Scientific Journal of Impact Factor (SJIF): 4.72

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 4, Issue 06, June -2017

Performance Evaluation of Wastewater Treatment Plant Based on UASB + Facultative pond Technology- A Case Study of Karnal city, Haryana (India)

Ashutosh Pipraiya

M.Tech, Department of Civil Engineering, National Institute of Technology Kurukshetra Haryana, India

ABSTRACT:- *Up flow anaerobic sludge blanket (UASB) process was one of the most widely used technology for sewage treatment in developing countries particularly in India. The reason for its wide publicity and implementation is its zero energy requirements and production of biogas as a valuable energy 'resource'. Despite their popularity, past one decade has witnessed decline in the UASB implementation. There has been criticism from various sections on the performance of UASB Reactors. The main focus of present study was to assess performance of these sewage treatment plants based on UASB + facultative pond technology. The performance of 40 MLD STPs at Karnal city was evaluated. Wastewater samples were analysed for pH, BOD, COD, TSS at inlet or raw sewage, at outlet of UASB reactor and outlet of facultative ponds unit and from which it is ready for final discharge. The results indicated consistently good performance. The treated effluents from all the three plants meet the discharge standards with reference to compulsory parameters pH, BOD, COD and TSS. Treated effluent is finally agriculture purposes and it meets guideline for reuse. Sludge generated is sold to farmers, which are used as fertilizers.*

KEYWORDS- *Wastewater, Performance Evaluation, STP, UASB, facultative pond, pH, BOD, COD, TSS.*

OBJECTIVE OF STUDY

To study Performance Evaluation on the sewage after treating with UASB + facultative pond technology at STP in Karnal city Haryana. In this study attempt has been made to study Performance of STP in respect of different Physical and Chemical parameters after treatment process is done. Process followed is as under
(1)Collection of the sample
(2)Determination of the selected parameters to calculate performance evaluation.

INTRODUCTION

The river Yamuna is heavily polluted by wastewater discharge by cities located at its bank. The Yamuna Action Plan (YAP) was a bilateral project between the Government of India and Japan. It was one of the largest river restoration projects in India. The government of Japan, via the Japanese Bank for International Cooperation (JBIC), has provided financial aid of 17.7 billion yen to carry out the project, which was being executed by the National RiverConservation Directorate, the Ministry of Environmental and Forest and the Government of India (CPCB, 2013). Since 1982, in several parts of the world experiments have been undertaken to assess the applicability of the UASB system - the Up flow Anaerobic Sludge Blanket system, described in detail by several authors (Lettinga et al., 1980, Lettinga and HulshoffPol, 1984) for the direct treatment of sewage in warm climates. Experiences in Brazil (Souza, 1986), Indonesia **(**National Institute for Public Health et al. 1988), India (Siddigi, 1990) and Colombia (Schellinkhout et al., 1985) showed that a BOD reduction of 75% is feasible under tropical conditions and somewhat lower in colder areas (Vieira and Souza, 1986). It is also indicated that considerable cost reductions could be achieved in comparison to other treatment systems.
In 1990, thus far largest sewage treatment plant based on UASB technology was built in the Colombian city of Bucaramanga. Smaller plants are being operated in Kanpur, India (5 000 m^3/day), Colombia (20,000 population equivalent. Successful use of anaerobic reactors (especially up-flow anaerobic sludge blanket reactors, (UASB) for the treatment of raw domestic sewage in tropical and subtropical regions opened the opportunity to substitute the aerobicprocesses with the anaerobic technology for the removal of organic matter from the influent wastewater (ASCE, 1998). Despite the success, effluent from the anaerobic reactors, treating domestic sewage, requires post-treatment in order to achieve the discharge standards prevailing in most countries. The use of UASB technology for sewage treatment has been explored as a feasible option in many developing countries like Colombia, Indonesia, Brazil, China, and India (Fernandez et al., 2000).

LOCATION OF SITE

Study area covers 40 MLD capacity, sewage treatment plant based on UASB + facultative pond technology in Karnal city, Haryana state India. The plant was constructed under Yamuna Action Plan (YAP) with the collaboration with Japan. This research work evaluated the performance of the STP based on UASB + facultative pond technology in terms physical and chemical parameters of wastewater and efficiency of treatment.

