JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

TREATMENT OF DAIRY INDUSTRY WASTEWATER USING REED BED TECHNOLOGY

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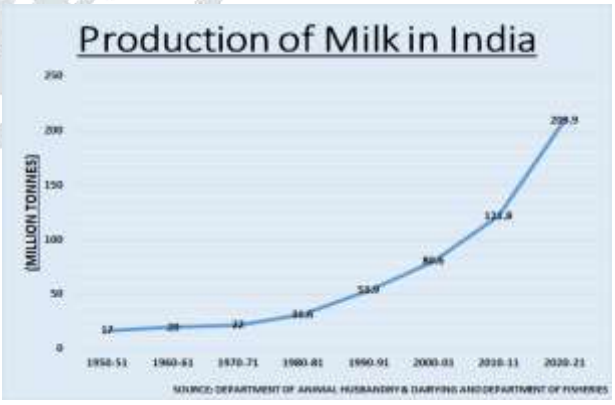
Abstract: Dairy industries are one of the most common and essential sectors in the world. India is the highest milk producer and ranks first position in the world contributing twenty-four percent of global milk production in the year 2021-22. Dairy industry is considered as largest source of food processing wastewater in many countries. So there is need for developing low cost technique for dairy wastewater treatment. One of the natural methods to treat this kind of wastewater is Reed Bed System. Reed bed is an engineered and managed systems, are progressively receiving worldwide attention for domestic and industrial wastewater treatment. The main objective of this study to monitor the performance of a reed bed system by reducing biochemical oxygen demand(BOD), chemical oxygen demand(COD), total suspended solids, total dissolved solids and pH . From the experimental study, it was found that the Reed Bed Technology gives a better quality of treated effluent with considerable reduction in biochemical oxygen demand (BOD), and chemical oxygen demand (COD). Reeds show an important role in removing organic matter from hybrid reed bed system. It is also found that by increasing in the retention period of the wastewater, the removal rate also increases.

Keywords: Vertical Reed bed, Dairy industry, Root zone, Wastewater.

I. INTRODUCTION

Dairy industries have shown remarkable growth in size and number in most countries of the world. In India dairy activities are essential for rural economy. India is the world's largest producer of dairy products and also their largest consumer. India's dairy industry is considered as one of the most successful development program in the post-Independence stage. In the year 2011-12 the total milk production in the country was over 127.9 million tones with a per capita availability of 290 grams per day. The industry is growing with an annual growth of 4% during the period 1993-2005, which is almost 3 times the average growth rate of the dairy industry in the world. In view of the increased milk demand, the dairy industry in India is expected to grow rapidly.



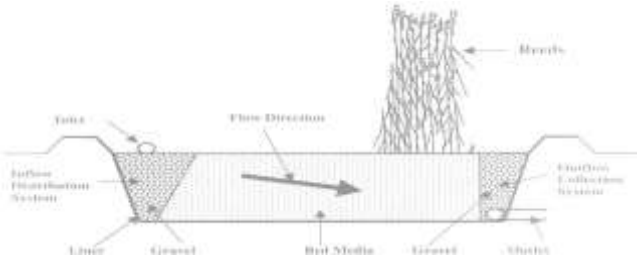
II. REED BED SYSTEM

Reed bed system is a filter beds consisting of sand, gravel, soil system and planted with vegetation which can grow in wetlands. After removal of coarse and floating material the wastewater is passing through the filter bed where biodegradation of the wastewater takes place. [CPCB, 2003] The red bed treatment is also known as the constructed wetland or root zone treatment system. Reed bed is also defined as an "Engineered systems, designed and constructed to utilize the natural functions of wetland vegetation, soils and their microbial population to treat contaminants in surface water, ground water or waste streams".[11] Reed bed uses common reed plants to dewater solids in a limited area. The beds can be any shape to accommodate existing land conditions and areas.

III. CLASSIFICATION OF REED BED SYSTEM

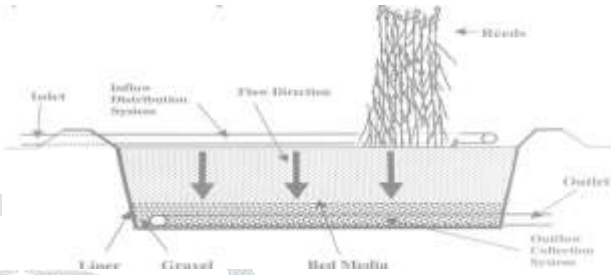
HORIZONTAL FLOW REED BED

It is called Horizontal flow treatment because the wastewater is fed in at the inlet and flow slowly through the porous substrate under the surface of the bed in a horizontal path until it reaches the outlet zone. During this passage the wastewater will come into contact with an aerobic and anaerobic zone. The aerobic zones will be around the roots and rhizomes of the wetland vegetation that leak oxygen into the substrate. During the passage of wastewater through the rhizosphere, the wastewater is cleaned by microbiological degradation.



