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Effective Sewage Treatment with Direct Current Ionization Technology

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Abstract*: Sewage treatment is the process of removing contaminants from wastewater and household sewage, runoff effluents from domestic, commercial and institutional units. Various waste water treatment technologies have been compared for the Kullu, Manali area where there are about 50 Sewage Treatment Plan (STPs) installed and operated by various hotels, industries and 7 common STPs operated by the Irrigation and Public Health (IPH) Department for treatment of the sewage waste generated from the household and hotels in the three Municipal areas. The sewage load to the treatment plant installed by individual hotels is not available at a constant rate from the hotel industries. This variation in quantity and quality of the sewage generation during the tourist and non- tourist season disturb the whole mechanism based upon the biological methods. Thus there is a need to test a new technology to overcome these difficulties and which is easy to handle and operate and economical to run. Detailed study in association with Himachal Pradesh IPH Department in Manali Campus on new technology called the "Electro- Coagulation Technique" for treatment of the sewage waste was conducted by installing a demonstration study plant with a capacity of 60 Kilo- litre capacity per day (60 KLD). It has been concluded that this technology coagulates the suspended solids and settles into sludge, oxidizes organics and reduces soluble COD, and destroys pathogens

***Keywords* : contaminants, filtration, sewage treatment plant, direct current ionization**

I. INTRODUCTION

The process of removing contaminants from household sewage and effluents from domestic, commercial and institutional buildings is termed as Sewage treatment. It includes physical, biological, and chemical processes to remove the contaminants. Its objective is to produce an environmentally safe fluid waste stream or treated effluent and a treated solid waste sludge suitable for disposal or reuse, usually as farm fertilizer. Various technologies are available for the treatment of sewage like, ASP, UASB, FBR, MBBR, MBR and SBR.

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The basic principle of all these technologies is biological and depends on the biomass. There are few more technologies which are independent of biological process and use other modes of energy to treat the effluent. The HPS PCB in association with Irrigation and Public Health Department, Kullu, Himachal Pradesh with the assistance of Punjab based company M/S Global Trading Engineers installed a Sewage Treatment Plant in common STP Plant of Manali town.

II. PROCESS DETAILS

The DCI Technology based sewage treatment plant follows the scheme for the treatment of influent: Raw Effluent Storage Tank ⇨ Direct Current Ionization Reactor ⇨ Clarifier ⇨ Break Water Tank => Dual Media Filter => Activated Carbon Filter => Treated Water Storage Tank [1].

2.1. Raw Effluent Storage Tank

Raw sewage generated from wash basins, kitchens, toilets is collected in the equalization tank having passed through a manually operated bar screen. Screening is the process to retain the large floating matter. The collected screenings are usually disposed-off manually. In the equalization tank, sufficient retention time is provided so as to equalize and homogenize the flow and pollutant concentration. Small quantum of iron is added into equalization tank so that iron will react with Hydrogen Sulfide generated there to form Ferrous Sulfate. This will eliminate the possibility of foul smell (caused by Hydrogen Sulfide) from collection tank [2].

2.2. Direct Current Ionization Reactor Going of electric flow through water has demonstrated powerful in the expulsion of contaminants from water by de-stabilizing and coagulating suspended organic and inorganic solids within sewage. This unique current-chemical sewage treatment system is noiseless, clean and significantly reduces COD, BOD, turbidity, suspended solids, color, odor & pathogenic bacteria count. It is environment friendly, user & operator friendly and compact taking much less space. DCIT-STP comprises the process of: (1) Current Coagulation and (2) Current Oxidation [3]. Direct Current Ionization is the way toward destabilizing broken up, suspended, and emulsified contaminants in a fluid medium. This is finished by bringing an immediate current into the medium. The electric flow gives the required electromotive power to drive the synthetic responses. For the most part, this steady state is a strong that isn't just less colloidal yet in addition less inclined to emulsify and break up than those at balance esteems. Amid this procedure, the contaminants get changed over to hydrophobic substances, for example, hastens or stage isolated that can without much of a stretch be expelled by other reasonable detachment systems.

The Reaction Chamber contains a progression of metal sharp edges put parallel to one another. Regularly, Iron/Aluminum cutting edges are utilized simultaneously. The influent to be dealt with is brought into the base of the chamber and scattered uniformly as it moves upward through the sharp edges. Direct Current (DC) is brought into the chamber by joining the positive & negative prompts the first and last terminal, situated outside the chamber. The fluid at that point turns into a conductor, enabling the DC to pass openly all through the chamber bringing about the accompanying responses:

Emulsion – It results when the oxygen and hydrogen particles bond with the water receptor locales of molecules of oil and make a complex which is insoluble in water. Through this procedure, water gets isolated from oil, inks, colors, and so on.

