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Performance Evaluation of Effluent Treatment Plant of SRF Limited, Malanpur Bhind (M.P.)

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Abstract: ***the present study has been undertaken to evaluate the performance of the effluent treatment plant (etp) of a synthetic fibre industry srf limited in malanpur, bhind (m.p.). The effluent treatment plant is treating 225 kl/day of wastewater generated from srf limited. The wastewater analyzed for the water quality parameter, such as; ph, total solids, suspended solids, dissolved solids, bod and cod. Samples were collected from 7 points; polymerization tank [p1],equalization tank [p2] aeration tank-1 [p3], primary clarifier [p4], aeration tank-2 [p5] & secondary clarifier [p6] including the treated effluent of fish pond [p7] to evaluate the performance of effluent treatment plant. The present study shows that cod and bod removal efficiency of etp found to be 90% & 93% respectively. These values are within the permissible limit for irrigation purpose complying with mppcb (madhya pradesh pollution control board) effluent standards. Concentration of suspended solids in treated effluent is 219 mg/l, which is higher than the permissible limit prescribed by mppcb (100 mg/l). Hence it is recommended to redesign the etp to achieve desired standards***.

I. INTRODUCTION

Nylon-6 was first introduced in 1889 but commercially feasible synthetic fibre was first discovered in 1935 by Paul Shalack. Nylon-6 is a first synthetic fibre introduced in India in 1960[14]. The world productions of synthetic fibre were 55.2 & 71 million tonnes in 2014-2016 respectively. Production of the Nylon filament yarn and Nylon industrial yarn is 36000 & 76000 tonnes in 2010-2011 respectively in India [12]. Nylon-6 is synthesized by ring-opening polymerization of caprolactam. Caprolactam has 6 carbon chains, when caprolactam is heated at about 533k in an atmosphere of nitrogen for about 4 to 5 hrs. The ring break undergoes polymerization. The molten mass is passed through spinner to form fibre of Nylon-6. Nylon-6 are strong, elastic, abrasion resistance, lustrous, easy to wash, resistance to damage from oil & many chemicals, low in moisture absorbency. Nylon-6 is widely used in apparel, home furnishings, tyre cord, hose, conveyer, and seat belts, parachutes, racket strings, rope tents thread etc. The fresh water requirement for the 45 MTPD Nylon-6 Plant shall not exceed 110 kl/day [2]. The wastewater generated about 50% of total fresh water consumption. The untreated synthetic fibre industry wastewater can cause rapid depletion of DO if it is directly discharge into the surface water due to higher values of TS, SS, DS, and BOD & COD. The effluent containing higher values of BOD & COD are highly toxic to flora and fauna. It is necessary to analyse the quality of such effluent by their physico-chemical and biological analysis. It gives a precise idea on performance evaluation of Effluent Treatment Plant (ETP) and if necessary, appropriate measures may be undertaken to prevent adverse impact on environment. The obtained results were very much useful in identification and rectification of operational and maintenance problems and it can also utilize to establish methods for improved synthetic fibre industry and plant wastewater minimization strategies.

A. General Description of SRF Limited Synthetic Fibre Industry, Malanpur

The present study on "Performance evaluation of existing wastewater treatment plant of Synthetic Fibre Industry" SRF Limited, Malanpur. Industry is located at Bhind area, it is nearby 15 km away from MITS College of Gwalior at co-ordinate 26°21'10''N78°17'4''E. It is a Nylon-6 industry, produce Nylon-6 yarn (tyre cord fibre) using caprolactam as a raw material. Synthetic fibre industry has Nylon-6 production capacity 70 MTPD. The fresh water consumption of SRF Limited is 500 Kl/day and wastewater generation is 225 KL/day.

B. Source of Wastewater Generation

Wastewater generate from Nylon-6 plant, in the form of process wastewater from polymerization, spinning, chips washing, cooling and cleaning operation. Wastewaters from polymerisation reach to the polymerization tanks and finally reach the Equalization tank by pumping well water from sump well. Wastewater generated from various sources as shown in table 1

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Table1: Category wise wastewater generation

s.no.	Particulars	Wastewater generation in (kl/d)
1	Domestic wastewater	30
2	Industrial wastewater	
i.	Process	40
ii.	Cooling tower blow down	100
iii.	Chips washing	50
iv.	Others	5
	Sub- Total: Industrial	195
	Grand Total	225

II. OBJECTIVE OF STUDY

The study was conducted in Public Health Engineering (PHE) laboratory, Department of Civil Engineering, MITS College Gwalior (M.P.) with the following objectives.

A. To identify the amount and sources and amount of the wastewater.
B. To study the composition and characteristics of composite wastewater.
C. To study the performance of existing wastewater treatment plant and
D. To suggest modification (if needed).

