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Hazard Identification and Risk Analysis of Liquid Effluent Treatment Plant Apply in Chemical Process Industry

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Abstract: *The chemical process industry is one of the categories of highly polluting industries and generates strong wastewater of high COD along with hazardous waste which requires effective treatment and disposal/reuse of effluents. In this review, the various sources of wastewaters in the chemical industry are identified and the best available technologies to remove them are critically evaluated. The aim of the present research work was to determine the behavior of various parameters of the chemical wastewater. During the entire study evaluate, monitor, and check various environmental parameters whether they are complying with a given standard or not given by regulatory authority at chemical Industry,. The India based industry produced bulk drugs, fatty acids, fatty alcohol, food additives, personal care products, and others. The monitoring data of the effluent treatment plant will give information on the pollutioncontrol by the company and the management of waste. Overall analysis showed that there is no significant difference in pH, BOD, COD, and ammoniacal Nitrogen. The use of conventional treatment methods along with membrane reactors and advanced post-treatment methods resulting in a Coagulation wastewater treatment technology appears to be the best*

Keywords: Hazards, Risk, Effluent Treatment Plant, Coagulation wastewater treatment, COD, BOD PH etc

I. INTRODUCTION

The chemical Process industry is of importance in terms of its impact on the environment. The wastewaters from this industry are generally strong and may contain toxic pollutants. Chemical industrial wastes usually contain organic and inorganic matter in varying degrees of concentration. It contains acids, bases, toxic materials, and matter high in biological oxygen demand, color, and low in suspended solids. Many materials in the chemical industry are toxic, mutagenic, carcinogenic or simply hardly biodegradable. Surfactants, emulsifiers and petroleum hydrocarbons that are being used in chemical industry reduce performance efficiency of many treatment unit operations. The best strategy to clean highly contaminated and toxic industrial wastewater is in general to treat them at the source and sometimes by applying onsite treatment within the production lines with recycling of treated effluent. Since these wastes differ from domestic sewage in general characteristics, pretreatment is required to produce an equivalent effluent. [1]

We are aware that chemical industries are one of the highly polluting types of industries and generate strong and high COD wastewater along with hazardous waste which requires effective treatment and disposal/reuse of effluents. Minimization of generation of these wastes at the source or recycling of these wastes will benefit bulk drug manufacturers by increasing product yields, reducing raw material needs, reducing disposal costs and liabilities associated with hazardous wastes

1.1 Occupational Hazard

An occupational hazard is a hazard experienced in the workplace. Occupational hazards can encompass many types of hazards, including

1. Chemical hazards

2. Biological hazards (biohazards)
3. Psychosocial hazards, and
4. Physical hazards etc.

Industrial development and increasing demand for diverse goods and services to cater to the increasing whims and needs of humanity have resulted in chemicals being utilized in many products and processes. This has increased the chemical exposure of people, both at home and in the workplace. Therefore, exposure to chemicals and their harmful effects has spread across the globe at alarming rates causing a rise in health problems and negatively affecting worker safety.

1.2 Routes of Chemical Exposure

While the use of chemicals in processes, production, and goods has benefited people in many ways, these chemical substances are also the cause of chemical hazards. There are several routes of chemicalexposure as described below.

- **Inhalation** – that is breathing in toxic vapors or small chemical particles
- **Absorption** – such as direct exposure to the skin by touching a chemical substance without any protection such as wearing gloves.
- **Injection** – that is when a sharp contaminated object or needle accidentally penetrates a worker's body (such as hand or foot)
- **Ingestion** – that is when toxins are accidentally swallowed

II. SCOPE AND APPLICATION OF THIS STUDY

This study can be used in the development of processes to effectively integrate the identification or recognition of hazards and calculate the behavior of various parameters of the chemical wastewater. Characterization of wastewater evaluate in terms of pH, total dissolved solids (TDS), Chemical oxygen demand (COD), with the aim of using this information to formulate a plan to minimize or manage the risks prior to the start of work. The application of this study is:

- Hazard assessment was proved the idea about treatment process.
- Process also reduced with the help of hazard assessment.
- Environmental policies are strictly followed and implemented the industry.
- The techniques here used are common and so many industries are using the same procedures to treat the effluent.
- Hazard assessment was to be demonstrating the safe operation of the effluent treatment plant.
- The treatment of wastewater in effluent treatment plant is completely removing the chemicalscomponents in wastewater.
- Implementation of effluent treatment plant and risk controls by providing feedback to all parties.

III. MATERIAL AND METHOD FOR STUDY

3.1 Material Used

Becoming water positive is one of the core aims of the Industry in their commitment to sustainability. At Company Chemicals too are working hard towards this goal by minimizing effluents and maximizing recycling of water. In fact, since 2011, specific water consumption has decreased by 31 per cent through multiple 'reduce, reuse and recycle' initiatives such as water treatment plants, rainwater harvesting and condensate recovery. We used 140,123 kL of water for irrigation and gardening purposes.