Halogen - This is a procedure stuck which the metal particles imbroglio themselves to chlorines to frame a chlorinated hydrocarbon molecule bringing about shaping an enormous insoluble complex. This procedure isolates water from synthetics like pesticides, herbicides, and so on.

Bleaching – In this, the oxygen particles are delivered in the reaction chamber which oxidize synthetic compounds like cyanides, bio-perils, dyes, microorganisms, viruses, and so on.

Electron flooding – This process kills the polar impact of the water complex. This accelerates the colloidal materials and the expansion of electrons results in osmotic pressure that isolates microorganisms, viruses, and cysts [4].

Oxidation - In this process, Reduction responses are compelled to their characteristic end point inside the Powell chamber. It accelerates the regular procedure in wet chemistry.

Generally, three principle forms happen sequentially amid Direct current Ionization: (1) electrolytic responses at electrode surfaces, (2) Formation of coagulants in fluid stage, (3) adsorption of dissolvable or colloidal contaminations on coagulants, and expulsion by sedimentation or floatation. In the meantime, auxiliary responses may happen likewise, for example, direct oxidation of organic compounds and of Cl−ions present in wastewater: $2Cl^- \rightarrow Cl_2 + 2e$. The chlorine created is a solid oxidant that can oxidize same organic compound and advance cathode responses.

2.3. Polymer Dosing System

This system is provided for dosing anionic polymer in the feed line of tube settler for decreasing the settling time of flocs in tube settler. Dose of 5PPM is dosed by means of automatic digital dosing pump through a FRP tank, in which solution of polymer is prepared. An agitator is also provided for making gentle solution of polymer with water and to maintain the viscosity of solution [5].

2.4. Chlorine Dosing System

This system is provided to dose sodium hypo chloride solution to DCI reactor for increasing the conductivity of raw sewage and this also provide protection to electrodes. Dose of 6 PPM is maintained by means of digital dosing system and FRP tank of 200 Ltrs

2.5. Acid Cleaning System

This system is provided for cleaning of plates in regular interval of time, this is 10 minutes process in which solution of Hydrochloric acid is circulated among the reactor. This is done by a FRP acid cleaning tank in which solution of water and HCL is prepared by keeping its pH at 2 and a acid transfer pump in PP MOC. This pump lift the acid solution from its storage tank and circulate the acid inside the reactor plates, which further removes the deposition of suspended matters from the plates. This cleaning process is to be done by frequently checking the conditions of plates by the operator.

2.6. Air Compressor

This system is provided to feed compressed air into the reactor, since there is very less clearance space between the plates and tendency of trapping of suspended solid in between the plates is very, hence compressed air from the compressor at a pressure of 3-4 Kg/Cm2 is provided for removing the suspended solids and particles from the plates.

2.7. Break Water Tank

This tank is an storage tank in for holding the water coming from tube settler after clarification. This tank provide water to tertiary treatment of plant and feed pumps from tertiary treatment lift water from this tank. The capacity of tank is 2000 Litres and MOC is PVC.

2.8. Filter Feed Pump

Two Pumps 1 Working 1 Standby is provided for feeding water from break water tank to Multigrade and activated carbon filter. Make of pumps is Grundfos and casing is Cast Iron. The flow of these pump is 4 M3/Hr @ Head of 30M.

2.9. Multigrade Filter

A vessel in FRP MOC is installed with multiport valve arrangement. Vessel is filled with layers of pebbles, gravels, anthracite, sand and fine sand so that to provide bed for filtration sand. Water from break water tank is pump through feed pump into the vessel by means of multiport valve from up to down direction.

2.10. Activated Carbon Filter

Activated Carbon filters are also provided to reduce the colour and suspended solids. Figures 1 to 7 show the pictures of the plant [6].

Figure 1: The sewage treatment plant

Figure 2: The study plant installed at Manali campus

Figure 6: Multi-grade filter and activated carbon filter

Figure 3: Reaction chamber holding the iron plates

Figure 4: Tube settler of the plant

Figure 5: The acid tank in the plant

Figure 7: Visual comparison between raw and treated sewage

III. RESULTS

The analysis and result of the demonstration plant [Direct Current Ionization Technique (DCIT)], 60KLD capacity installed in the campus of STP Manali, (IPH Dept.) is shown in Table 2.

