iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL
FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 Issue: VI Month of publication: June 2017

DOI:

www.ijraset.com
IC Value: 45.98

Volume 5 Issue VI, June 2017
ISSN: 2321-9653

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Performance Evaluation of Effluent Treatment Plant of Dairy Industry in Gwalior (M.P.)

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Abstract: Dairy industries are generally considered to be the largest source of wastewater in many countries. Although they are not commonly associated with severe environmental problems, they must continually consider their environmental impact, particularly as dairy pollutants are mainly of organic origin. Due to the increase in the population hence the increased milk demand, the dairy industry in India is expected to grow rapidly and have the waste generation and related environmental problems are also assumed increased importance. Dairy industry is among the most polluting of the food industries in regard to its large water consumption. Dairy is one of the major industries causing water pollution. 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 dairy 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 ETP for dairy waste. An intensive study is followed for 3 months for monitoring the effluents from dairy wastewater. Samples of wastewater were collected from the effluent treatment plant from the dairy for the characteristic analysis. This study revealed that average concentrations of COD, BOD, TSS, TDS, oil and grease, alkalinity and chlorides removal in the effluent from the effluent plant were 199 mg/l, 79.4 mg /l, 186 mg/l, 1047 mg/l, 8 mg/l, 410 mg/l and 58.6 mg/l respectively, which met the effluent standards for all the above described parameters except BOD and TSS which are 30 mg/l and 100 mg/l respectively as per the BIS standards .The COD, BOD, TSS, TDS, alkalinity, oil and grease and chlorides removal efficiency was observed as 88%, 87%, 77%, 18%, 9%, 65% and 55% respectively.

Keywords— dairy, effluent, efficiency, wastewater characteristics, performance, concentration.

I. INTRODUCTION

Dairy plants are considered as ‘wet industry’ because they consume large volumes of water, which is used for very diverse purposes. As a result, dairy plants discharge large volumes of wastewater[1]. The rapid growth of industries has not only enhanced the productivity but this also resulted in the production and release of toxic substances into the atmosphere, creating health hazards and effected normal operations, flora and fauna.

Dairy industries are of critical importance to India. India is called “The Oyster” of the global dairy industry. It offers opportunities galore to entrepreneurs worldwide, who wish to capitalize on one of the world’s largest and fastest growing markets for milk and milk products. This country is the world’s largest milk producer, accounting for more than 13% of world’s total milk, consuming it’s almost 100% of its own milk production. Dairies are centres where raw milk is processed either for immediate consumption or converted into other dairy products such as cheese, butter, whey etc.

The dairy industry involves water as a key processing medium used for various processes like cleaning, heating, cooling, sanitization, floor washing, which implies that amount of water required is large which gives rise to a huge amount of wastewaters produced. Hence to combat this problem of environmental issues of present day society, efficient and environmental safe technologies are needed.

It is estimated that approximately 2% of the total amount of milk processed is wasted into drains. To cater to increased water demand due to urbanization and industrialization, reduced rainfall, increase in standard of living, depletion in natural water resources, water recycling is necessary, which is known as zero effluent discharge. In such a situation, finding of present research on study of waste water quality may become very useful for milk processing industry to plan its proper disposal, recycling and utilization strategy in order to avoid pollution as well as keeping environment clean.

A. Objective And Scope

The main objective of this study is to determine the behaviour of various parameters of the dairy wastewater. Dairy wastewater is generally treated using biological methods such as activated sludge process, aerated lagoons, trickling filters, sequencing batch reactor, upflow anaerobic sludge blanket reactor, anaerobic filters, etc[2] .Characterization of wastewater was evaluated in terms of the performance of effluent treatment plant in terms of COD, BOD, TSS, TDS, oil and grease, alkalinity and chlorides removal from the selected plants. The performance of the effluent treatment plant was also evaluated & the quality of the reclaimed wastewater will be compared with BIS (Bureau of Indian Standards) to determine its suitability for reuse. Procedure of the present study can be explicitly stated as the following:

1) To monitor performance of the ETP
2) To address wastewater compliance issues related to irrigation.