VERTICAL FLOW REED BED

Vertical Flow treatment comprises of layers of various sized gravels planted with reeds. Wastewater is fed from the top and then gradually percolates down through the bed and is collected by a drainage network at the base. The advantage of vertical flowsystems is an improved oxygen transfer into the soil layer.



HYBRID REED BED

Horizontal Flow treatment is used to remove biochemical oxygen demand and total suspended solids for secondary wastewater treatment. In Vertical Flow treatment there are some limitation like less efficient in solids removal and can become clogged if the media selection is not correct. Due to these reasons, the hybrid wetlands are used. In these systems, the advantages and disadvantages of the Horizontal Flow and Vertical Flow can be combined to complement each other. Depending on the purpose, hybrid wetlands could be either Horizontal Flow wetland followed by Vertical Flow wetland or Vertical Flow wetland followed by Horizontal Flow wetland.

IV. MATERIAL AND METHODOLOGY

CHARCOAL

Charcoal filters are used in the purification process of many liquids Charcoal filters are used in air conditioning units and exhaust fans to rid air of unwanted odors. The process is known as leaching Removal of materials by dissolving them away from solids. Charcoal filters come in different forms such as solid carbon, impregnated foam materials, powder & cloth, which is shown in the figure.

COARSE & FINE GRAVEL

Coarse and fine layers of gravel filters are provided in the reed bed system. Different sizes of gravel are provided for the effective filtration. Which removes the minute suspended particles for the waste water because they form permeable layers, Due to tiny spaces water can pass slowly. A slower flow of water through the system produces clean water. Which is shown in the fig

