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Treatment of Pharmaceutical Waste Water Treatment

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***Abstract*— Ayurvedic pharmaceutical industry is consideredbto be the leading industry throughout the world. The main reason is the usage of herbs, synthetic chemical in the manufacturing process. Chemical used include alcohol, sugar gelatin, lactose, mineral salts, clay, different organic solvents and also include different alkaloids. They are being treated using various treatment process were the end product obtained can be used for the cleaning purpose and biogas produced from anaerobic digestion in a waste water treatment plant was considered as renewable carbon dioxide source and renewable hydrogen was produced.**

Keywords*— Turbidity, pH, DO, COD, BOD, treatment proces, components of treatment plants

I. INTRODUCTION

Water pollution from organic wastewater has become a serious issue nowadays. It is important to prevent this water contamination. Waste management is the activities and actions required to manage waste from its inception to its disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process. Wastewater treatment is a process used to remove contaminants from wastewater or sewage and convert it into an effluent that can be returned to the water cycle. Once returned to the water cycle, the effluent creates an acceptable impact on the environment or is reused for various purposes. At the global level, an estimated 52% of wastewater is treated.

The increase in the disposal of refractory organics demands for newer technologies for the complete mineralization of these wastewaters. The presence of these organic compounds in water poses serious threat to public health since most of them are toxic, endocrine disrupting, mutagenic or potentially carcinogenic to humans, animals and aquatic life in general.

The removal from the contaminated water is of high priority. In certain cases, conventional treatment methods such as biological processes are not effective due to the recalcitrant nature of the contaminants present. The effluents discharged from these industries, organic-synthesis pharmaceutical plants generally produce waste streams with high COD and salinity, as well as limited biodegradability Advanced Oxidation Processes (AOPs) are widely considered as an efficient option to treat effluents of low biodegradability. We consider wastewater treatment as a water use because it is so interconnected with the other uses of water. Much of the water used by homes, industries, and businesses must be treated before it is released back to the environment. If wastewater is not properly treated, then the environment and human health can be negatively impacted. These impacts can include harm to fish and wildlife populations, oxygen depletion, beach closures and other restrictions on recreational water use, restrictions on fish and shellfish harvesting and contamination of drinking water.

The major aim of wastewater treatment is to remove as much of the suspended solids as possible before the remaining water, called effluent, is discharged back to the environment. As solid material decays, it uses up oxygen, which is needed by the plants and animals living in the water. The wastewater treatment process does not only produce clean reusable water, but also has the potential to produce various other benefits. It has the potential to reduce a country's waste production, to produce energy through methane harvesting, and the potential to produce natural fertilizer from the waste collected through the process.

II. WASTE WATER TREATMENT PROCESS

Wastewater treatment uses chemical, physical and biological processes to disinfect wastewater in order to protect the environment and public health [23].

A. Physical Unit Operations

- Screening - The main aim of screens is to remove large floating material and coarse solids from wastewater. Screening done in two stages. In the first stage also called coarse screening it catches the large articles. In the second stage called fine screening and the openings differ between 1.5 mm to 6.4 mm, for removing material that may cause operation and maintenance problems [21].
- Sedimentation - Sedimentation is the process of allowing settling of solid particles that are heavier than water particles under gravity i.e., the particle size less than 0.2 mm and specific gravity 2.65. In wastewater treatment, sedimentation is used to remove both inorganic and organic materials [21].

B. Chemical Unit Operations

- Coagulation - The turbidity from waste water can be removed by performing coagulation. The coagulation may have carried out using two categories of metals type. They are aluminium and iron. Aluminium is relatively low cost and simple metal coagulants and easiness in application. The observed study that alum was found to be more efficient than ferric chloride and

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ferrous sulphate. It is the best method of removal of turbidity. Alum was found to be more effective with removal percentage of 98.9 under optimum conditions [22].

- Ozonation - This process has been widely applied in water and wastewater treatment, such as for disinfection, for degradation of toxic organic pollutants. Ozone can be used in wide pH range and rapidly reacts with bacteria, viruses, and protozoans which has stronger germicidal properties than chlorination. Has a very strong oxidizing power with a short reaction time. So they can eliminate the inorganic, organic and microbiological problems and taste and odor problems. ozonation can improve biodegradability of wastewater at alkaline pH and higher treatment time favored the enhanced biodegradability of wastewater, so in acidic condition 32.73mg/l ozone is required [4]. Ozonation helps in the reduction of TOC when they are kept at standard temperature for two hours thereby 60% reduction in the TOC is observed and 10% in the colour of waste water.