II. METHODOLOGY

The objective of this work is the evaluation of pollution parameters of wastewater from dairy industry and check whether the treatment units are working with designed efficiency or not. Within this view, the experimental work has been designed and is presented here with:

A. Work plan: An overview

Samples were collected in three consecutive months feburary, march and april from ETP at different sampling points of ETP and characterize for parameters BOD, COD, Nitrogen, Phosphorus, Oil & grease, pH, Alkalinity etc. Overview of ETP and location of sampling points is given in section B

B. Effluent Treatment Plant: An overview

The processing of the industry Gwalior Sahakari Dugdh Sangh Maryadit includes milk which is received at the plant or receiving station in standard 80- lb cans. It is dumped to a weigh vat and the cans are washed in a can washer and returned to the producer. From the weigh vat milk is pumped to a storage tank or, if the plant is a receiving station, the milk is cooled and pumped to a tank truck for hauling to a bottling or processing plant. About 50% of the milk produced in here is used as whole milk. A small amount of this is bottled as raw milk, but the major portion is pasteurized prior to further handling. Pasteurization is accomplished by heating either to 143º F for 30 minutes or 160º F for 15 minutes. The milk may then be bottled for distribution, condensed to produce evaporated milk, or dried to milk powder. A small amount of whole milk is used in the manufacture of ice-cream mixes and in some type of cheese. About 41% of the milk supply is separated into cream and skim milk. Some of cream is bottled for distribution or is used for ice-cream mix. A considerable portion however is used, in the manufacture of butter. In some cases the producer may separate the cream and deliver it to the plant where it is cooled and processed. Butter milk is by-product of butter manufacture and may be condensed in the vacuum pan or may be dried on heated rolls with or without pre condensing. Powdered butter milk is used mainly in the preparation of stock and poultry feed. Skim milk from the separator may be condensed in the vacuum pan and/ or dried to produce skim milk powder. Condensed and powdered whey are also used in food products and animal feeds. Some of the skim milk may be used for the manufacture of cottage cheese and casein[3].

The ETP of Gwalior Sahakari Dugdh Sangh Maryadit, Banmore district Morena having capacity to treat 700- 1300 m3/day of wastewater was selected for the study. A general systematic flow diagram of WWTP is shown in fig. The system was designed to handle to treat wastewater having high organic content and suspended solids. The heart of the system is Aerobic biological reactor. The system was designed to handle BOD5 at 20°C of 800 mg/L and Suspended Solids (SS) 250 mg/L. The various point sources of wastewater is collected in a combined underground sewer and conveyed to the effluent sump, equalization take place, than feed the wastewater into the subsequent units. Than effluent passes through the oil separator, after that flow is divided into two parts and passes through the parallel combination of two aeration tanks. The combined effluent from the aeration tanks the passes through the secondary clarifier. The treated effluent from secondary clarifier is discharged to the land and use for irrigation.

The effluent treatment facility consists of the following units

Effluent collection sump

Equalisation tank

Aeration Tanks

Secondary clarifier

Filter feed tank

Treated water tank

Sludge drying beds

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ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