Water Consumption at Plant

The total water consumption this year was 750,695 kL with specific water use per ton of product at 5.06 kL/T much lower than the previous year and 25 per cent lower than the baseline FY 2011. The majority ofour water is sourced from municipal water, while we also have rain water harvesting systems in operation.No major water bodies are affected by our water use activities

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Wastewater Samples were collected for every five days in a week from ETP plant. Five sets of samples comprising of S1 = Raw effluent. S2 = Equalization tank S3 = Aeration tank.S4 = Treated water. S5 = Boring water.
Were collected and analyzed for the parameters Shown in Table. Samples for BOD, COD, Alkalinity and Solids etc were analyzed in accordance with the procedure laid down in Standard Methods for the Examination of Water and Wastewater.

Table-3.1: Instruments used formeasurement of different parameters

S.No	Parameters	Measurements
1	pH	pH meter
2	BOD (Bio-Chemical Oxygen Demand)	Titrimetric Method
3	COD (Chemical Oxygen Demand)	Closed reflux method
4	Total Solids	Drying Oven
5	Total Dissolved Solids	Drying Oven
6	Total Suspended Solids	Drying Oven
7	Alkalinity	Titrimetric Method

Table-3.2: Standards for Waste Water Quality

S.No	Parameters	Collection site	Frequency	Standards Inlet	Standards Outlet
1	pH	Inlet & Outlet	Daily	9.5-11.0	6.5-8.5
2	BOD	Inlet & Outlet	Daily	1500-2000	100 max
3	COD	Inlet & Outlet	Daily	4000-5000	250max
4	Total Solids	Inlet & Outlet	Daily	2000-3000	2100 max
5	TDS	Inlet & Outlet	Daily	1000-1500	100 max
6	TSS	Inlet & Outlet	Daily	600	100 max
7	Alkalinity	Inlet & Outlet	Daily	200	600 max

IV. METHODOLOGY

4.1 Coagulation Method

The coagulation process involves adding iron or aluminum salts, such as aluminum sulphate, ferric sulphate, ferric chloride or polymers, to the water. These chemicals are called coagulants, and have a positive charge. The positive charge of the coagulant neutralizes the negative charge of dissolved and suspended particles in the water. When this reaction occurs, the particles bind together, or coagulates (thisprocess is sometimes also called flocculation). The larger particles, or floc, are heavy and quickly settle to the bottom of the water supply. This settling process is called sedimentation. The following diagram illustrates the basic reactions and processes that occur during coagulation.
"Coagulation process are used on wastewater sample"
Coagulation Method = Raw Sample Water, 1 liter
Data representation in table – 4.3 the initial reading of raw water sample in this reading are completely optimization solution to be find , the coagulation process are used on wastewater sample are to be beast solution are to be find .
For the treatment we get 1 liter sample which pH value at this time 6.2, alkalinity value is 497 mg/l, Chemical Oxygen Demand value is 730 mg/l, Biochemical Oxygen Demand value is 610 mg/L, Total Solids value is 2049 mg/l, Total Dissolved, Solids value is 1604 mg/l and Total Suspended Solids value is798 mg/l. below the value of table-4.1.

Table-4.1: Coagulation Method raw water

pH	Alkalinity	COD	BOD	TS	TDS	TSS
6.2	497 mg/l	730 mg/l	610 mg/l	2049 mg/l	1604 mg/l	798 mg/l

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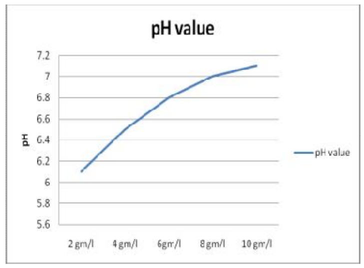
Coagulation Method = Alum Dosing 1liter Sample Water pH

Data represented in table – 4.2 alum dosing 1 liters Sample Water pH value to be maintained. The variation of value alum dosing in five steps. The optimum solution of coagulation method applied is 1 liter of sample to add 6 gm/l to8 gm/l of alumdosing

Table-4.2: pH Value Alum Dosing

Alum Dosing	2 gm/l	4 gm/l	6gm/l	8 gm/l	10 gm/l
pH value	6.1	6.5	6.8	7	7.1

Figures 4.1: Effect of alum dosing on pH



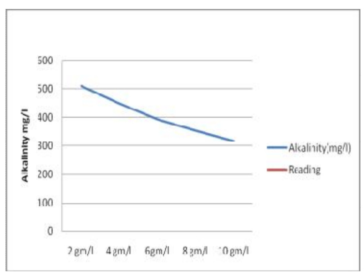
Coagulation Method = Alum Dosing 1liter Sample Water Alkalinity (mg/l)

Table – 4.3 represent concentration of alkalinity at different sampling. Alum dosing 1 liters Sample Water pH value to be maintained. The variation of value alum dosing in five steps the optimum solution of coagulation method applied is 1 liter of sample to add 6 gm/l of alum dosing. The optimum reading is 395 mg/l.