1) Benefits

a) Prevent associated taste and osour producing compounds.

b) Removal of color causing compounds.

c) Partial oxidation of organic compund for removal of subsequent organic compound.

d) After ozonation there is no regrowth of microrganisms, except for those protected by the particulates in the wastewater streams.

C. Biological Unit Operations

The biological unit process of sewage is a secondary treatment in which decompose the organic wastes in the water, from primary sedimentation tank. The attached growth process, i.e., trickling filter, a biological film containing aerobes remain attached with filter media [21].

- Sludge digestion – The activated sludge process involves introduction of air or oxygen into a wastewater and hence develop a biological floc which reduce organic content of sewage [27]. The solids sediment might be dried and disposed off and also we can treat the highly concentrated wastes in the absence of oxygen by anaerobic bacteria [21]. The ultimate aim of this process is to remove BOD and suspended solids [27].

D. Screening

Usually fine screens are preceded be a preliminary screening for providing protection [28]. Coarse screens are the first operation that must be carried out in a waste water treatment plant. The standard width should be in between 6mm to 20mm and depth in between 30mm to 80mm. For circular bars diameter should be in between 6mm to 12mm. The spacing of bars should be in between 6mm to 40mm [18].

E. Grit Chamber

Grit removal chambers are the sedimentation tanks placed before screen to remove inorganic particles having specific gravity 2.65 like sand, may damage pumps due to abrasion. The grit basin is proposed to scour the lighter particles whereas the heavier grit particles remain settled down [21]. Standard length should be in between 7.5m to 20m, width should be in between 1m to 7m and depth between 1m to 5m [18].

F. Skimming Tank

A skimming tank is a chamber inorder to remove floating matter like oil, fat and grease. Blowing air is introduced from bottom for the removal of floating matter. Detention period of 3 minutes is enough.

G. Primary Sedimntation Tank

Sedimentation is the process of allowing settling of solid particles that are heavier than water particles under gravity i.e., the particle size less than 0.2 mm and specific gravity 2.65. In wastewater treatment, sedimentation is used to remove both inorganic and organic materials [21]. They can be normally used were the organic content is present which results in the production of sludge and thereby they can be used for the production of biogas which is considered to be energy saving. The main criteria is the removal of readily settleable solids and floating material from wastewater, It give 50-70% suspended solids removal efficiency and 25-40% BOD removal of waste water [7].

H. Coagulation Tank

Coagulants (lime, alum, ferrous sulphate and ferric chloride) individually and in combination with synthetic polyelectrolytes of three different charges (Magnafloc-E-207, Magnafloc-1011, Zetag-7563, Zetag-7650 and Oxyfloc-FL-11) in combination with the optimal dose of lime 200 mg/L, was very effective in the reduction of COD - 67.6% and BOD – 71%. [11][4].

$$\alpha + \beta = \chi. \quad (1) \qquad (1)$$

I. Trickling Filter

Circular tank with a bed of coarse materials as the filter media**.** It can remove the dissolved organic matter that may escape from coagulation tank [19]. Standard diameter of trickling filter should be in between 30m to 60m, if it exceeds additional unit must be provided to compensate it [18].

J. Sludge Digestion Tank

Capacity of sludge digestion tank depends on operation hours, moisture content, retention time, etc.

1) Biogas production by anaerobic digestion

Biogas can be obtained from the anaerobic digestion of the waste water, in this process were the breakdown of organic matter takes place. Ayurvedic waste water is having high organic content so in the absence of oxygen digestion takes place results in increased production of carbon dioxide and good amount of methane in it. The production of sludge is very less and also the energy required is less, this method is very effective by anaerobic biological treatment 60 to 70 % COD removal efficiency is obtained [9].

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Table 1 presents the composition of the biogas, which is mainly composed by methane, carbon dioxide, some residual nitrogen and water moisture. The main biogas impurities are hydrogen sulfide, volatile organic compounds, ammonia, siloxanes and some residual aromatic hydrocarbons. So by anaerobic digestion process 100 Nm3/h of biogas can be obtained from 4.0% dry content [9].

