*IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*
*e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 10, Issue 2 Ver. I (Feb. 2016), PP 17-23*
*www.iosrjournals.org*

# Biogas Production fromUASB Technology: A Review onFunctioning and Suitability ofUASB Based Sewage Treatment Plant atRaipur Kalan, Chandigarh

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***Abstract:*** *Number of technologies are used for the treatment of sewage in Sewerage Treatment Plant. Out of many technologies used in India one of the most common technologies used for the wastewater treatment or more precisely sewage treatment is the UASB i.e. Up-Flow Anaerobic Sludge Blanket technology. This technology is being used in Sewage treatment plant situated in Raipur Kalan, Chandigarh of 5MLD capacity. This paper review's thefunctioning and suitability of UASB based Sewage Treatment Plant at Raipur Kalan, Chandigarh. The paper describe the whole process of UASB technology and also the suitability of the UASB technology is being revealed by comparing its physiochemical parameters of effluent with Central Pollution Control Board Effluent Discharge Standards. Applications with advantages and disadvantages of UASB are also being discussed in the paper.*
***Keywords:*** *Anaerobic treatment, UASB, Sewerage Treatment Plant, Biogas*

## I. Introduction

Sewage Treatment Plant is a facility designed to receive the waste from domestic, commercial and industrial sources and to remove materials that damage water quality and compromise public health and safety when discharged into water receiving systems. It works on the objective to allow human, domestic and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment.
Conventional wastewater treatment consists of a combination of physical, chemical, and biological processes and operations to remove solids, organic matter and nutrients fromwastewater.

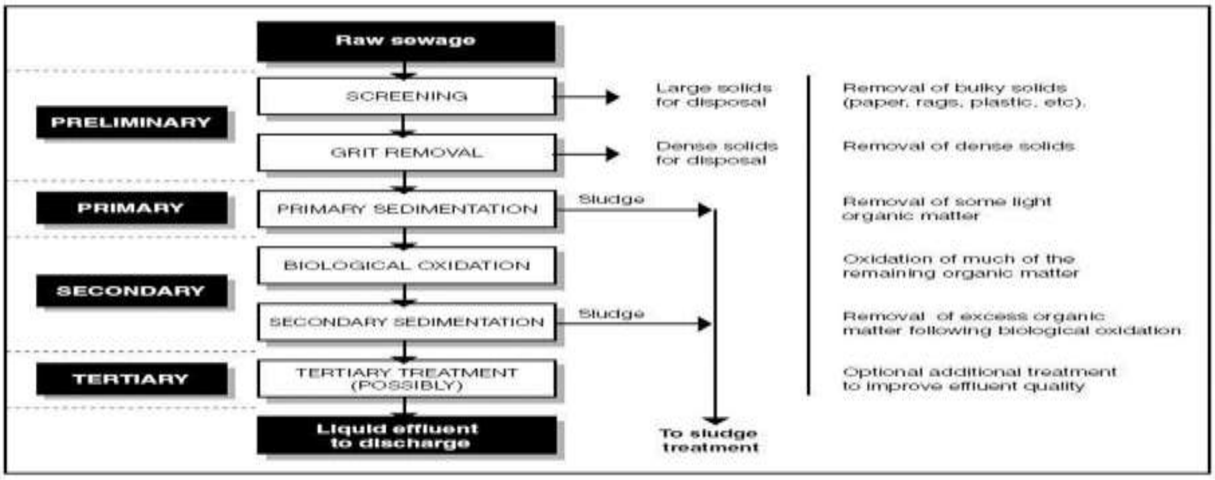



**Figure 1. Typical stages in the conventional treatment of sewage**

Sewerage Treatment Plant at Raipur kalan,Chandigarh is based up on UASB technology which is an anaerobic process.
The main functional units of UASB technology are:
1. Inlet channel
2. Inlet chamber
3. Mechanical screens : 2
4. Manual Screen : 1
5. Grit Channel : 2
6. Parshal Flume : 2
7. Collection Chamber : 1
8. Divison Box : 1

