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TREATMENT OF WASTEWATER FROM DAIRY INDUSTRY BY ROOT ZONE METHOD

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ABSTRACT

In India, the dairy industry contribute a significant percentage of the total quantity of waste generated. Since, milk processing consumes large amount of water, the volume of effluent discharged from the industry is very high. It increases level of BOD and depletes dissolved oxygen of the receiving waters. In this paper various water quality characteristics such as pH, electrical conductivity, COD and TDS of the effluent are studied before and after the application of root zone treatment system (RZTS), and it is found that the treatment is very effective.

INTRODUCTION

Dairy effluents contain dissolved sugars, proteins, fats and possibly residues of additives. The process of producing cream, butter, cheese, and whey from milk increases the BOD of the wastewater. Among the treatment methods applied to dairy wastes, root zone treatment has been found to be quite effective (CPCB 2005). Root Zone Treatment Systems (RZTS) are artificially prepared wetlands comprising of clay or plastic lined excavation and emergent vegetation growing on gravel/sand mixtures (Conley et al. 1991). In this system, the wetland of the RZTS diffuse oxygen through their stems into the root systems and create favourable conditions for the growth of bacteria (Brix 1987). Several researchers have carried out studies on the feasibility of RZTS using plant species such as *Phargmites australis* (Gries 1989). The objective of this paper is to study the effectiveness of the root zone treatment for dairy waste using the plant species, *Arundo donax* which is widely found in Indian conditions.

MATERIALS AND METHODS

The root zone treatment installations are constructed according to the desired level of purification, the concentration of pollutants and hydraulic and organic loadings. The RZTS plants can be set-up as secondary or tertiary treatment for domestic and industrial wastewater treatment systems.

The dairy waste was collected from a dairy plant located at Sulur in Coimbatore district. The diameter of the bin is taken as 0.4 metres and the depth of the Bin as 0.7 metres (Fig. 1). The bin type is off circular fibered type with required number of holes for draining purpose. The filter media was taken as sand and filled up to 7 cm thickness. The soil used for growth of the plant was taken as red soil with a depth of 53 cm. A depth of 10 cm was left for loading dairy waste. A rectangular tray was placed below the bin for collection of treated effluent. The wastes were diluted in the ratio (1:4) and then loaded at the rate of 2 litres per day for each reactor, and the tests performed for the drained effluent in alternate intervals. In order to adopt a suitable plant for Indian conditions, the species of

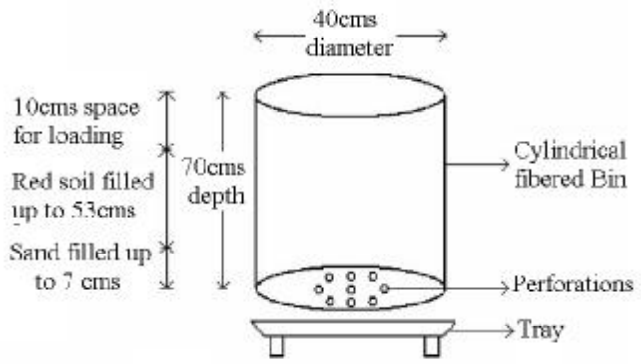

Fig.1. Reactor diagram.

plant selected was *Arundo donax*, which is a strong bamboo grass which can grow with minimum amount of water and sunlight. The maximum height of a well grown plant is around 1.5 metres. The maximum depth of root zone of this plant is around 0.5 to 0.6 metres.

RESULTS AND DISCUSSION

The initial quality characteristics of the dairy effluent are given in Table 1. The variation of the characteristics after the application of RZTS is given in Table 2. At the end of 22 days of study period, it was found that the drained water is almost colourless and odourless due to effective root zone treatment.

The initial pH for the dairy waste was 4.4 due to the presence of acids like fatty acids, lactic acids, etc., which slowly changes from acidic to neutral conditions (7.2) in the first week of the treatment. After the tenth day, the pH remained fairly constant till the end of the study period of 22 days. The removal of acidity from the waste may be due to the degradation of acids in root zone environment.

The initial electrical conductivity of the dairy waste was 0.25 mmho, indicating the presence of soluble salts. However the electrical conductivity decreased with time and the treated effluent

Table 1: Physico-chemical characteristics of the dairy waste.

Color	Grayish Black
Odor	Unpleasant
pH	4.42
Electrical Conductivity (mmho)	0.25
Total Dissolved Solids (mg/L)	610
Chemical Oxygen Demand(mg/L)	1400

Table 2: Variation of physico-chemical characteristics of drained dairy effluent on different days.

Days	1	2	4	6	8	10	12	14	16	18	20	22
pH	5.45	6.4	6.8	7.2	7.4	7.5	7.5	7.6	7.7	7.7	7.6	7.5
EC (mmho)	0.25	0.22	0.2	0.18	0.17	0.16	0.15	0.14	0.14	0.13	0.12	0.11
TDS(mg/L)	610	520	460	420	380	350	310	300	290	270	250	240
COD(mg/L)	1400	1260	1190	1020	940	860	756	628	586	496	416	385

contained an electrical conductivity value of 0.1 mmho at the end of the study period. Since the E.C. is very low, the treated water can be utilized for irrigation purposes.

The dissolved solids consist mainly of inorganic salts and small amount of organic matter. Initially the TDS were 610 mg/L, which reduced to 240 mg/L at the end of the study period. The decrease in TDS was due to the development of the root zone of the plant and subsequent absorption.

Chemical oxygen demand (COD) is a measure of organic matter present in wastewater. Initially, the COD was high at 1400mg/L, which decreased to 385mg/L at the end of 22 days due to microbial degradation in the root zone environment.

CONCLUSION

In the root zone treatment process of dairy wastes, various quality characteristics were studied and it was found that the concentration of the pollutants reduced significantly and the treated waste can be effectively used for irrigation. Hence, the root zone treatment process may prove to be a handy solution for the organic effluents from agrobased industries.

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