International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 06 | June - 2022 Impact Factor: 7.185 ISSN: 2582-3930

Hydrodynamic Cavitation as a Preliminary Treatment for CETP Influent

Sumitkumar Surendra Chauhan
Asst. Prof. Kalpna Saini
Department Of Environmental Engineering (SIT)
Swarrnim startup & Innovation University

Abstract –
The industrial effluent discharges into the water bodies resulting water pollution has become a major problem for the environment, human being and living creatures. Now days, new parameters such as dyes, pesticides, and pharmaceutical drugs are being spotted in the water bodies, which are bio-refractory to microorganisms and easily not removable. CETP wastewater consist of high refractory organic compounds in very large amount which cannot be degraded by biological treatment and therefore advanced oxidation process are required to treat them which convert the complex refractory organic compounds into simpler compounds such as CO_2 and H_2O. For meeting the high standards of environmental regulations, day by day there is evolution in the field of wastewater treatment schemes. The present work illustrates the use of such techniques like hydrodynamic cavitation for CETP wastewater treatment. Hydrodynamic cavitation is one of the latest advanced oxidation processes which uses venturi/orifice plate as a cavitating device to generate the cavities, these cavities get collapsed and generate OH^* and H^* radicals which react with refractory organic compounds in wastewater and oxidized them.

Key Words: CETP Wastewater, Hydrodynamic Cavitation, Advanced Oxidation Process.

1. INTRODUCTION

The process of industrialization is adversely impacting the environment globally. Pollution due to inappropriate management of industrial wastewater is one of the major environmental problems particularly in India. With burgeoning numbers of Small Scale Industries, concern towards the ever increasing volume of the effluent generated has tremendously increased. Also due to lack of space, technical manpower, and often finances, individual small scale units cannot install and operate captive wastewater treatment plant, which constraints their ability to control pollution. Developing economies have encouraged small scale industries for employment generation although they are known to be highly polluting. Common Effluent Treatment Plants (CETPs) are considered as one of the viable solution for small to medium enterprises for effective wastewater treatment.

Cavitation can be in general defined as the phenomena of the formation, growth and subsequent collapse of micro-bubbles or cavities occurring in extremely small intervals of time milliseconds releasing large magnitudes of energy over a very small location.

Cavitation may occur when local static pressure in a fluid reach a level below the vapor pressure of the liquid at the actual temperature.

Cavitation define as formation of vapour bubbles within a liquid at low-pressure regions that occur in places where the liquid has been accelerated to high velocities, as in the operation of centrifugal pumps, water turbines, and marine propellers.

2. NEED OF STUDY

CETP wastewater consist of high refractory organic compounds in very large amount which cannot be degraded by biological treatment and therefore advanced oxidation process are required to treat them which convert the complex refractory organic compounds into simpler compounds such as CO2 and H2O.

Some high refractory organic pollutants are not oxidized in secondary treatments and there is need of Advanced Oxidation Process (AOPs), so If the hydrodynamic cavitation carried out at initial stage, it can be used to increase the efficiency of secondary treatment and hence directly reduction in cost.

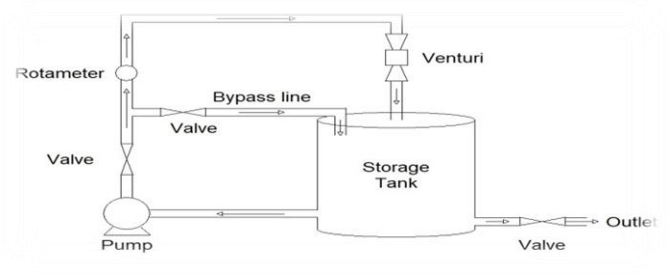
Conventional treatment methods such as coagulation, adsorption, and flocculation do not involve chemical transformation of the refractory organic compounds. They simply transfer compounds from one phase to another phase. Advanced Oxidation Process (AOPs) is an effective treatment which will degrade or break down the refractory organic molecules into end products such as CO2 and H2O with the help of Hydroxyl Radicals.