Figure 1 40 MLD, STP at Karnal city (Haryana) India.

MATERIALS AND METHODS

The influent and effluent grab samples were collected with the help of sampling bottles which were well cleaned before use. While collecting samples, contamination of samples was avoided with any foreign material. The collected samples were brought to laboratory and then analysis was carried out. In case if storage is necessary, the samples were stored at 4 ^{0}C in refrigerator. The Sampling and analysis was carried out alternative day from April 10, 2014 to May 12, 2014 in STP based on UASB+FPU and analysed for pH, BOD, COD, TSS as per Standard Methods (APHA, 2005).

S.No	Parameters	Bottle Type	Preservation of samples	Analysis Methods	References
1	pH	Sampling bottle	Refrigerator, below 4^{0}C	pH meter	
2	BOD	Sampling bottle	Refrigerator, below 4^{0}C	5 day BOD at 20^{0}C	APHA,2005
3	COD	Sampling bottle	Refrigerator, below 4^{0}C	CRT Method	APHA,2005
4	TSS	Sampling bottle	Refrigerator, below 4^{0}C		APHA,1998

RESULT AND DISCUSSION

All anaerobic treatment processes including UASB technology are very sensitive to hydraulic and organic loadings. Intermittent feeding can greatly affect the performance of a UASB reactor, as the anaerobic bacteria are very sensitive to shock loading. This happens frequently at most of the places due to power cuts. The performance of UASB reactors also depends upon the level of regular monitoring of the sludge. It has been reported that inadequate presence of desired sludge significantly reduces the performance of UASB reactors. Performance of facultative ponds, which is the terminal unit of the scheme, is also very crucial in deciding overall performance of the plant. The combined effect of above factors often results in a final effluent having BOD >20 or 30 mg/L. The quality of raw sewage and the characteristics of UASB effluent as well as facultative pond effluent is presented in Table 5.3 (b) – 5.3 (c). The removal efficiencies of UASB reactor and Polishing pond is also shown in Table 5.3 (a). The Variation of different parameters with time are shown in figure 5.3 (a)-5.3 (d). The results have revealed that the total BOD removal efficiency the UASB reactor is about 67% whereas the total COD removal efficiency is found to be 75%. The incoming total BOD to the UASB reactor varies between 241mg/l to 186 mg/l whereas the reactor is designed for incoming BOD of 250 mg/l. The variation in the values can be attributed to the incoming sewage quality. The UASB effluent has BOD between 59 mg/l – 81mg/l. mg/l and the removal efficiency of the reactor issatisfactory. The Total COD in UASB effluent varies between 227 mg/l -317 mg/l. and again the removal efficiency is found good. There is not satisfactory variation in the TSS value at the inlet of UASB reactor and this is due to the quality of incoming raw sewage to the STP. UASB effluent has TSS value ranging from 187 mg/l 231 mg/l. Generally, it is observed that when TSS value is high, the COD value is also high. The average TSS removal efficiency of the UASB reactor is found to be 27.86%. These problems may be due to poor operation, accumulation of sludge in the reactor as the sludge is not removed regularly.In case of polishing ponds, the average total BOD removal efficiency is about 67.19% whereas average total COD removal efficiency is found to be about 30.14% and the TSS removal efficiency in the pond is about 60.33%. The pond outlet has total BOD in between 19 mg/l and 26 mg/l which is within the permissible limit. Pond effluent also experiences wide variation in total COD value and ranges

from 171 mg/l to 224 mg/l whereas the TSS value of the pond effluent varies between 71 mg/l and 94 mg/l which is close to the desired limit.