Table-4.3: Alkalinity Value Alum Dosing

Alum Dosing	2 gm/l	4 gm/l	6gm/l	8 gm/l	10 gm/l
Alkalinity(mg/l)	510	450	395	356	319

Figures 4.2: Removal of Alkalinity with alum dosing



Coagulation Method = Alum Dosing 1liter Sample Water Chemical Oxygen Demand

Data presented in Table – 4.4 shows the Chemical oxygen demand is defined. Alum dosing 1 liters Sample Water Chemical oxygen demand value to be maintained. The variation of value alum dosing in five steps the optimum solution of coagulation method applied is 1 liter of sample to add 6 gm/l of alum dosing. The optimum reading is 445 mg/l.

Alum Dosing	2 gm/l	4 gm/l	6gm/l	8 gm/l	10 gm/l
COD (mg/l)	679	540	445	412	370

Table-4.4: Chemical Oxygen Demand (mg/l) Value Alum

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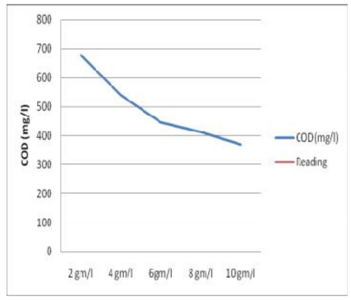


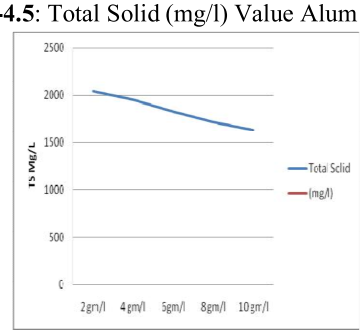
Figures 4.3: Removal of COD with alum dosing

Coagulation Method = Alum Dosing 1liter Sample Water Total Solid (Mg/L)

Data presented in Table – 4.5 shows the Total Solid is defined. Alum dosing 1 liters Sample Water Total Solid value to be maintained. The variation of value alum dosing in five steps the optimum solution of coagulation method applied is 1 liter of sample to add 6 gm/l of alum dosing. The optimum reading is 1821 mg/l

Alum Dosing	2 gm/l	4 gm/l	6gm/l	8 gm/l	10 gm/l
Total Solid(mg/l)	2040	1950	1821	1710	1628

Table-4.5: Total Solid (mg/l) Value Alum Dosing



Figures 4.4: Removal of TS with alum dosing

Coagulation Method = Alum Dosing 1liter Sample Water Total Suspended Solids

Data presented in Table – 4.6 shows the Total Suspended Solids is defined. Alum dosing 1 liters Sample Water Total Suspended Solids value to be maintained. The variation of value alum dosing in five steps the optimum solution of coagulation method applied is 1 liter of sample to add 6 gm/l of alum dosing. The optimum reading is 470 mg/l

Alum Dosing	2 gm/l	4 gm/l	6gm/l	8 gm/l	10 gm/l
Total Suspended solid (mg/l)	650	520	470	400	350

Tab-4.6: Total Suspended Solids (TSS) mg/l Value Alum Dosing Tab

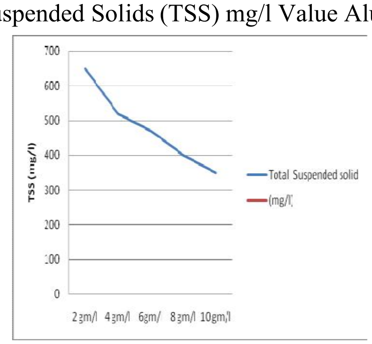


Fig. 4.5: Removal of TSS with alum dosing

Data presented in Table – 4.7 shows the Biochemical Oxygen Demand is defined. Alum dosing 1 liters Sample Water Biochemical Oxygen Demand value to be maintained. The variation of value alum dosing in five steps the optimum solution of coagulation method applied is 1 liter of sample to add 6 gm/l of alum dosing. The optimum reading is 340 mg/l.

