in horizontal flow mode varies from 80 96%. Several examples of organic material removal are sited here. In case of Phragmites in North Europe studied for phenol removal 72% was metabolized by soil organisms, 16.7% by plant tissue and 9% was volatilized [1].

2. By G. Baskar, V.T. Deeptha and A. Abdul Rahaman, The influent samples were collected once every month over a 6-month period for the characterization of waste water. Samples were analyzed to determine the quality of influent, variation in quality with respect to student strength and season. There is considerable change in the values of TSS, BOD and COD during peak activity in the university. The steep rise in COD

in the month of October 2007 could be due to a sudden discharge of chemicals from the laboratories. The other parameters do not show any steep changes. It can also be inferred that during vacation period, in the month of December 2007, BOD, TSS and TN are low in value and increase once college has reopened in the month of January 2008. Thus the effect of the presence or absence of students has a clear correlation with the concentrations. This factor is very important because it differs from a typical municipal waste water sample. The lower values of COD, BOD or TSS were found at the high rainfall time, in the month of November 2007 indicating a clear dilution effect [2].

3. By Ms. J. Kalaiselvy, Mr. K. Jaiganesan (2016) stated that the treated dairy wastewater using root zone technique by using Phragmites australis has the following inferences at the end of 4 days for each sample are as follows: For a maximum influent BOD concentration of 310 mg/l, there was a greater reduction in the treated effluent with 94 mg/l. The treated effluent has BOD of 85 mg/l for the minimum influent BOD concentration of 280 mg/ l. A reduction in COD concentration at the outlet of the RZT for a maximum influent COD concentration as was observed to be 86 mg/l. Similarly for a minimum influent COD concentration of 690 mg/l the treated effluent by RZT was found to be 83 mg/l. The turbidity of the treated effluent was reduced to the range of 2 to 4 NTU as maximum and minimum influent value (26 to 30 NTU). Hardness of the treated effluent vary from 216 to 243 mg/l for Maximum and minimum influent values. A considerable decrease in the value of alkalinity was observed for the various influent characteristics. It accounts to 379 to 410 mg/l after passing through the Root Zone [3].

4., Sandeep Kankal, Sanjivan Mahadik, Ashutosh Pachpute concluded that pH, Total Suspended Solid, Total Dissolved Solids found to be after the analysis of inlet effluent is The settling basin pH values fluctuated with pH values that ranged from a low of 7.6 to a high of 8.2, The milk house wastewater discharge had a Total suspended solids (TSS) average effluent concentration of 1280 mg/L or 92.08% of the Total Dissolved solids (TSS) concentration. This is consistent with what is found with highly organic wastes, using flow-based composite sampling the dairy's wastewater effluent was found to have an average TDS concentration of 1390 mg/L. TDS concentrations and TDS removal efficiencies, total System performance always recorded a month with an average above 49% removal[5].

VII. APPLICATIONS OF ROOT ZONE TECHNOLOGY

1. For Dairy effluent vertical flow root zone system may be recommended.
2. Treatment of polluted streams, nallas, rivulets and water-bodies (floating beds may be recommended) water-bodies (floating beds may be recommended).
3. Bathroom water recycling. In combination with vertical as well as horizontal flow system may be used.
4. It can be used as polishing treatment for any waste water. E.g.– Brewery, Sugar factories, Paper and pulp.

VIII. CONCLUSION

The root zoning technique is very useful for small scale work and we can use RZTS as tertiary treatment for dairy industrial waste water. This has shown us that how dairy industry plays major role in pollution fresh water bodies. This Seminar reviews the Root Zone Treatment System (RZTS) which are planted filter beds consisting of soil. This technology uses a natural way to effectively treat Dairy industrial waste water.

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