TABLE1 BIOGAS CHARACTERISTICS

Major Component	Biogas (%)
CH_4	63 - 65
CO_2	35 – 37
N_2	0.1 – 0.3
O_2	< 0.1
$C_2 – O_6$	0.04 – 0.02

K. Disinfection

Specially designed reactors are used to remove pathogenic microorganisms. The inactivation is achieved by destroying the major systems of microbe. Disinfection can be achieved through several ways such as using physical agents, mechanical means, radiation and chemical agents [28].

III. CONCLUSION

Pharmaceutical waste water treatment plant is considered to be efficient in the removal of organic impurities, because the usage of herbs and other materials has been increased widely which result in increased pollution in waterbodies. Conventional wastewater treatment consists of a combination of physical and biological processes to remove solids, organic matter and nutrients from wastewater [23].

While designing treatment plant characteristics of water should be properly determined which include pH, turbidity, DO, BOD, COD and TSS only there by proper condition of water can be identified.

Thereby the treatment with anaerobic process is considered to be more effective for sludge digestion [4]. By the removal of impurities and after the treatment with trickling filter sludge is obtained and they can be treated by using digestion tank and after the treatment biogas is being obtained [9]. Factors like age of treatment plant, maintenance, economical and political situations, technical problems etc. had a great impact on the efficiency of the components.

REFERENCES

[1] Marian Barbu, Ramon Vilanova, Montse Meneses, Ignacio Santin , “Global Evaluation of Wastewater Treatment Plants Control Strategies Including CO2 Emission”, IFAC PapersOnLine 50-1 (2017) 12956–12961.

[2] Hayder M. Issa, “Optimization of Wastewater Treatment Plant Design using Process Dynamic Simulation: A Case Study from Kurdistan”, ARO-The Scientific Journal of Koya University Volume VII, No.1 (2019).

[3] Renju Rajan, Delvin T. Robin, Vandanarani M , “Biomedical waste management in Ayurveda hospitals - current practices & future prospectives”, Journal of Ayurveda and Integrative Medicine (2018) 1e8.

[4] Rajender Singh Rana , Prashant Singh ,Vikash Kandari ,Rakesh Singh , Rajendra Dobhal ,Sanjay Gupta , “A review on characterization and bioremediation of pharmaceutical industries’ wastewater: an Indian perspective”, Appl Water Sci 2017.

[5] Shriom Singh , Seema Singh , Shang Lien Lo , Navneet Kumar, “ Electrochemical treatment of Ayurveda pharmaceuticals wastewater: Optimization and characterization of sludge residue”, Journal of the Taiwan Institute of Chemical Engineers, 2016.

[6] Harshananda T N, Anand Lali Neera , “ Treatment of Ayurvedic Pharmaceutical Wastewater by Electrocoagulation”, Vol No 6,issueNo 5,May 2017.

[7] Annmol Mechery, Jayakrishnan , Jinuraj K, Stebin K Shaji, Boby Jacob, “ Design of Water Treatment Plant”, Volume: 06 Issue: 04 | Apr 2019.

[8] Smita Raghuvanshi,,Vikrant Bhakar,Chelikani Sowmyab, K.S. Sangwan,“ Waste water treatment plant life cycle assessment: treatment process to reuse of water”, Procedia CIRP 61, 2017.

[9] Jordi Guilera Teresa Andreu , Núria Basset , Tim Boeltken , Friedemann Timm , Ignasi Mallol ,Joan Ramon Morante,“ Synthetic natural gas production from biogas in a waste watertreatment plant”, Renewable Energy 146, 2020.

[10] Santhosh K Sar,Megha sahu,Shwetha singh, “Wastewater Treatment by Effluent Treatment Plants”, International Journal of Civil Engineering · December 2016.

[11] Magdalena Zajda1, Urszula Aleksander-Kwaterczak1, “Wastewater Treatment Methods for Effluents from the Confectionery Industry – an Overview”,2019.

[12] Manar El-Sayed Abdel-Raouf ,“ Wastewater Treatment Methodologies”, Review Article,2019.