Advanced Oxidation Process is the alternative method which involves the chemical transformation of organic pollutants and oxidizes pollutants into CO2 & H2O.

Treatment of CETP wastewater by hydrodynamic cavitation has the following advantages:

- Equipment are simple.
- No reactants are needed.
- Less polluting as no byproducts formed.
- Low cost as compared to conventional AOPs.
- Material cost is less.

Hydrodynamic cavitation Setup



Experimental Study

Reactor tank (50 liter), Pump (70 LPM), Venturi & Rotameter are used for hydrodynamic cavitation.
Different ways for study

1. Treatment by Hydrodynamic Cavitation at 30 LPM flow rate.
2. Treatment by Hydrodynamic Cavitation at 50 LPM flow rate.
3. Treatment by Hydrodynamic Cavitation at 70 LPM flow rate.

Treatment by Hydrodynamic Cavitation at 30 LPM flow rate			
Sr. No.	**Time (min)**	**COD (mg/l)**	**% COD Reduction**
1	Initial	1319	0%
2	30	1325	0%
3	60	1294	2%
4	90	1268	4%
5	120	1255	5%
6	150	1200	9%
7	180	1183	10%
8	210	1175	11%
9	240	1152	13%
10	270	1135	14%

Treatment by Hydrodynamic Cavitation at 50 LPM flow rate			
Sr. No.	**Time (min)**	**COD (mg/l)**	**% COD Reduction**
1	Initial	1510	0%
2	30	1495	1%
3	60	1416	6%
4	90	1380	9%
5	120	1372	9%
6	150	1345	11%
7	180	1322	12%
8	210	1310	13%
9	240	1292	14%
10	270	1257	17%

Treatment by Hydrodynamic Cavitation at 70 LPM flow rate			
Sr. No.	**Time (min)**	**COD (mg/l)**	**% COD Reduction**
1	Initial	1370	0%
2	30	1283	6%
3	60	1254	8%
4	90	1175	14%
5	120	1152	16%
6	150	1140	17%
7	180	1112	19%
8	210	1075	22%
9	240	1030	25%
10	270	1013	26%

3. CONCLUSIONS

The influent of CETP wastewater when treated with Hydrodynamic Cavitation at a time intervals of 270 mins, achieves 26% reduction in COD at 70LPM flow as compared to 17% and 14% reduction in COD at 50LPM and 30LPM flow. TC and IC are constantly decreasing and at initial phase TOC are slightly increasing and after that it is constantly decreasing.

ACKNOWLEDGEMENT

I humbly express thanks to my guide Asst. Prof. Kalpna Saini Department Of Environmental Engineering (SIT) Swarrnim startup & Innovation University for practical suggestions, constant and valuable guidance, invaluable time and advice in completing this dissertation work within the stipulated timeframe.

REFERENCES

1. *Anand G. Chakinala, Parag R. Gogate, Arthur E. Burgess, David H. Bremner "Industrial wastewater treatment using hydrodynamic cavitation and heterogeneous advanced Fenton processing" Chemical Engineering Journal 152 (2009) 498–502*
2. *Andrej sarc, tadej stepisnik-perdih, martin petkovsek, matevz dular, "The issue of cavitation number value in studies of water treatment by hydrodynamic cavitation", ultrasonics sonochemistry 34(2017)51-59*
3. *Arati J. Barik, Parag R. Gogate "Degradation of 4-chloro 2-aminophenol using a novel combined process based on hydrodynamic cavitation, UV photolysis and ozone" Ultrasonics Sonochemistry 30 (2016) 70–78*
4. *Chunhai Yi, Qianqian Lu, Yun Wang,Yixuan Wang, Bolun Yang "Degradation of organic wastewater by hydrodynamic cavitation combined with acoustic cavitation" Ultrasonics Sonochemistry (2018) 01-39*
5. *Jigneshkumar Brahmbhatt, prof. R. L. Patel "Treatability study of pharmaceutical wastewater by Hydrodynamic cavitation process" International Journal of Engineering Research and General Science Volume 3, Issue 3, May-June, 2015,74-78*