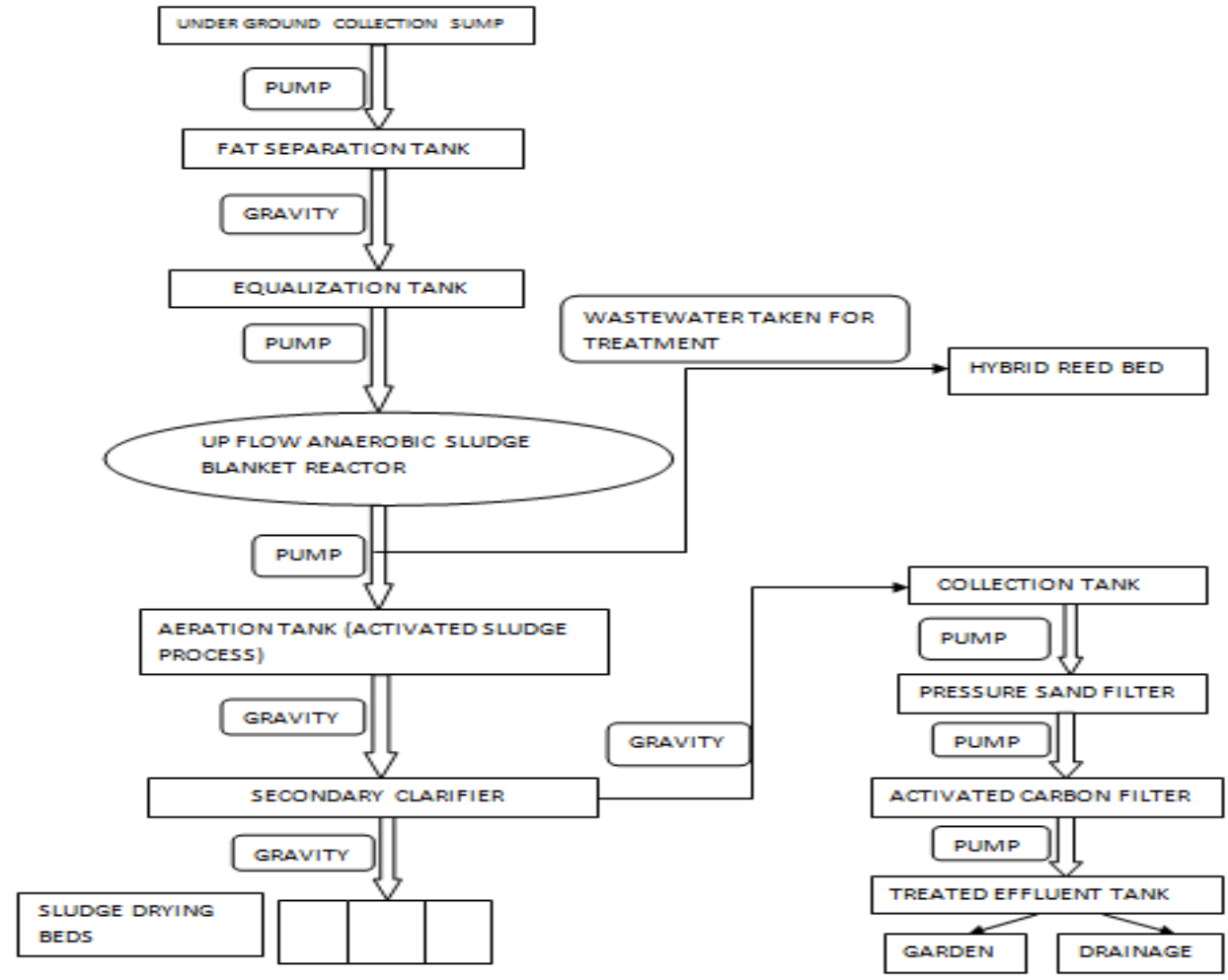
SAND

Sand filters can produce very high quality water free from pathogens, taste odour without the need for chemical aids. It traps the suspended materials and it reducing the numbers of bacteria and removing most of solids. Sand filters become clogged with floc after a period in use and then they are back washed or pressure washed to remove the floc. In these filters the sand traps residual suspended material and bacteria and provides a physical matrix for bacterial decomposition of nitrogenous material, including ammonia and nitrates, into nitrogen gas. Which is shown in the fig

REED

A tall, slender-leaved plant of the grass family, which grows in water or on marshy ground. Wet plants transfer atmospheric oxygen down through their roots in order to survive in water logged conditions. This creates both aerobic and anaerobic soil conditions. It creates a channel for the waste water to pass through, and the roots introduce oxygen into the body of soil and provides an environment for the bacteria to survive, these organisms are necessary to break down many types of compound, in particular the oxidation of ammonia to nitrate. Finally the plants themselves take up a certain amount of nutrients from the waste water, which acts as a Natural Fertilizer. Which is shown in the fig

V. FLOW DIAGRAM OF EFFLUENT TREATMENT PLANT OF DAIRY INDUSTRY



VI. RAW WASTEWATER CHARACTERISTICS

The characteristics of dairy wastewater taken from up flow anaerobic sludge blanket are described in the table. The various tests were conducted on the wastewater as per procedure laid down in standard methods.

Sr. No	Parameter	Before Treatment
1	pH	7.5
2	Total Dissoled Solids (mg/L)	1860
3	Total Suspended Solids (mg/L)	133
4	COD (mg/L)	408
5	BOD (mg/L)	146
6	Ammonical Nitrogen (mg/L)	17

VII. RESULTS

PERFORMANCE OF VERTICAL REED BED REMOVAL OF TOTAL DISSOLVED SOLIDS AT DIFFERENT DETENTION TIME

	Detention time	Initial	Final
TDS	12 Hours	1860 (mg/L)	1793 (mg/L)
	18 Hours	1860 (mg/L)	1720 (mg/L)
	24 Hours	1860 (mg/L)	1698 (mg/L)

PERFORMANCE OF VERTICAL REED BED REMOVAL OF CHEMICAL OXYGEN DEMAND (COD) AT DIFFERENT DETENTION TIME

	Detention time	Initial	Final
COD	12 Hours	408 (mg/L)	387 (mg/L)
	18 Hours	408 (mg/L)	320 (mg/L)
	24 Hours	408 (mg/L)	193 (mg/L)

PERFORMANCE OF VERTICAL REED BED REMOVAL OF TOTAL SUSPENDED SOLIDS AT DIFFERENT DETENTION TIME

	Detention time	Initial	Final
TSS	12 Hours	133 (mg/L)	118 (mg/L)
	18 Hours	133 (mg/L)	109 (mg/L)
	24 Hours	133 (mg/L)	96 (mg/L)

PERFORMANCE OF VERTICAL REED BED REMOVAL OF BIOCHEMICAL OXYGEN DEMAND (BOD)AT DIFFERENT DETENTION TIME

	Detention time	Initial	Final
BOD	12 Hours	146 (mg/L)	139 (mg/L)
	18 Hours	146 (mg/L)	124 (mg/L)
	24 Hours	146 (mg/L)	78 (mg/L)

VIII. CONCLUSION

From the results of the laboratory analysis of Vertical reed bed treatment we can conclude:

1. The waste water used for experimental work is of dairy industry, therefore the pH value of the given waste water is not alkaline nor acidic. There is negligible change in pH value after treatment.

2. The Vertical reed bed system is highly effective in removing BOD up to 68 mg/L and COD at up to 215 mg /L at 24 hours detention time with a removal efficiency of BOD is 46%, and COD is 52%.

3. The Vertical reed bed give significant TDS and TSS reduction for Dairy waste water treatment performance.

4. The Vertical reed bed treatment process is a useful solution for the organic effluents from food based industries.

Organic matter removal is higher in reed bed system because plants play an important role in removing organic matter. Overall percentage removal is better for the retention time of 24 hours as compared to the retention time of 12 or 18 hours. Reed bed treatment process is a useful solution for the organic effluents from food based industries. The treated wastewater can be effectively used for irrigation and local purpose.

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