Table 5.3 (a) Removal Efficiencies (%) of Different Parameters at point of Sampling

SN	Parameters	At Outlet of Reactor	At Outlet of FPU	Overall
1	BOD	67.00	67.19	89.17
2	COD	75.19	30.14	82.77
3	TSS	27.86	60.33	71.39

Table 5.3 (b) Results of 40 MLD STP Based on UASB + FPU Treatment Technology

S.N	Date of Sampling	Raw sewage				At UASB Reactor			
		pH	BOD	COD	TSS	pH	BOD	COD	TSS
1	10/04/14	7.16	211	444	286	6.87	74	246	218
2	12/04/14	7.18	213	526	300	6.81	69	231	198
3	14/04/14	7.09	202	423	287	6.92	61	227	196
4	16/04/14	7.12	186	472	281	6.81	67	247	187
5	18/04/14	7.19	189	474	245	6.97	68	245	192
6	20/04/14	7.15	217	481	300	6.94	76	294	216
7	22/04/14	7.21	229	496	314	6.84	81	317	214
8	24/04/14	7.24	206	513	272	6.87	78	314	224
9	26/04/14	7.13	223	506	310	6.99	59	289	231
10	28/04/14	7.16	219	427	279	7.01	63	284	214
11	30/04/14	7.10	241	413	281	7.06	64	298	197
12	02/05/14	7.11	213	447	245	6.91	71	231	199
13	04/05/14	7.15	203	562	287	6.97	76	249	201
14	06/05/14	7.15	221	465	313	6.86	73	303	191
15	08/05/14	7.12	216	587	269	6.98	77	305	198
16	10/05/14	7.18	215	456	266	7.02	72	297	203
17	12/05/14	7.19	209	479	278	7.09	63	287	193

Table 5.3 (c) Results of 40 MLD STP Based on UASB + FPU Treatment Technology

	At Outlet of FPU																
pH	7.8	7.94	8.01	8.08	8.16	8.09	7.90	7.96	7.86	7.69	7.71	7.98	8.00	7.95	7.76	7.71	7.69
BOD (mg/l)	23	25	24	23	25	21	24	26	19	22	26	21	20	19	23	24	26
COD (mg/l)	214	224	186	187	196	181	187	186	171	179	186	198	203	195	186	183	196
TSS (mg/l)	80	81	84	86	87	92	94	93	81	76	64	68	71	77	76	89	78

