

PERFORMANCE EVALUATION OF UASBR FOR MILK PROCESSING PLANT OF S.R.THORAT MILK PRODUCTS PVT.LTD AT RAJAPUR

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Abstract

This work was aimed to evaluate the performance of UASBR for treating milk processing wastewater. The study has been conducted for the UASBR installed at S.R.Thorat Milk Products Pvt. Ltd. at Rajapur, Tal. Sangamner, District Ahmednagar. The organic loading rate was 3.69 Kg COD/m³/day, hydraulic retention time was 10 hours, and flow rate was 10m³/hr. And up flow velocity was 0.6m/hr. The COD: N: P ratio was followed as 100:5:1 for nutrient feed. The performance of UASBR is reported in terms of % removal of various wastewater characteristics by UASB process. It is observed that the biogas yield of 0.6m³/m³ reactor volume/day is sufficient to carry out natural mixing in the reactor. So Upflow Anaerobic Sludge Blanket (UASB) reactor can be suitable alternatives for treatment of such wastewater to reduce overall operational cost of the treatment. [2]

Keywords: Wastewater, BOD, COD, Organic Loading Rate (OLR), Milk processing waste.

1. INTRODUCTION

The protection and improvement of environment is a major issue, which affects the well being of people and economic development. The rapid urbanization and industrialization is posing additional challenges for environmentalists for proper management of the wastewater, to protect water quality in the receiving water body. In recent years energy consideration and environmental concerns have increased the interest in direct anaerobic treatment of industrial wastes. The anaerobic method of waste treatment offers under the present circumstances a number of significant advantages with little serious or inseparable drawbacks over other treatment methods. The interest in anaerobic liquid wastewater treatment processes in practice is sharply increasing all over the world.

1.1 Anaerobic Process

One of the most serious problems in the use of anaerobic treatment for low strength wastes, being the retention of a sufficient quantity of viable sludge under short hydraulic retention time (less than a day) now appears to have been overcome as a result of the development of the high-rate anaerobic processes e.g., anaerobic filters, anaerobic expanded / fluidized bed reactor, and Upflow Anaerobic Sludge Blanket (UASB) reactor. [4] One common feature offered by all the high-rate processes is the ability to achieve high solids retention time, even at short hydraulic retention time. In anaerobic filters and expanded / fluidized beds, this is accomplished by the development of biofilm on support surfaces. [5]

1.2 Sources of Wastewater

- Process waste streams: Milk processing wastewater
- Non-process waste streams: Cooling water, Waste wash water, Water treatment plant wastewater, Boiler blow down, Bottling plant wash wastewater, other wastes.

1.3 Objectives of the Study

The study was conducted at S.R.Thorat Milk Products Pvt. Ltd., Rajapur, Sangamner, Ahmednagar, and Maharashtra with the following objectives.

- 1) To determine characteristics of Milk processing industry wastewater.
- 2) To study the efficiency of the UASBR.
- 3) To study the anaerobic digestion under optimum conditions.
- 4) To find the amount of biogas produced.

2. MATERIALS AND METHODOLOGY

2.1 Analysis of General Characteristics

2000ml of effluent sample was collected for analysis of various physico-chemical parameters such as pH, BOD, COD, alkalinity, total solids, etc. and the analysis were carried out as per the Standard Methods, 20th edition. [1]

Process Design Parameters:-

- Hydraulic Retention Time (HRT): 10 hours.

- Solids Retention Time (SRT): 30 days.
- Organic Loading on sludge blanket: 3.69 kg COD /m³/ day.
- Flow Regime : Constant rate for pumped inflows
- Upflow velocity: 0.6 m/hour.
- Flow rate: 10 m³/hour.
- COD:N:P ratio : 100:5:1
- Gas production : 60 m³/day
- Inlet feed points: 2 Nos.

compounds and solids. Biodegradability may be estimated on the basis of BOD / COD ratio. This ratio ranges between 0.21-0.23, which indicates that the part of the organic compounds in the wastewater is not easily biodegradable. The BOD₅ is 534mg/L, COD is 2,461mg/L, Total Dissolved Solids in wastewater was found to be 2382 mg/L and Total Suspended Solids was 488mg/L. The pH value in this case varies from 7.4 – 7.6. When wastewater contains high concentration of organic matter, dissolved oxygen depletes because of the breakdown of organic matter, in absence of oxygen, sulphate acts as an electron acceptor to produce H₂S and odour. The results of pH, alkalinity, percentage COD removal, Gas production are shown in Table no.1, Table no.2 & Table no.3.