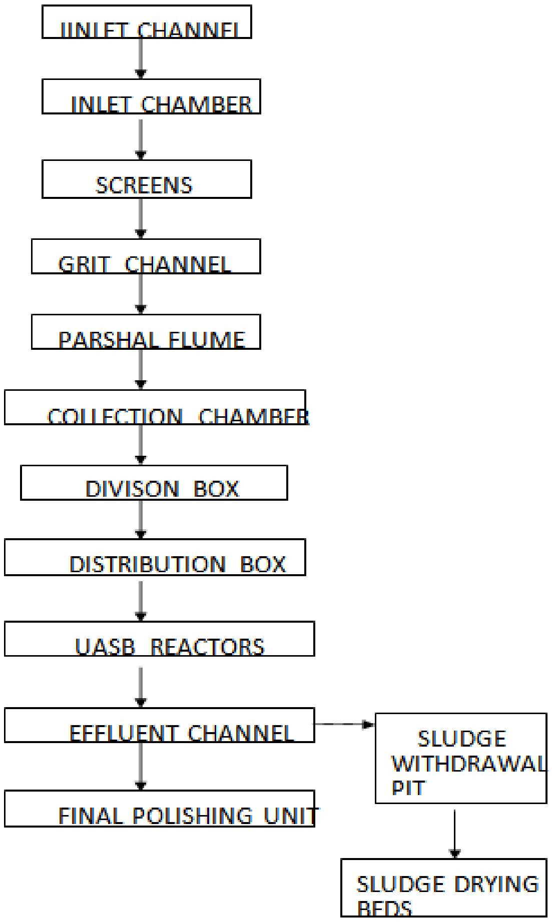
9. Distribution Box : 4
10. UASB Reactor : 2
11. Final Polishing Unit
12. Sludge Drying Beds

Upflow Anaerobic Sludge Blanket is an Anaerobic Treatment system where organic matter without the aid of oxygen is digested, degraded and converted into bacterial cell mass and biogas. The sludge Blanket maintaining a high concentration of biomass through the formation of microbial aggregates is generated in the bottom of reactor. A GLSS (Gas Liquid Solid Separator) is placed above sludge blanket to achieve separation of gas and solids from liquid. Any biomass leaving the reaction zone is separated and settled back into reaction zone. During process biogas is produced, which can be used for limited non-conventional energy usage. The excess treated sludge which is removed periodically, is used as manure after dewatering and drying. The treated liquid is collected at the top of reactor and is passed on to final polishing unit.

**Working of UASB Technology at Raipur Kalan STP**

The sewage from feed boxes is fed through pipes to bottom of reactor and is evenly distributed over reactor floor and sewage flows upward through sludge blanket already formed and organic matter gets entrapped and is digested. **During digestion biogas is produced**. Above sludge blanket GLSS (Gas Liquid Solid Separator) is provided with help of which gas and any biomass leaving with upflow waste water is separated from liquid. The **biogas is then collected in gas hood** provided at top of reactor and is further conveyed through gas pipes for ignition and flare up. The remaining liquid mixture enters settling zone where sludge can settle and flow back to digestion zone and treated. Liquid effluent is collected into effluent gutters placed near top of reactor and then passed on to combined effluent channel and further to final polishing units. The excess sludge is removed periodically through sludge withdrawal pits and after pumping conveyed to sludge drying beds.