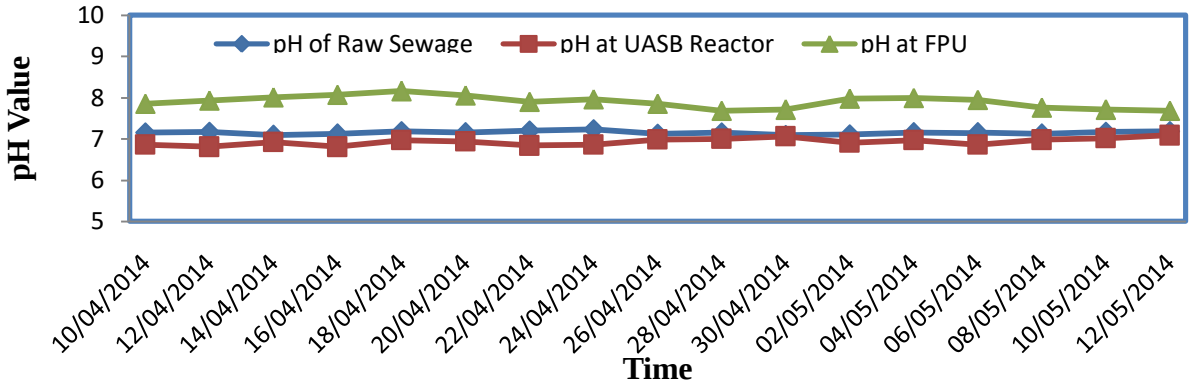

Figure 5.3 (a) Variation of pHwith Date of sampling

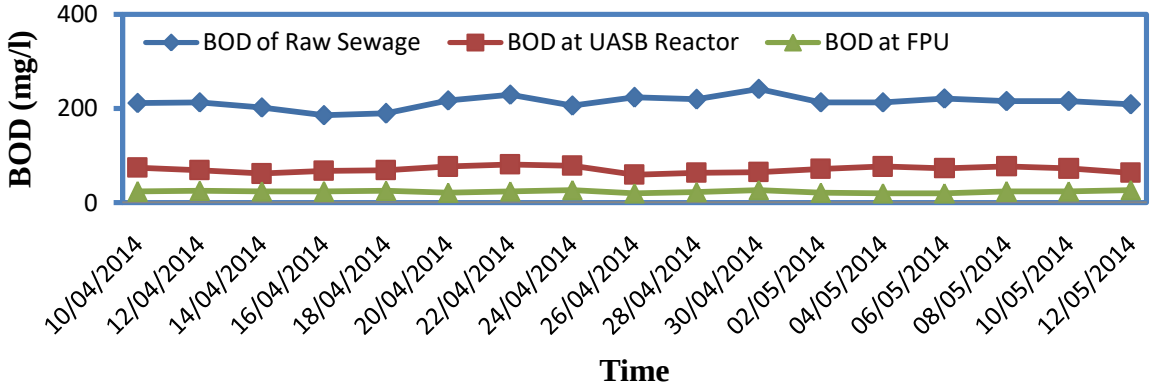

Figure 5.3 (b) Variation of BOD_5 with Date of sampling

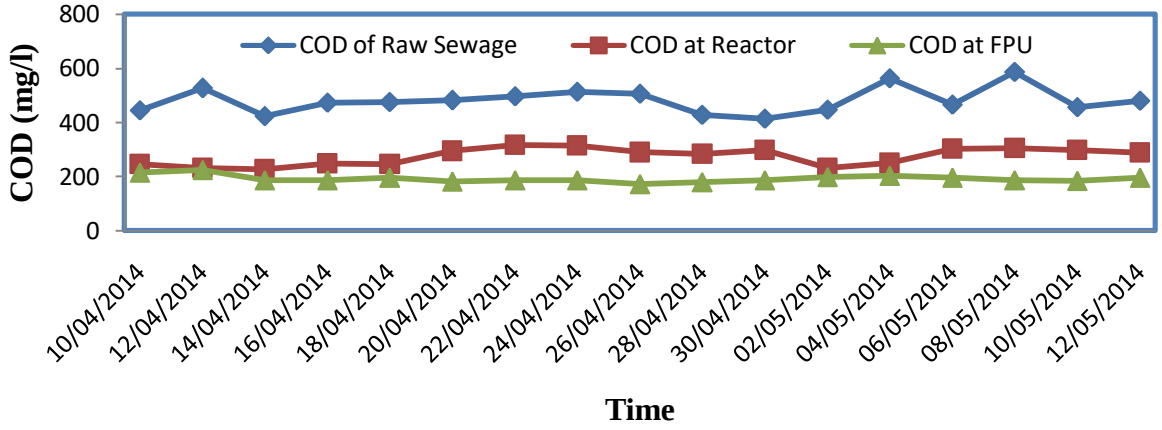

Figure 5.3 (c) Variation of COD with Date of sampling

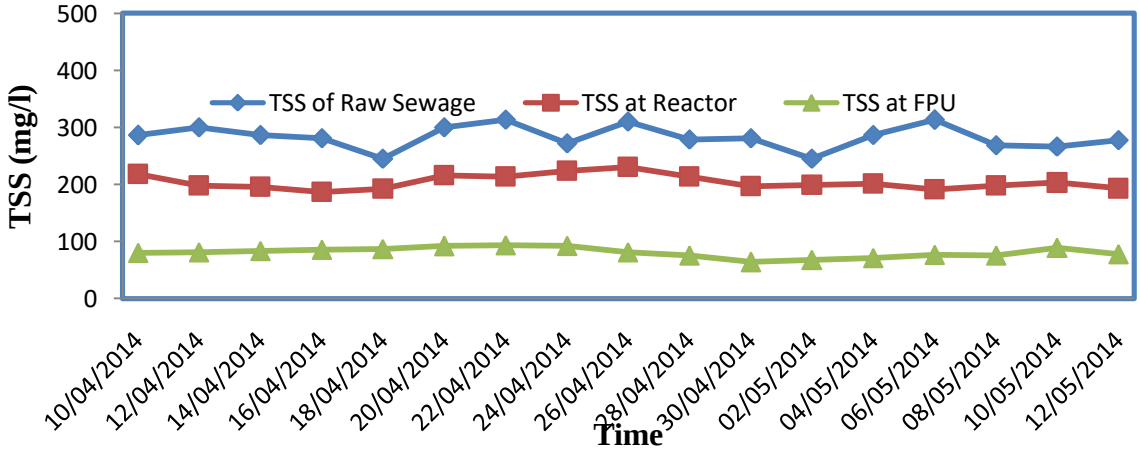

Figure 5.3 (d) Variation of TSS with Date of sampling

CONCLUSION

UASB+Polishing Pond technology is the most suitable option for sewage treatment in developing country like India where energy is main constraint but poor operation and maintenance of the plants has led to the development of a bad impression about thetechnology itself as about 39% plants are not conforming to the general standards prescribed under the Environmental (Protection) Rules for discharge into streams (CPCB, 2005). The performance of the sewage treatment plant at Karnal city, Haryana is also not up to the mark and it is discharging the final effluent into river Yamuna .Up flow Anaerobic Sludge Blanket (UASB) treatment method requires maximum land area and least energy requirement. BOD and SS of the effluent is 20 mg/l and 30 mg/l, respectively. The average area requirement