Table 2: Test result report of sampling done on various dates

Date of sample collection: 07.08.2014				
Point of collection: After filtration of DCIT(EC)				
Lab. Report No:5459 , **Date:**27.08.2014				
Sr. No	**Parameters**	**Results**	**Prescribed Limits**	**Remark**
1.	TSS	5.0 mg / l	100.0 mg / l	Acceptable
2.	BOD	2.0 mg / l	30.0 mg / l	Acceptable
3.	COD	16.0 mg / l	250.0 mg / l	Acceptable
4.	Oil and Grease	Zero	10.0 mg / l	Acceptable
5.	pH	6.82	5.5 – 9.0	Acceptable
Date of sample collection: 07.08.2014				
Point of collection: Before filtration of DCIT(EC)				
Lab. Report No:5460 **Date:**27.08.2014				
Sr. No	**Parameters**	**Results**	**Prescribed Limits**	**Remark**
1.	TSS	20.0 mg / l	100.0 mg / l	Acceptable
2.	BOD	8.6 mg / l	30.0 mg / l	Acceptable
3.	COD	52.0 mg / l	250.0 mg / l	Acceptable

4.	Oil and Grease	0.8 mg / l	10.0 mg / l	Acceptable
5.	pH	7.66	5.5 – 9.0	Acceptable
Date of sample collection: 05.09.2014				
Point of collection: Before filtration of DCIT(EC)				
Lab. Report No:9327 **Date:**25.09.2014				
Sr. No	**Parameters**	**Results**	**Prescribed Limits**	**Remark**
1.	TSS	30.0 mg / l	100.0 mg / l	Acceptable
2.	BOD	18.0 mg / l	30.0 mg / l	Acceptable
3.	COD	140.0 mg / l	250.0 mg / l	Acceptable
4.	pH	7.80	5.5 – 9.0	Acceptable
Date of sample collection: 05.09.2014				
Point of collection: After filtration of DCIT(EC)				
Lab. Report No:9328 **Date:**25.09.2014				
Sr. No	**Parameters**	**Results**	**Prescribed Limits**	**Remark**
1.	TSS	8.0 mg / l	100.0 mg / l	Acceptable
2.	BOD	2.0 mg / l	30.0 mg / l	Acceptable
3.	COD	16.0 mg / l	250.0 mg / l	Acceptable
4.	pH	7.82	5.5 – 9.0	Acceptable

IV. CONCLUSION

The improved demonstration plant based upon Direct Current Ionization Technique (similar to Electro – Coagulation technique) of capacity 60 KLD extendable to 100 KLD has been installed at the STP campus at Manali and study was conducted in the Month of December, January, and March of the year to assess the performance during different temperature conditions. In this technology, contaminants were removed from the waste water which includes household sewage, other domestic waste water, and effluent from commercial and institutional buildings. This technology covers physical, chemical, as well as biological removal of all kinds of physical, chemical and biological contaminants. Through this process, we can create an environment-friendly and safe fluid waste stream of treated effluent and a solid waste treated sludge which is suitable for either disposal or reuse as organic fertilizer). It has been concluded that this technology coagulates the suspended solids and settles into sludge, oxidizes organics and reduces soluble COD, and destroys pathogens.

REFERENCES

1. Fengxian, L., Shanping, L., Clienglu, Z., & Haixia, Z. (1995). Application of Corrosive Cell Process in Treatment of Printing and Dyeing Wastewater [J]. Environmental Protection of Chemical Industry, 3.
2. Chen, X., Chen, G., & Yue, P. L. (2003). Anodic oxidation of dyes at novel Ti/B-diamond electrodes. Chemical Engineering Science, 58(3-6), 995-1001.
3. Kovatcheva, V. K., & Parlapanski, M. D. (1999). Sono-electrocoagulation of iron hydroxides. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 149(1-3), 603-608.
4. Eliceche, A. M., Corvalán, S. M., San Román, M. F., & Ortiz, I. (2005). Minimum membrane area of an emulsion pertraction process for Cr (VI) removal and recovery. Computers & chemical engineering, 29(6), 1483-1490.
5. Can, O. T., Bayramoglu, M., & Kobya, M. (2003). Decolorization of reactive dye solutions by electrocoagulation using aluminum electrodes. Industrial & engineering chemistry research, 42(14), 3391-3396.
6. Kobya, M., Can, O. T., & Bayramoglu, M. (2003). Treatment of textile wastewaters by electrocoagulation using iron and aluminum electrodes. Journal of hazardous materials, 100(1-3), 163-178.
7. Kumar, V., Kumar, A., Chhabra, D., & Shukla, P. (2019). Improved biobleaching of mixed hardwood pulp and process optimization using novel GA-ANN and GA-ANFIS hybrid statistical tools. Bioresource technology, 271, 274-282.