III. MATERIALS AND METHODOLOGY

A. Wastewater Treatment: The Layout Plan of Effluent Treatment Plant

The layout plan of ETP as shown in figure 1 clearly shows that how wastewater reaches from equalization tanks to the secondary clarifier by passing from different processing units. At the inlet of Aeration Tanks-1 dosing of Urea and DAP apply @ 67 mg/l & 9mg/l respectively. Samples are collected from ETP at different sampling points and characterized pH, Total Solids, Suspended Solids, Dissolved Solids COD, BOD, etc. The layout plan of ETP and location of sampling points are given below-

Polymerisation Tank[P1] (P/T)
Equalization Tank[P2] (E/T)
Aeration Tank[P3] (A/T-1)
Primary Clarifier[P4] (P/C)
Secondary Aeration[P5] (A/T-2)
Secondary Clarifier[P6] (S/C)
Treated water[P7] (F/P)

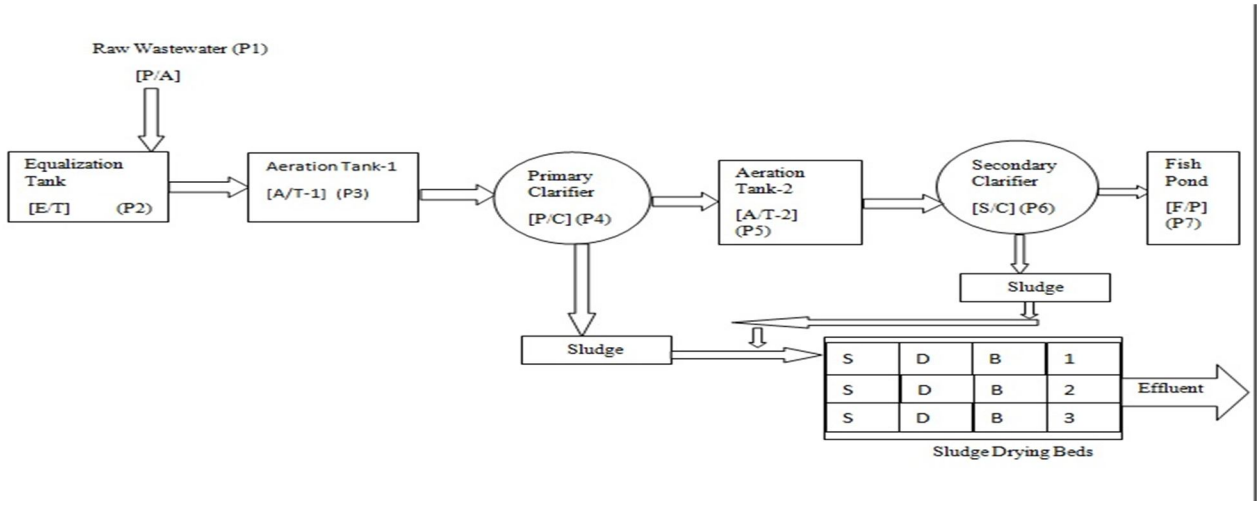

Figure 1: Layout plan of existing ETP with sampling points

B. Sampling Schedule and Frequency

Samples were collected weekly from ETP at the sampling points as shown in figure 1. Samples were collected in plastic bottles and analysed for the various parameter like pH, Total Solid, Suspended Solids, Dissolved Solids, BOD, COD, etc. as per procedure laid down in MITS Laboratory Manual for water and wastewater. Instruments and Methods used for analysis are tabulated in table 2 with different parameter.

Table 2: Instruments and Methods used for measurement of different parameters

Parameters	Unit	Instruments and Methods
pH	----------	Digital pH meter and pH strips
Total Solids	Mg/l	Hot air oven
Suspended Solids	Mg/l	Hot air oven
Dissolved Solids	Mg/l	Hot air oven
BOD_5 at 20^oc	Mg/l	Winkler's Azide modification method
COD	Mg/l	Close reflux method

IV. RESULTS AND DISCUSSION

A. Performance of ETP

The physico-chemical characteristics of raw wastewater are given table 3. The key pollutants in the wastewater from synthetic fibre industry are BOD, COD, TS, SS & DS. Total Solids in wastewater was found to be 1269mg/l which include the suspended solids obtained from processing of caprolactam for production of Nylon-6 yarn. BOD & COD of wastewater is found to be 22&90 mg/l respectively.

Table 3: characteristics of raw wastewater from ETP

Sampling points	Colour	pH	Total Alkalinity	Total Acidity	Total solids	Dissolved Solids	Suspended Solids	BOD	COD	Chloride
P1(P/T)	yellow	8.1	350	75	674	174	500	278	1200	80
P2(E/T)	yellow	7.8	334	70	928	450	478	260	920	74
P3(A/T-1)	Light yellow	7.8	610	130	1410	961	449	180	480	46
P4(P/C)	Light yellow	7.7	600	146	1500	915	585	150	352	48
P5(A/T-2)	Light yellow	7.6	346	144	1333	1087	246	140	320	286
P6(S/C)	Colour less	7.5	420	140	1300	1070	230	27	96	320
P7(F/P)	Colour less	7.5	320	120	1269	1050	219	22	90	550

* All parameters are in mg/l except colour and pH

The performance of ETP in terms of removal efficiency (%) in the pollution parameters is given in table 4.