for Activated Sludge Plant is 450 m^2/MLD and capital cost for the treatment is Rs. 68 lacs/MLD(CPCB 2013). BOD, COD, TSS removal efficiency of UASB + polishing pond unit ranges between 80-88%, 80-85 %, 80-85% in Indian atmosphere (MoEF, 2004, 2005). Results for BOD, COD, and TSS removal efficiencies are 89.17%, 82.77%, 71.39% which are within permissible limits except TSS. It is recommended for effective removal of TSS is increase HRT or decrease organic loading.

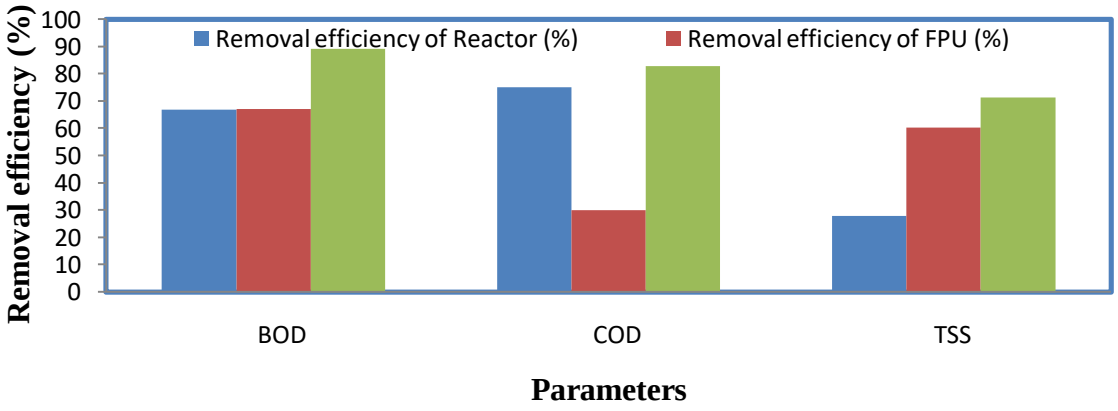

Figure 5.3 (e) Removal Efficiency of Various Parameters

REFERENCES

[1] Ahmad, T.; Khalil, N. and Nawab, M. D. (2013). Qualitative response of UASB reactor and polishing pond for sewage treatment, 2nd International Conference on Emerging Trends in Engineering & Technology, College of engineering, teerthankermahaveer university, April12, 2013**.**

[2] APHA (2005). Standard methods for examination of water and wastewater, 21st edition. American public health association, Washington, D.C.

[3] Awuah, E. And Abrokwa, K. A. (2008). Performance evaluation of a UASB sewage treatment plant at James town, (Mudor) Accra, 33rd WEDC, International conference Accra, Ghana.