**Flow Diagram of UASB based Raipur Kalan STP**



**Photographs of STP Raipur Kalan**

**Fig 1.1: Inlet Channel**

**Fig 1.2:UASB Reactors**

**Fig 1.3: Polishing Ponds**

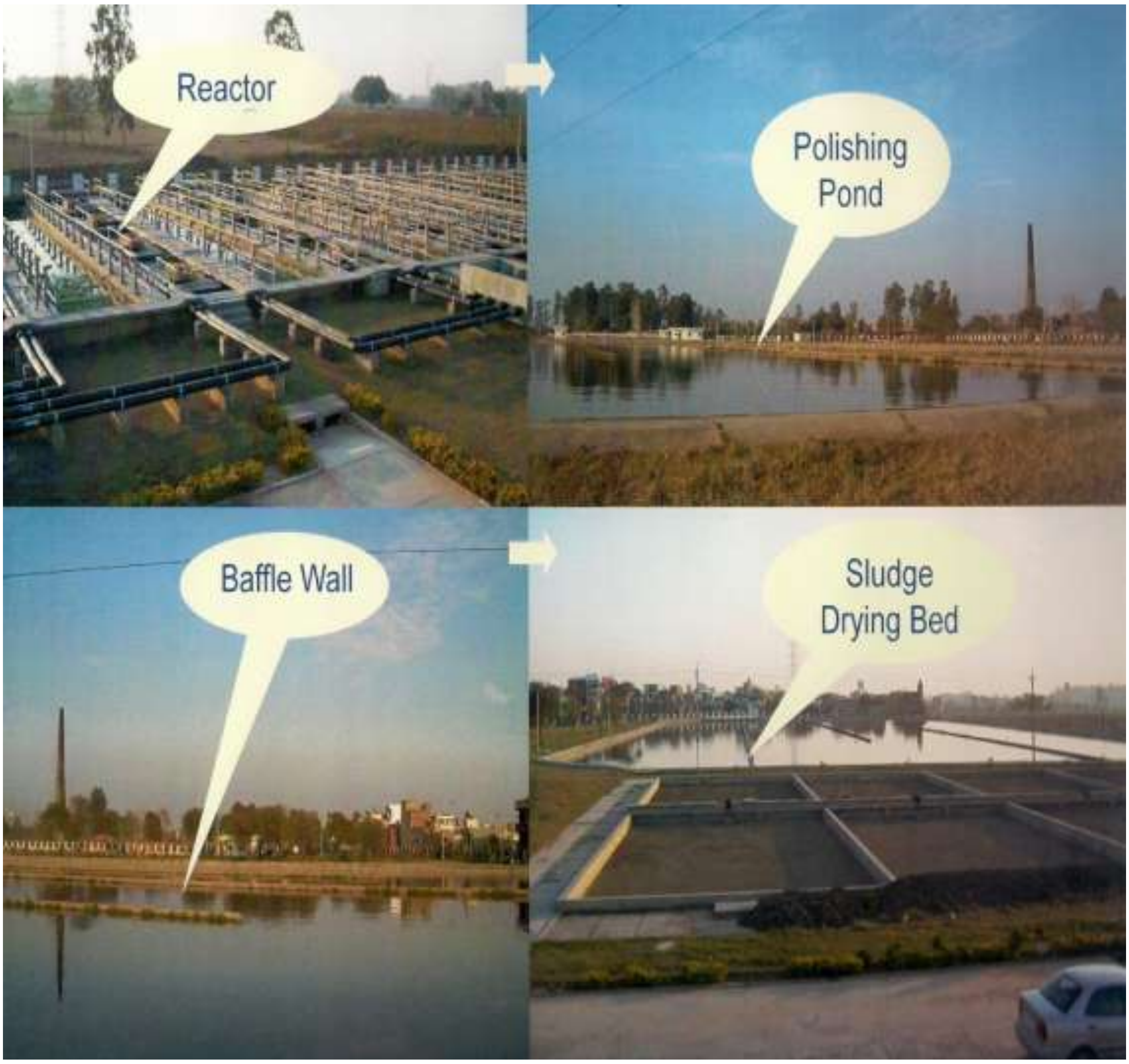



**Fig 1.4: Combined Photographs of STP Raipur Kalan**

## II. Materials And Methodology

**Selection of Sites and Sampling Points**
Samples were collected six times during the duration of the study. Sampling points were the Influent and Effluent of Raipur kalan STP.