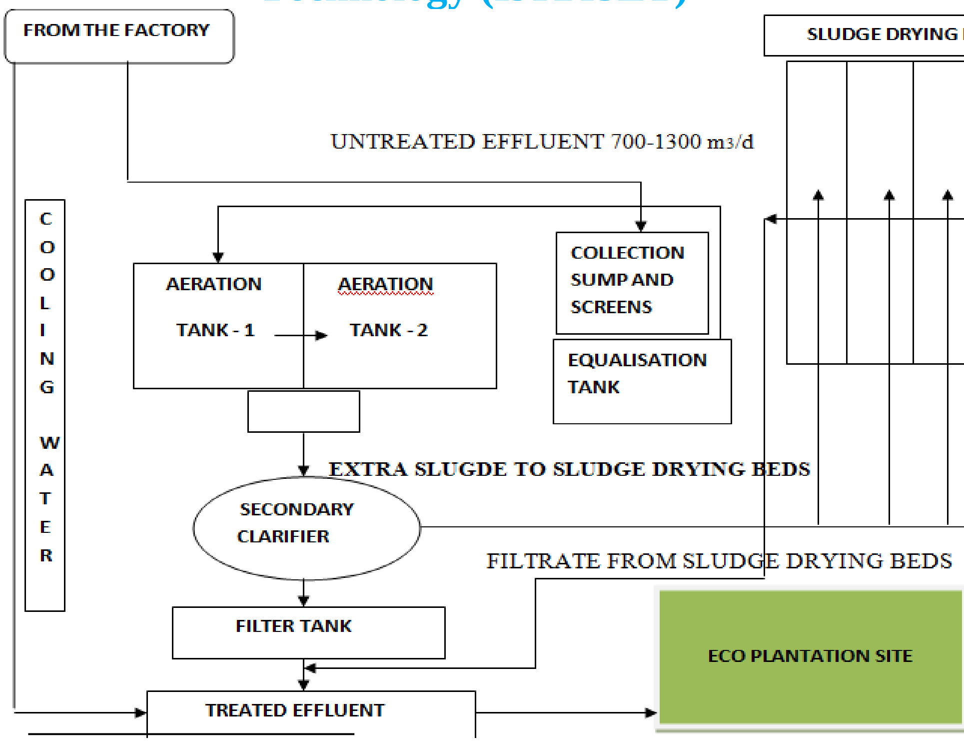

Fig 1: Process flow diagram of wastewater treatment plant

C. Sampling procedure and frequency

The setting up of a proper sampling program was the first step into characterizing the constituents of the wastewater and thereby documenting the performance of the treatment plant. Several factors were considered to meet the need of a representative sampling program. These factors included number of and selection of sampling locations, type of samples (grab or composite samples), sample sizes, time intervals between samples and total number of samples needed to achieve statistically representative output values from the analyses. Each sample was implemented as a grab sample. For each control point there was collected a minimum of 1 litre for the chemical/physical analyses and a total of 0.25 litres for the microbial analyses. The amounts are correlated to the actual minimum amount needed to carry out the appurtenant analyses. For the microbial analyses, sterile plastic bottles were used, while for physical / chemical analyses cleaned water bottles were used. After collection, the samples were immediately transferred into a cooling box and transported to the laboratory for analysis. The control points, which served as locations for the samples, are as follows:

Point 1: Effluent collection sump
Point 2: Equalisation tank
Point 3: Aeration tank-1
Point 4: Aeration tank-2
Point 5: Secondary clarifier
Point 6: Filter tank

Sampling was carried out from 07.02.2017 to 01.04.2017. Sampling was accomplished every day of the week except Sundays. Due to frequent interim closedowns of the plant, in addition to a sickness period, sampling was not undertaken every day through the period. Sampling was carried out from 8:00 and 12:00 each morning during the sampling period. The methods used for the testing of samples were done using Standard Methods for the Examination of Water and Wastewater APHA 1996[4].

III.OBSERVATIONS AND RESULTS

Data taken during 3 months of this study are presented and discussed. The nature of the waste water from dairy industries varies throughout the working day. The Concentration of these pollutants should not be allowed to go beyond a certain range according to the BIS Standards, and extra care should be taken to avoid shock load.