3. RESULTS AND DISCUSSION

3.1 Characteristics of Wastewater:

The fresh wastewater samples were brought to laboratory to analysis the typical characteristics. The key pollutants in the wastewater from the milk processing industry are organic

Table1. Influent Waste Water Characteristics

Sample No.	Time (Days)	Temp. °C	pH	TDS mg/L	TSS mg/L	BOD mg/L	COD mg/L	Cl mg/L	SO ₄ mg/L	TKN mg/L	O&G mg/L	VFA mg/L
1	1	26	7.5	2400	486	510	2448	190	450	32.06	9	94
2	4	26	7.5	2360	500	580	2544	190	445	31.78	8	81
3	8	26	7.4	2390	476	590	2368	190	451	31.92	8	81
4	11	25	7.5	2340	468	470	2272	190	448	31.64	7	77
5	15	24	7.6	2410	512	600	2576	192	440	31.64	8	81
6	18	25	7.4	2420	490	540	2496	194	441	31.78	9	94
7	22	26	7.5	2390	470	470	2336	194	430	32.06	8	94
8	25	25	7.5	2340	488	520	2464	194	435	31.92	8	90
9	29	27	7.5	2350	508	590	2560	192	425	32.20	8	94
10	32	25	7.6	2330	498	550	2528	196	420	32.06	8	81
11	36	27	7.5	2360	478	490	2384	194	434	32.06	9	86
12	39	27	7.5	2380	480	490	2416	190	443	32.20	8	86
13	43	28	7.6	2390	492	570	2528	190	449	31.92	8	86
14	46	28	7.6	8370	472	470	2320	190	439	32.06	9	90
15	50	27	7.6	2420	474	480	2336	194	446	32.06	9	94
16	53	29	7.5	2410	482	500	2432	194	434	31.78	8	90
17	57	29	7.5	2400	486	510	2448	192	432	31.78	7	90
18	60	27	7.5	2400	494	570	2528	192	445	31.78	8	81
19	64	32	7.6	2410	490	530	2480	190	449	32.06	8	81
20	67	29	7.4	2430	504	590	2560	194	420	32.20	8	81
21	71	29	7.5	2390	504	590	2560	194	427	32.06	7	81
22	74	29	7.5	2370	496	560	2528	194	430	32.06	8	90
23	78	30	7.6	2370	492	550	2512	192	430	31.92	8	90
24	81	32	7.5	2360	488	510	2448	192	439	32.06	9	77