**Parameters Analysed**

1. Physico-chemical parameters: The parameters analysed in this study were pH, Temp (Temperature), TSS (Total Suspended Solids), TDS (Total Dissolved Solids), Oil and Grease, chlorides and Chemical Oxygen Demand (COD).
2. Biological parameters: The biological parameters analysed in present study included Biochemical Oxygen Demand (BOD)
3. Nutrient Load: The Nutrients analysed in this study were Nitrate-Nitrogen (NO3 –N), Ammonical Nitrogen (NH3 –N) and Phosphate (PO4-)

**Duration of the Study: 3 July 2013 – 7 Dec 2013**

## III. Results

3.1 Table giving the Average Result obtained from the experimental analysis during the course of the study of the Effluent from UASB based STP.Results are being compared with the Central Pollution Control Board Effluent Discharge Standards for the Discharge of Environmental Pollutants according to The Environment (Protection) Rules, 1986 Schedule-VI Part –A: Effluents

| **Parameter** | **Raipur kalan STP based on UASB technology Effluent result in mg/l** | **Comparison with Central Pollution Control Board Effluent Discharge Standards** |
|---|---|---|
| pH | 7.2 | Lower than Permissible Limit |
| Temp | 21.8 $^{0}$C | Lower than Permissible Limit |
| TSS | 37.3 | Lower than Permissible Limit |
| TDS | 153.3 | Lower than Permissible Limit |
| Oil and Grease | 0.5 | Lower than Permissible Limit |
| BOD3, 27 °C | 27.2 | Lower than Permissible Limit |
| COD | 156.0 | Lower than Permissible Limit |
| Cl- | 46.9 | Lower than Permissible Limit |
| NO3 -N | 1.3 | Lower than Permissible Limit |
| NH3 –N | 23.8 | Lower than Permissible Limit |
| $PO_{4-}$ | 3.9 | Lower than Permissible Limit |

## IV. Discussions

The parameters selected for the evaluation of the quality of effluent are important since they are the criteria parameters usually calculated to access the performance of the STP. BOD is the prime parameter which depicts the strength of the sewage. pH an indicator of biological life since most of them thrive in a quite narrow and critical pH range. In addition to all above, Chemical processes used to coagulate wastewater, dewater sludge or oxidize certain substances, such as cyanide ion requires that the pH be controlled within a narrow range. Thus, any variation beyond acceptable range could be fatal to a particular organism.

The determination of Oil and Grease in sewage is important because such matter forms scum on the top of the sedimentation tanks and clogs the voids of the filtering media. They thus interfere with the normal treatment methods, and hence need proper detection and removal.Nitrates indicates the presence of fully oxidized organic matter in sewage. Therefore the determination of Ammonical nitrogen (NH3 –N) and Nitrate nitrogen (NO3 –N) are important in sewage.TDS and TSS are common indicators of polluted water and wastewater therefore these to parameters are must to determine.

Also in overall performance of an STP they are considered as important parameters. More over TDS of the wastewater is of concern as it affects the reuse of wastewater for agricultural purposes, by decreasing the hydraulic conductivity of irrigated land.Determination of BOD is considered very important because BOD value can be used as a measure of waste strength in terms of oxygen required. The quantity of oxygen required may be taken as a measure of its content of decomposable organic matter.COD determination is considered important because it is widely used for measuring the pollution strength of wastewater. Determination of Cl- is important because Cl- is one of the major inorganic anions in water and wastewater. Chloride is not strictly a pollutant but high concentration may harm agriculture crops and corrode the metallic pipes.

## V. Conclusion

As per the results obtained from the experimental analysis of the effluent from Raipur Kalan STP based on UASB technology it is clear that the STP using the UASB technology is discharging its effluent under the central pollution control boards norms which proves its suitability to discharge its effluent in Inland Surface water body like Ghaggar river where the effluent is usually discharged. The advantage of UASB process over other processes is that no external electrical energy and mechanical equipment's are required, and maintenance requirements is less than other processes as there is no moving equipment. The Biogas produce from the plant can be utilised by the villagers of Raipur kalan and also to the nearby places which are the source of sewage influent to the Raipur Kalan STP based on UASB technology these areas include Manimajra township, Modern Housing Complex,Shivalik Enclave and Mauli Jagran Colony.