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TABLE 1

CHARACTERISTICS OF INFLUENT , EFFLUENT AND THE PERFORMANCE OF ETP IN TERMS OF REMOVAL EFFICIENCY (%) IS GIVEN BELOW

pH				TDS			
Month of Sampling	Influent	Effluent	% Efficiency	Month of Sampling	Influent	Effluent	% Efficiency
February	7	7.1	-	February	1296	990	23%
March	6.5	8	-	March	1330	986	25%
April	6.9	8.2	-	April	1228	1165	5%
TSS				BOD			
Month of Sampling	Influent	Effluent	% Efficiency	Month of Sampling	Influent	Effluent	% Efficiency
February	398	170	81%	February	640.8	78.1	87%
March	790	200	74%	March	528.2	69	86%
April	870	188	78%	April	693	91.1	86%
COD				CHLORIDES			
Month of Sampling	Influent	Effluent	% Efficiency	Month of Sampling	Influent	Effluent	% Efficiency
February	2000	220	89%	February	135	45.9	66%
March	1750	190	89%	March	127	70	44%
April	1278	188	85%	April	129	60	53%
OIL AND GREASE				ALKALINITY			
Month of Sampling	Influent	Effluent	% Efficiency	Month of Sampling	Influent	Effluent	% Efficiency
February	23	8	65%	February	437	420	4%
March	27	8.5	68%	March	458	415	10%
April	26.9	10	62%	April	445	393	12%

* All parameters are in mg/l except pH

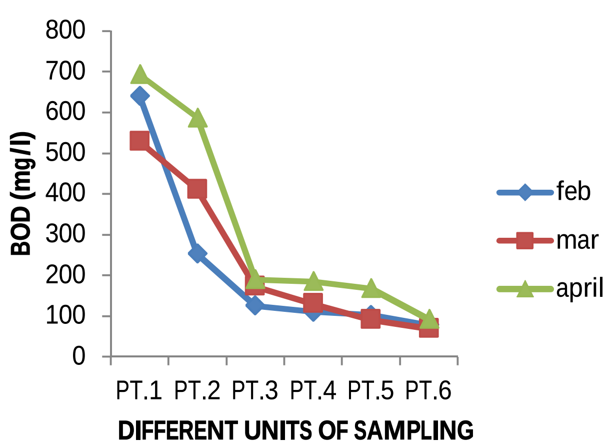

Fig. 2: Monthly variation of BOD at different sampling points

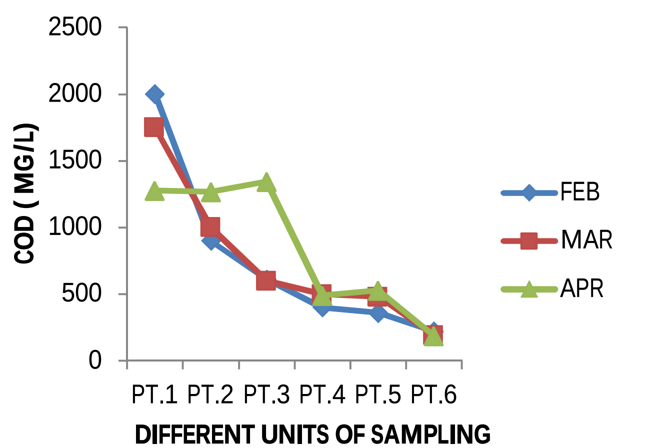

Fig. 3: Monthly variation of COD at different sampling points

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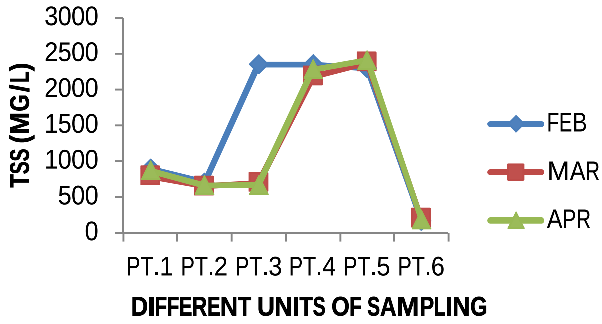