[13] Dr. akshey Bhargava, “Physico-Chemical Waste Water Treatment Technologies: An Overview”,2016.

[14] Omprakash Sahu, Dubasi Govardhana Rao, Arun Thangavel & Saravanan Ponnappan, “Treatment of sugar industry wastewater using a combination of thermal and electrocoagulation processes”, International Journal of Sustainable Engineering, 11:1, 16-25, DOI: 10.1080/19397038.2017.1334098, 2018.

[15] Silvana Revollar, Ramón Vilanova, Mario Francisco, Pastora Vega, “PI Dissolved Oxygen control in wastewater treatment plants for plantwide nitrogen removal efficiency”, Preprints of the 3rd IFAC Conference on Advances in Proportional Integral-Derivative Control, Ghent, Belgium, May 9-11, 2018.

[16] Yadav Yadevendra, Sunny Sani, Sharma K. C., Peter Hema, Adhana Kumar Rajesh, “Review: A Novel Ayurvedic Techniques Approach for Value Addition of Waste Materials”, Yadav et al RJLBPCS 2019.

[17] Mahendra R. R. Raj, “Biomedical waste management: An overview”, http://www.jiaomr.in on Friday, March 17, 2017, IP: 207.90.39.3.

[18] M. Bhargavi, E. Ananta Rao, T.Pravallika, Y. Sri Teja, “Analysis and Design of Sewage Treatment Plant: A Case Study on Vizianagaram Municipality”, Volume 5 Issue 4–April 2018.

[19] G.Elangovan, V.M. Rajanandhini, “Analysis and Design of Sewage Treatment Plant: A Case Study Atnagore”, 2019.

[20] Swati Shree Samal, “Design of Sewage Treatment Plant”, e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 13, Issue 5 Ver. V (Sep. - Oct. 2016), PP 25-31.

[21] Puspalatha P and Kalpana P, ” Design Approach for Sewage Treatment Plant: A Case Study of Srikakulam Greater Municipality, India”, Environ Sci Ind J. 2016;12(9):112.

[22] Hemath Naveen K.S, Hema Priya.M, Swathi.S.D, Vinothan K.G, “Sewage Treatment Methodology-A Review”, Volume-45 Number3 - March 2017.

[23] Nuralhuda Aladdin Jasim, “The design for wastewater treatment plant (WWTP) with GPS X modelling”, Cogent Engineering (2020), 7: 1723782.

[24] Sasan Kordrostami, Rami Ismail,” Waste – water treatment plant: Design”, 2015.

[25] Niraj S. Topare, S. J. Attar and Mosleh M. Manfe, “Sewage/Wastewater Treatment Technologies: A Review”, 2011.

[26] Shobhan Majumder, Poornesh, Reethupoorna M.B., Razi Musthafa, “Design of a Sewage Treatment Plant at Bearys Institute of Technology, Mangalore”, Volume 13, Issue 5 Ser. I (May. 2019), PP 25-36.

[27] Rakesh Singh Asiwal, Dr. Santosh Kumar Sar*, Shweta Singh, Megha Sahu, “Wastewater Treatment by Effluent Treatment Plants”, Volume 3 Issue 12 – December 2016.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 06, June-2021

[28] Manar Elsayed Abdel-Raouf, Nermine E Maysour, Reem Kamal Farag and Abdul-Raheim Mahmoud Abdul- Raheim, "Wastewater Treatment Methodologies, Review Article", Raouf MEA, et al. Int J Environ & Agri Sci 2019, 3:1 3: 018.

[29] Santhosh Gulabrao Chavhan, "A Critical Review of Ayurvedic & Modern Methods of Purif Cation of Drinking Water", IAMJ: Volume 3; Issue 3; March- 2015.

[30] Dr. Mark Gross, "Wastewater Characterization", 2004.

[31] Shuokr Qarani Aziz, Jwan Sabah Mustafa, "Step-by-step design and calculations for water treatment plant units",Advances in Environmental Biology 13(8): 1-16. DOI:10.22587/aeb.2019.13.8.1.

[32] Shuokr Qarani Aziz, Jwan Sabah Mustafa, "Step-by-step design and calculations for water treatment plant units",Advances in Environmental Biology 13(8): 1-16. DOI:10.22587/aeb.2019.13.8.1.