## VI. Recommendations

The system helps to lower only two parameters of wastewater which are BOD and Suspended Solids (SS). Eventually, the system does not help in the removal of toxic pollutants, like heavy metals, which may present in some of the wastewater. The UASB system will therefore have to be supported by subsidiary disposal systems to remove the toxic pollutants, if present in the wastewater.

Like all other anaerobic high rate systems, UASB reactors also require larger quantity of organic matter as compared to the aerobic reactors, because the growth of aerobic bacteria per unit of organic matter is about 10-20 times the growth of anaerobes. In order to support microbial growth and metabolism in UASB systems, therefore, 20 to 30 times more of organic matter has to be metabolized, as compared to that in Aerobic systems. For the success of UASB, it therefore becomes necessary to ensure the presence of at least 10% of suspended solids in the wastewater. Hence for better efficiency of the plant the above two recommendations can be considered and research work should be emphasised on it.

## References


[1]. APHA –AWWA-WPCF, 2005. Standard Methods for Examination of Water and Wastewater, 21st edition. American Public Health Association, Washington, DC, USA.
[2]. Abid Ali khan,Rubia Zahid Gaur,V.K Tyagi,Anwar Khursheed, Benilew, Indu Mehrotra
[3]. and A.A Kazmi, Sustainable option of post treatment UASB,Resources ,Conservation and Recycling,Vol.55,Issue 12,Oct (2011),pp.1232-1251
[4]. A.P Annachhatre and S.M.R Bhamidimarri, Microbial attachment and growth in fixed films
[5]. Reactor: Process start up considerations, Biotechnology Advances, Vol.10, Issue 1, (1992) pp.69-91
[6]. Amit Sonune and Rupali Ghate, Developments in wastewater treatment methods, Journal of Desalination, Vol.167, 15 Aug (2004), pp 55-63
[7]. A. Tawfik Æ F. El-Gohary Æ H. Temmink. Treatment of domestic wastewater in an up-flow anaerobic sludge blanket reactor followed by moving bed biofilm reactor,Bioprocess Biosyst Eng (2010) 33:267–276
[8]. Bjorn Rusten, Mike Mcoy, Robert Proctor, Jon G.Siljudalen., The innovative moving bed biofilm reactor/solids contact reaeration process for secondary treatment of municipal sewage,Water Environment Research, Vol.70, No 5 (Jul-Aug 1998) pp.1083-1086
[9]. Chidozie Charles Nnaji, A review of the Upflow Anaerobic Sludge Blanket reactor, Journal of Desalination and water Treatment (2013) pp.1-12
[10]. Colmenarejo, M. F., Rubio, A., Sanchez, E., Vicente, J., Gracia,M. G., & Bojra, R. (2006).
[11]. Evaluation of municipal wastewater treatment plants with different technologies at Las-
[12]. Rozas, Madrid (Spain). Journal of Environmental Management, 81, 399–404
[13]. D. Pokhrel, T. Viraraghavan. Treatment of pulp and paper mill wastewater—a review, Science of the Total Environment 333 (2004) 37– 58
[14]. Dilip M. Ghaitidak & Kunwar D. Yadav (2013). Characteristics and treatment of
[15]. Greywater—a review, Environ Sci Pollut Res DOI 10.1007/s11356-013-1533-0
[16]. E.Hosseini Koupaie, M.R Alavi Moghaddam and H. Hashemi, Comparison of overall performance between "Moving Bed" and Conventional Sequencing Batch Reactor,Iranian Journal ofEnvironmental Health Science& Engineering, (2011), pp.235-244
[17]. Enrique J. La Motta, Eudomar Silva, Adriana Bustillos,Harold pardon and Jackeline Luque, Combined Anaerobic/Aerobic Secondary Municipal waste water treatment:Pilot-Plant Demonstration of the UASB/Aerobic Solids contact System, Journal of Environmental Engineering, Vol.133, Issue 4 (April 2007)
[18]. Hossein Hazrati and Jalal Shayegan, Upgrading Activated Sludge Systems and reduction in excess Sludge, Bioresource Technology, Vol.102, Issue 22, Nov (2011),pp.10327-10332
[19]. Husham T.Ibrahim, He Qiang, Wisams. AI-Rekabi and Yang Qiqi, Improvenments in Biofilm Processes for wastewater treatment, PakistanJournal of Nutrition, (2012),pp.610-636
[20]. Hospido A, Moreira MA, FeijooG (2007): A Comparison of Municipal Wastewater
[21]. TreatmentPlants for Big Centres of Population in Galicia (Spain). Int J LCA13 (1) 57–64
[22]. I garashi, T., watanbe, Y, asano, T. and tambo, N. the moving bed biofilm reactor, Water
[23]. Environmental Engineering and Reuse of Water, Hokkaido Press 1999,p. 250-305
[24]. Kadiya Calderón , Jaime Martín-Pascual , José Manuel Poyatos , Belén Rodelas, Alejandro González-Martínez and Jesús González-López. Comparative analysis of the bacterial diversity in a lab-scale moving bed biofilm reactor (MBBR) applied to treat urban wastewater under differentoperational conditions, Bioresource Technology 121 (2012) 119–126
[25]. Kwan- Chowlin,Ping and Zhenxiang Yang, Technical Review on the UASB process, International Journal of Environmental StudiesVol.39, Issue 3, (1991)