Table 4: Removal Efficiency of ETP

Parameters	Unit	Efficiency of primary clarifier	Efficiency of secondary clarifier	Overall Efficiency
COD	Mg/l	27%	72%	90%
BOD_5 at 20^oc	Mg/l	17%	82%	93%

B. Use of Treated Wastewater for Irrigation

The treated wastewater used for 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. Wastewater used for irrigation purpose is necessary to full fill the standards prescribed by Madhya Pradesh Pollution Control Board. These Standards are tabulated in table 5.

Table 5: Treated effluent value from ETP with standards

S. No.	Parameters	Units	Treated wastewater	Permissible limits
1	pH	-----	7.5	5.5 to 9.0
2	TSS	Mg/l	219	100
3	TDS	Mg/l	1050	2100
4	COD	Mg/l	90	250
5	BOD	Mg/l	22	30

V. CONCLUSIONS

Based on study following conclusion can be drawn.

A. The COD removal efficiency of ETP found to be 90%

B. The BOD removal efficiency of ETP found to be 93%

C. The current results suggest that to treated effluent is complying with std. values and can be used for irrigation purposes.

D. Though the efficiency of ETP in respect of COD & BOD is satisfactory but value of Suspended Solids exceed the permissible limit. Hence it is recommended to redesign the wastewater Treatment Plant to achieve the desired standards.

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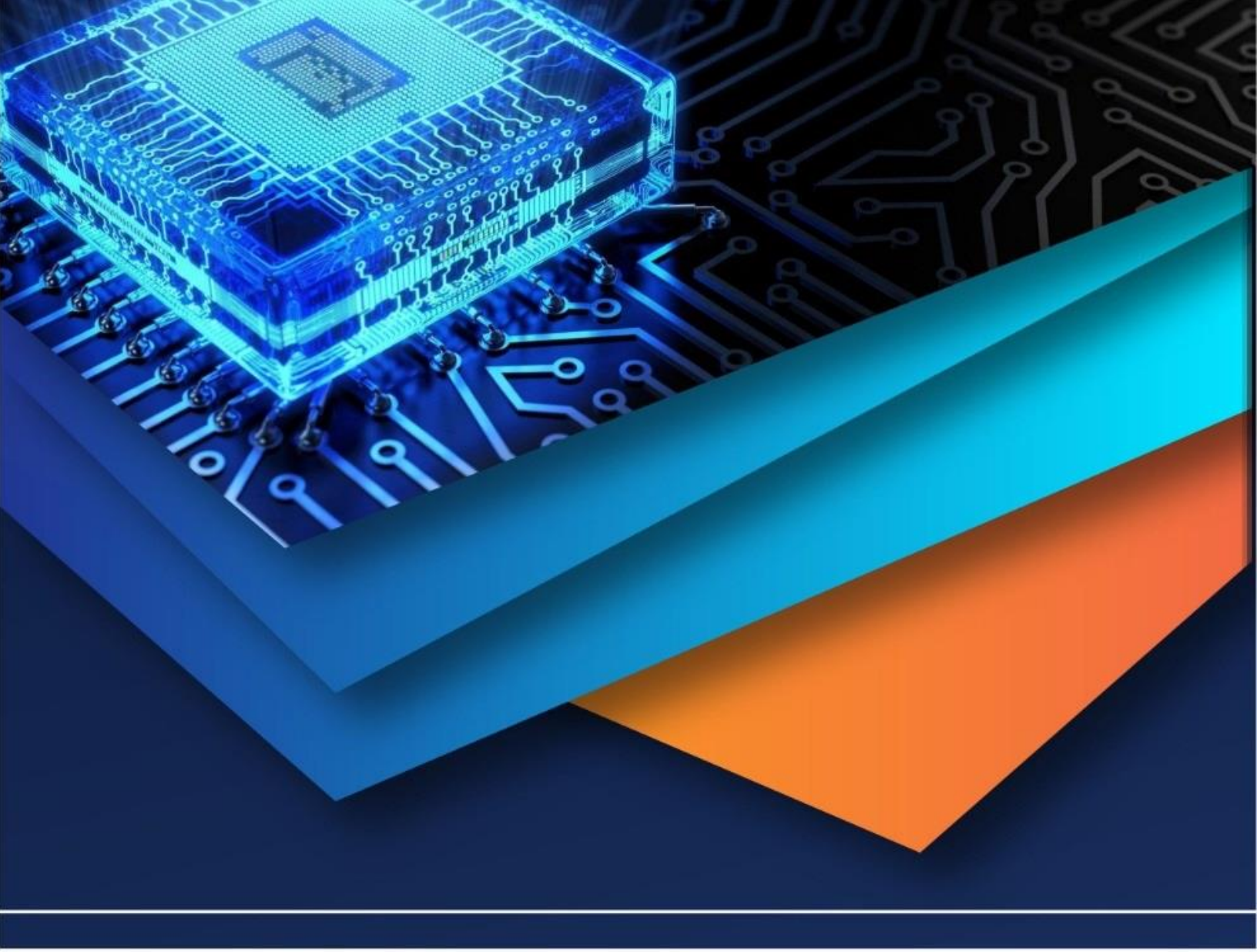

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