Fig. 4: Monthly variation of TSS at different sampling points

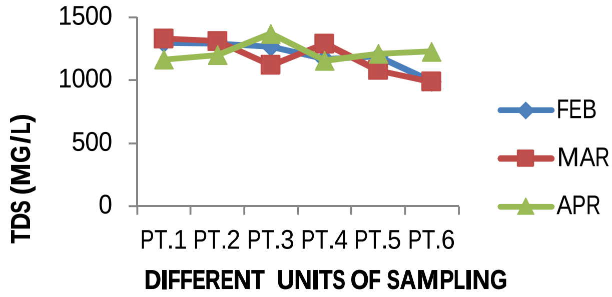

Fig. 5: Monthly variation of TDS at different sampling points

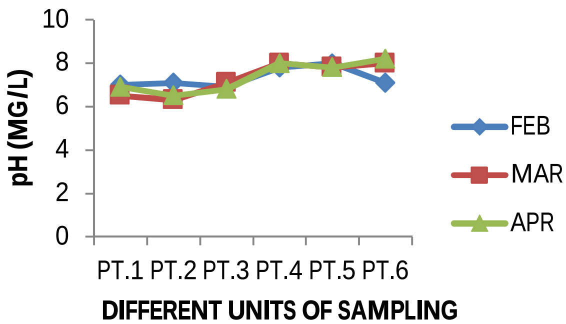

Fig. 6: Monthly variation of pH at different sampling points

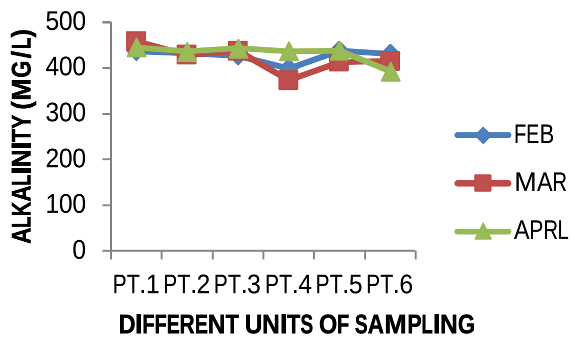

Fig. 7: Monthly variation of ALKALINITY at different sampling **points**

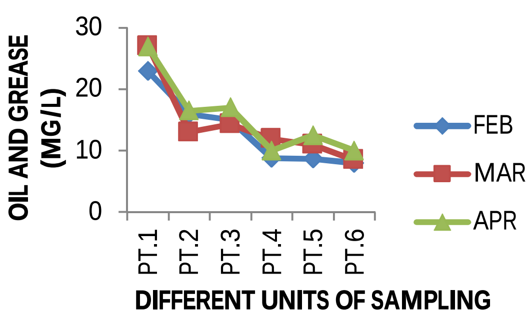

Fig 8. : Monthly variation of OIL AND GREASE at different sampling points

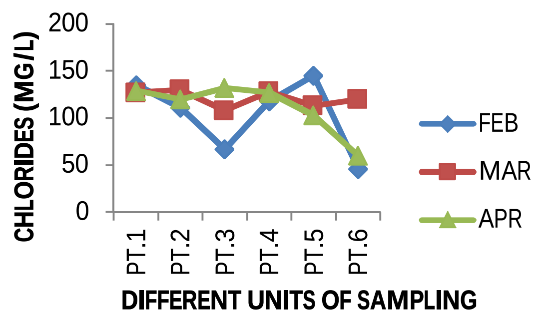

Fig. 9: Monthly variation of CHLORIDES at different sampling different sampling points