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Alum Dosing	2 gm/l	4 gm/l	6gm/l	8 gm/l	10 gm/l
Biochemical OxygenDemand (Mg/L)	474	415	340	301	270

Tab-4.7: Biochemical Oxygen Demand (Mg/L) value Alum Dosing

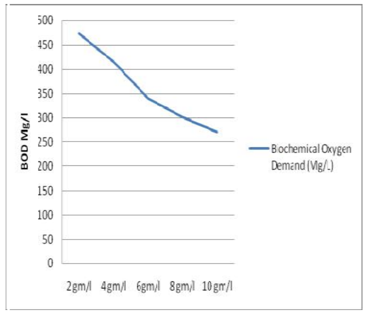

Fig. 3.6: Removal of COD with alum dosing

Coagulation Method = Alum Dosing 1liter Sample Water Total Dissolved Solids

Data presented in Table – 4.8 shows the Total Dissolved Solids is defined. Alum dosing 1 liters Sample Water Total Dissolved Solids value to be maintained. The variation of value alum dosing in five steps the optimum solution of coagulation method applied is 1 liter of sample to add 6 gm/l of alum dosing. The optimum reading is 965 mg/l.

Alum Dosing	2 gm/l	4 gm/l	6gm/l	8 gm/l	10 gm/l
Total Dissolved Solid (mg/l)	1100	1055	965	860	788

Tabe-4.8: Total Dissolved Solids (TDS) (mg/l) Value Alum Dosing

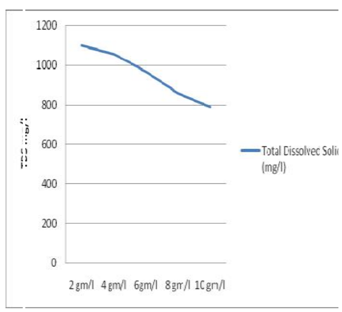

Fig 4.7: Removal of TDS with alum dosing

V. RESULT AND CONCLUSION

After going through all the waste handling procedures in environmental health and safety department is also considered as a production department and it is having this organization one can come to a conclusion that equal importance with all other departments. Environmental policies are strictly followedand implemented the industry. The techniques here used are latest in the present world and only very fewindustries are using the same procedures to treat the effluent.

The bulk drug industry discharges effluents like acid, alkali effluents and gaseous emission, the present study is aimed on effluent treatment process, the effluents discharged during manufacturing of drugs process is collected and treated by mechanical, chemical and biological methods in effluent treatment plant which worked under Environmental Health and Safety Department.

The composite sample was collected from ETP. The value of ETP inlet was found as pH-6.2, TSS-788 mg/l, COD- 730 mg/l and BOD-610 mg/l. The values of ETP outlet found as pH-7.10, TSS-350mg/l, COD- 370 mg/l, BOD-270 mg/l. It may be seen that % removal of TSS load is 55.58 %, COD load -49.31 %, BOD load- 55.73 %.The pH, COD, TSS, and BOD monitored values are well within prescribed limit. Analysis report is attached at Table 5.1

Table 5.1 Analysis report of plant

Treatment Technology							
Coagulation Method- 1liter Sample Water- Alum Dosing-10gm/l							
Parameter	**pH**	**TSS**	**COD**	**BOD**	**Alkalinity**	**TS**	**TDS**
Inlet	6.2	788	730	610	497	2050	1604
outlet	7.10	350	370	270	319	1628	788
% removal ofload		55.58	49.31	55.73	35.81	20.58	50.87

VI. POSSIBLE RECOMMENDATIONS

1. Industries should adopt the concept of resource conservation through reduction of the waste generation at source, recycling and reuse of waste. The treated effluent should be recycled /reused in process/cooling/ horticulture to reduce the demand of fresh water.
2. The major pollution control equipment (scrubbers attached with process fumes, incinerator and solvent recovery system) should be interlocked with production process / raw material feeding system.
3. Separate storm water drains should be constructed to avoid mixing of spillages of process waste with storm water. The unit shall provide separate covered channels for process waste and floor washings. The utility effluent should be treated and utilized in plant premises.
4. The industry should provide proper collection and treatment to all the effluent. A holding tank of adequate storage capacity should be provided to store the untreated effluent in case of non- functioning of ETP.
5. Water flow meters should be installed at inlet and outlet of ETP to measure the volume of influent and treated effluent and its record of utilization should be maintained.
6. Continuous running and regular maintenance of ETP should be ensured along with regular sludge removal to avoid the sludge bulking and related problems.
7. The effluent should be treated up to the norms prescribed by SPCBs. Some industry's ETPs needs up gradation (installation of RO and MEE) for treatment of effluent containing high COD and high TDS.
8. The industry should provide proper safety device to the workers including occupational health surveillance of the workers on regular basis. The industries should take Insurance under Public Liability Insurance Act applicable according to the provision of Act.
9. The Industry should ensure development of green belt as per the conditions imposed by SPCBs and more trees plantation around the premises along with development of lawns inside the premises.
10. The hazardous waste should be stored at centralized storage area designated and developed for storage. Onsite storage and subsequent disposal of waste should be ensured as per the provisions of Hazardous Waste (Management, Handling & Tran boundary Movement) Rules, 2008. Industries should not develop onsite secured land fill facilities to avoid associated environmental problems.

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