[4] Bastos, R. K. X., Calijuri, M. L., Bevilacqua, P. D., Rios, E. N., Dias, E. H.O., Capelete, B. C., and Magalhães, T. B. (2010) Post-treatment of UASB reactor effluent in waste stabilization ponds and in horizontal flow constructed wetlands: a comparative study in pilot scale in Southeast Brazil, Water Science & Technology, WST Vol 61 No 4, PP 995–1002 © IWA Publishing 2010.

[5] Bhunia, P., Ghangrekar, M. M (2008) Analysis evaluation and optimization of kinetic parameters for performance appraisal and design of UASB reactors, Bio resource technology, Vol – 99, PP 2132 – 2140

[6] Central Pollution Control Board (2005). Performance evaluation of sewage treatment plants under NRCD. Ministry of Environmental and Forest Government of India, New Delhi.

[7] Central Pollution Control Board (2013). Performance evaluation of sewage treatment plants under NRCD. Ministry of Environmental and Forest Government of India, New Delhi.

[8] Elmitwalli, T. A., Shalabi, M., Wendland, C. and Otterpoh, R. (2007). Grey water treatment in UASB reactor at ambient temperature, Water science & technology Vol 55 No 7 pp 173– 180.

[9] Elmitwalli, T. A., Shalabi, M., Wendland, C. and Otterpoh, R. (2007). Grey water treatment in UASB reactor at ambient temperature, Water science & technology Vol 55 No 7 pp 173– 180.

[10]INDIAN STANDARD (IS 3025, part 44, reaffirmed, 2003) Methods of Sampling and Test (physical and chemical) for water and wastewater, Environmental Protection Sectional Committee, CHD 012.

[11] Khan, A.A., Gaur, R. Z., Mehrotra, I., Diamantis, V., Lew, B., and Kazmi, A. A, (2014). Performance assessment of different STPs based on UASB followed by aerobic post treatment systems, Journal of Environmental Health Science & Engineering 2014, 12:43.
[12] Korsak, L., (2008). Anaerobic treatment of wastewater in a UASB reactor, Licentiate thesis in chemical engineering Department of chemical engineering and technology Stockholm, Sweden
[13] Lettinga, G. and Vinken, J. N. (1980). Feasibility of the upflow anaerobic sludge blanket (UASB) process for the treatment of low strength waste. 35 Industrial waste conferences. West Lafayette, Indiana, pp 625 – 632
[14] Metcalf & Eddy (2010). Waste water engineering treatment disposal and resuse , 4 th edition McGraw-Hill, New York
[15] Narnoli, S. K. and Mehrotra, I. (1996). Sludge blanke of UASB reactor: mathematical simulation. Water Research, Vol-31, PP 715-726.
[16] Recent trends in technologies in sewage system (2012). Ministry of Urban development government of India
[17] Sharma, P., (2009). Performance evaluation of UASB+ Facultative ponds based Sewage Treatment Plant (STP), M.tech thesis, Thapar University.
[18] Sing, D. D. And John, S. (2013). Study the different parameters of sewage treatment with UASB & SBR technologies. IOSR Journal of mechanical and civil engineering (IOSRJMCE) e-ISSN: 2278-1684 Volume 6, Issue 1 (Mar. - Apr. 2013), PP 112-116.
[19] Siddiqi, R. H. (1990). Treatment of municipal wastewater by UASB reactor, performance of 5 MLD Plant at Kanpur. Singular publication. Dept. of civil engineering, Aligarh muslim university, Aligarh, India
[20] Souza, M.E. (1986). Criteria for the Utilization, Design and Operation of UASB Reactors. Wat. Sci. Tech. Vol 18, PP 55-69.
[21] Tawfik, A., Zeeman, C., Kalpwijk, A., Sanders, W., Gohary, E. I. And Lettinga, G. (2003) Treatment of domestic sewage in combined UASB/RBC system process optimization for irrigation purposes, Water science and technology, Vol – 48 no 1, PP 131 – 138, @ IWA publishing.
[22] Yamuna action plan wikkipedia.