Milk has a BOD content 250 times greater than that of sewage [6] .It can, therefore, be expected that dairy wastewaters will have relatively high organic loads, with the main contributors being lactose, fats, and proteins (mainly casein), as well as high levels of nitrogen and phosphorus that are largely associated with milk proteins[7]. Reduction of wastewater pollution levels may be achieved by more efficiently controlling water and product wastage in dairy processing plants. Comparisons of daily water consumption records vs. the amount of milk processed will give an early indication of hidden water losses that could result from defective subfloor and underground piping. An important principle is to prevent wastage of product rather than flush it away afterwards. Spilled solid material such as curd from the cheese production area, and spilled dry product from the milk powder production areas should be collected and treated as solid waste rather than flushing them down the drain [8] .Small changes could also be made to dairy manufacturing processes to reduce wastewater pollution loads, as reviewed by Tetrapak [8] .The treated wastewater used for

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ISSN: 2321-9653

eco-plantation. Nutrients present in the wastewater are used by the plants and partially retained in a soil matrix without defecting the soil eco-system. Milk and product spillage can further be restricted by regular maintenance of fittings, valves, and seals, and by equipping fillers with drip and spill savers. Pollution levels could also be limited by allowing pipes, tanks, and transport tankers adequate time to drain before being rinsed with water [9] .Wastewater used for irrigation purpose is necessary to fullfill the standards prescribed by Madhya Pradesh Pollution Control Board. These Standards are tabulated in table 2.

TABLE 2

SECONDARY EFFLUENT FROM ETP AND IRRIGATION WATER QUALITY GUIDELINES

PROPERTIES	SECONDARY EFFLUENT	BIS GUIDELINES
COD	199 mg/l	250 mg/l
BOD	80 mg/l	30 mg/l
PH	7.7	5.5 – 9.0
TSS	186 mg/l	100
ALKALINITY	410 mg/l	-
OIL AND GREASE	8 mg/l	10
CHLORIDES	58.6 mg/l	-