[26]. Lucas Seghezzo,Grietje.Zeeman, Jules B.Van Lier,H.V.M hamelers,gatzeLettings, A Review: The anaerobic treatment of sewage in UASB and EGSB reactors, Journal of Bioresource Technology,Vol.65, Issue 3, Sept (1998),pp.175-190
[27]. Madun Tandukar,Izarul Machar, Shigeki Vemura,Akiyoshi Ohashi and Hideki Harada, Potential of combination of UASB and DHS reactor as a Novel Sewage treatment system for developing countries: Long term Evaluation, Journal of Environmental Engineering,Vol.132, Issue 2 ,Feb (2006)
[28]. Madan Tandukara, A. Ohashib and H. Harada.Performance comparison of a pilot-scale UASB and DHS system and activated sludge process for the treatment of municipal wastewater, WAT ER RES E ARCH 41 (2007) 2697 – 2705
[29]. Mark W.Fitch, Adrid Lam,Robeet Segar. Biological Fixed Film Systems; Water Environment Research, vol.72, No.5
[30]. Markus Boller, Small waste water treatment plants: A Challenge to waste water engineers, Journal of Water Science and Technology,Vol.35, Issue 6, (1997), pp.1-2
[31]. Metcalf and Eddy Inc., (2003), "Wastewater Engineering- Treatment, Disposal and Reuse",
[32]. 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
[33]. M. Von Sperling, V.H Freire and C.A De Lemos Chernicharo, Performance Evalution of a UASB-Activated Sludge System treating Municipal wastewater, Journal of Water Science and Technology, Vol.43,(2011), pp.323-328
[34]. M.Ji, J. Yu, H. Chen and P.L.Yue, Removal of slowly biodegradable COD in combined
[35]. Thermophilic UASB and MBBR systems, Journal of Environmental Engineering, Vol.22,
[36]. Issue 9, (2001), pp.1069-1079
[37]. Muhummad Asif, Latif, Rumana Gtrufran, Zularisam Abdul Wahid, Anwar Ahmad, Integrated application of Upflow Anaerobic Sludge Blanket Reactor for the treatment of wastewater, Journal of Water Resource,Vol.45, Issue16, 15 Oct (2011), pp. 4683-4699
[38]. Operation and Maintenance Manual for Sewage Treatment Plant, Municipal Corporation, Chandigarh.