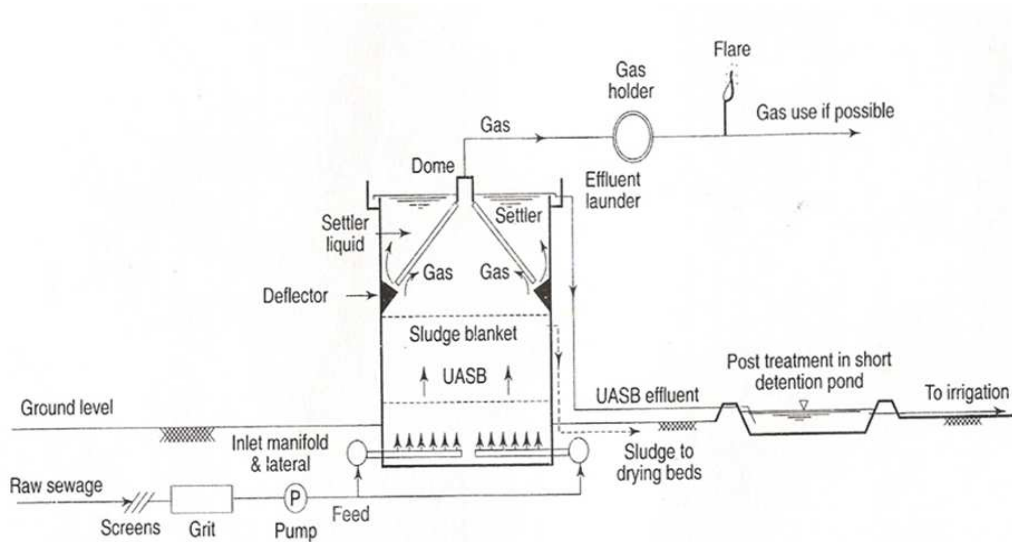


Fig1. A UASBR installation for Milk Processing Wastewater

Table2. Effluent Waste Water Characteristics

Sample No.	Time (Days)	Temp. °C	pH	TDS mg/L	TSS mg/L	BOD mg/L	COD mg/L	Cl mg/L	SO ₄ mg/L	TKN mg/L	O&G mg/L	VFA mg/L
1	1	28	7.3	1350	80	70	240	190	148	61.74	0	17.1
2	4	28	7.3	1320	76	74	256	190	144	61.74	0	8.5
3	8	28	7.3	1340	78	68	240	190	152	62.86	0	8.5
4	11	27	7.3	1310	80	66	224	190	144	62.86	0	8.5
5	15	27	7.4	1360	72	74	256	192	140	62.58	0	12.8
6	18	28	7.3	1370	76	70	240	194	140	62.02	0	12.8
7	22	28	7.2	1390	70	68	224	194	132	61.88	0	8.5
8	25	28	7.3	1290	78	70	240	194	132	62.02	0	17.1
9	29	29	7.3	1280	72	74	256	192	128	62.16	0	12.8
10	32	28	7.3	1270	76	72	256	196	128	62.30	0	12.8
11	36	30	7.3	1280	78	68	240	194	136	62.16	0	12.8
12	39	29	7.3	1290	68	68	240	190	144	62.02	0	8.5
13	43	30	7.4	1300	70	72	256	190	148	62.16	0	8.5
14	46	30	7.4	1320	72	68	224	190	140	61.74	0	17.1
15	50	29	7.4	1310	72	68	224	194	144	61.74	0	17.1
16	53	31	7.3	1400	78	70	240	194	132	62.72	0	12.8
17	57	31	7.3	1400	76	70	240	192	132	62.58	0	12.8
18	60	31	7.3	1390	78	72	256	192	144	62.22	0	8.5
19	64	32	7.35	1400	74	70	240	190	148	62.44	0	12.8
20	67	32	7.2	1410	78	74	256	194	128	62.72	0	12.8
21	71	31	7.3	1440	72	74	256	194	128	62.72	0	8.5
22	74	32	7.25	1410	72	72	256	194	132	63.00	0	8.5
23	78	32	7.45	1390	76	72	256	192	132	63.00	0	12.8
24	81	33	7.3	1390	80	70	240	192	140	62.44	0	12.8

Table3 Performance of UASB Reactor

Sample No.	Time (Days)	Percentage Removal						
		TDS	TSS	BOD	COD	SO ₄	O&G	VFA
1	1	43.75	83.54	86.27	90.19	67.11	100	81.81
2	4	44.40	84.40	87.24	89.94	66.15	100	89.51
3	8	43.93	85.71	88.47	89.89	66.30	100	89.51
4	11	44.01	85.89	85.96	90.14	67.85	100	88.96
5	15	43.56	85.54	87.67	90.06	68.18	100	84.19
6	18	43.39	84.49	87.04	90.38	68.25	100	86.38
7	22	41.84	85.11	85.53	90.41	69.30	100	90.95
8	25	44.87	84.01	86.45	90.25	69.65	100	80.22
9	29	45.53	85.83	87.45	90.00	69.88	100	86.38
10	32	45.49	84.34	86.91	89.87	69.52	100	84.19
11	36	45.76	83.68	86.12	89.93	68.66	100	85.12
12	39	45.80	85.83	86.12	90.06	67.49	100	90.12
13	43	45.61	85.77	87.37	89.87	67.04	100	90.12
14	46	44.30	84.75	85.53	90.34	68.11	100	81.00
15	50	45.86	84.81	85.53	90.41	67.71	100	81.81
16	53	41.91	83.82	86.00	90.13	66.82	100	85.77
17	57	41.67	84.36	86.27	90.19	69.44	100	85.77
18	60	42.08	84.21	87.72	89.87	67.64	100	89.51
19	64	41.91	84.90	86.42	90.32	67.04	100	84.20
20	67	41.97	84.52	87.46	90.00	69.52	100	84.20
21	71	39.75	84.71	87.46	90.00	72.02	100	89.50
22	74	40.51	85.48	87.14	89.87	69.30	100	90.55
23	78	41.35	84.46	86.91	89.81	69.30	100	85.77
24	81	41.10	83.61	86.27	90.19	69.12	100	83.37

3.2 Discussion

TSS removal was in the range of 82 to 86%, the BOD reduction was achieved in the range of 84 to 89%, the COD reduction observed was 88 to 91%, the VFA got reduced by 80 to 90%, the sulphates removal was 66 to 72% and 100% removal of oil and grease was observed. These values of the percentage removal of various parameters are in itself an indicator of the efficient and good performance of the UASB reactor at S.R.Thorat Milk Products Pvt. Ltd., These values are also indicative of the stability of the UASB reactor.

CONCLUSIONS

1. At the milk processing plant it has been observed that the production of methane gas on an average is about 60m³/day with a methane content of 75%. This

amounts to a comparative revenue generation of Rs.1,37,970=00 per annum.

2. The fact that the UASB process generates energy rather than consuming it, amounts to positive environmental impact.
3. Wherever the UASB process is feasible to provide, it is the least demanding process on resources in terms of land, energy, operating & maintenance costs. The land requirement is just above 5% of that of most of the conventional treatment processes.
4. The installation & operational cost for the 100 m³ UASB reactor at S.R. Thorat Milk Products Pvt. Ltd. has been realized as Rupees One Crore (Rupees Ten Million).
5. The maximum COD efficiency observed is 91%.

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