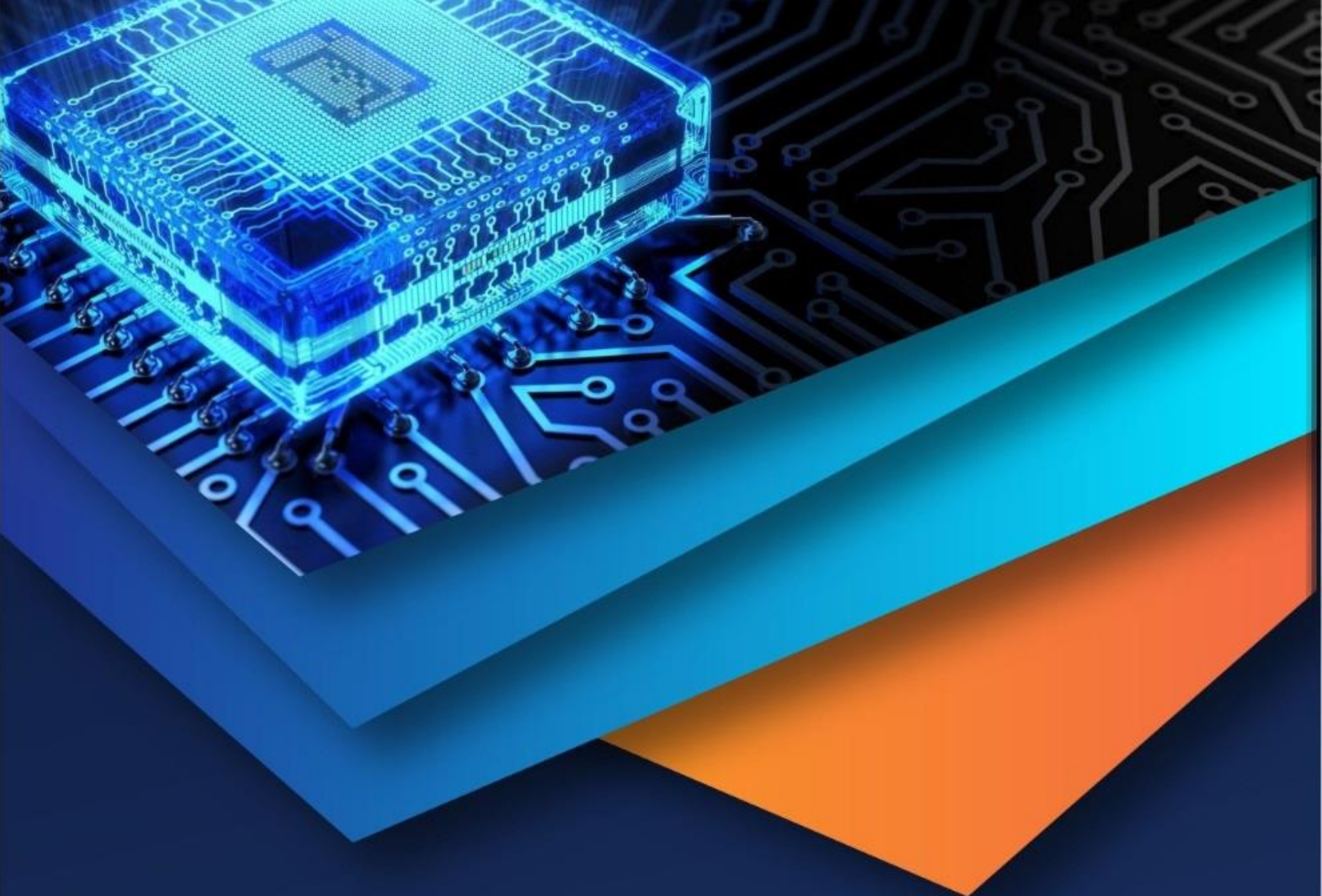
IV. CONCLUSIONS

Present study concerned with the performance evaluation of ETP for dairy industry and it is used for the gardening purpose. The COD, BOD and TSS removal efficiency of ETP was observed to be 88%, 87 % and 77 % respectively but value of BOD and Suspended Solids exceed the permissible limits. Hence it is recommended to redesign the wastewater Treatment Plant to achieve the desired standards.

The Treated effluent is used for eco-plantation. The plants which are grown are Eucalyptus, Poplar, Teak and Jatropha. The high transpiration capacity of plants grown in soil matrix enables the system to serve as biopump [5] .The wastewater of that plant is used for the gardening purpose or it will go to the sewerage system. It is not reused. The performance studies on the dairy wastewater treatment plant were evaluated. As per available 3 months data, existing effluent treatment plant appears to be capable of withstanding the shock loads without affecting the efficiency of the plant. The individual units are also performing well and their removal efficiencies are satisfactory. Thus this activated sludge process can be considered as a potential plant for industrial wastewater treatment.

REFERENCES

[1] Wildbrett G (2002) Dairy plant effluent: Nature of pollutants. In: Roginski H, et al (eds) Encyclopedia of Dairy Sciences, Elsevier, Oxford. pp 727–33.
[2] Demirel B, Yenigun O, Onay TT (2005) Anaerobic treatment of dairy wastewaters: a review. Process Biochem 40, 2583–95.
[3] Eldridge, E.F. “Milk Product Waste”.
[4] APHA, AWWA and WPCF 1995, “Standard methods for the Examination of water and wastewater”.19th edition, jointly edited by Eaton, A.D.; Clesceri, L.S. and Greenberg, A.E.
[5] Garg, S.K. (1998), “Sewage Disposal and Air Pollution Engineering”
[6] Burton, C. FOG clearance. Dairy Ind. Int. 1997, 62 (12), 41–42
[7] Donkin, J. Bulking in aerobic biological systems treating dairy processing wastewaters. Int. J. Dairy Tech. 1997, 50, 67–72
[8] Tetrapak. TetraPak Dairy Processing Handbook; TetraPak Printers: London, UK, 1995
[9] Steffen, Robertson, Kirsten Inc. Water and Waste-water Management in the Dairy Industry, WRC Project No. 145 TT38/89. Water Research Commission: Pretoria, South Africa, 1989.



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