Analysis And Modification On Effluent Treatment Plant A Case Study

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Abstract*—Most of industrial Wastewater has high organic pollutant and are highly toxic. This WasteWater is harmful and not soluble in water. This is biggest reason that most of the industries often reuse Waste water for more than one purpose. The existing solution for reuse or purification of WasteWater is Effluent Treatment Process, But it cause some issues while purification. The Effluent Treatment Process contains various operations for purification of Waste water where we need to find out parameters like BOD (100mg/lit), COD (250 mg/lit), TSS (100 mg/lit), oil Grease (100 mg/lit) and pH level (5.5-9.0) within the limits. This paper gives an overview and modifications of ETP by testing various parameters of WasteWater. The modification of ETP has reduced the problems at time of processing and the parameters are also within the limits. The output waste of ETP i.e. Sludge are of two types i.e. Biological sludge and Chemical sludge which contains some toxic elements which can be eliminated and used as a fertilizer or for Land Filling. The treated water after purification can be used for various purposes like gardening, landscape development, washing roads etc. thus leading towards water conservation.

Keywords – Effluent Treatment, Wastewater, water reuse, sludge reuse.

I. INTRODUCTION

Water is most important natural resource on the earth for all living mediums. In most of the industries like paper industry, chemical, pharmaeutical water is used and it produces waste water. The waste water form pharmaceutical or chemical industry produce toxic and strong pollutants. Waste water is also known as influent. ETP is a process design for treating the industrial waste water is safe disposal to the environment. The ETP are used for removal of amount of dirt, grit,organic compounds, pollution, debris, toxic, non-toxic, etc. from industrial effluents. ETP use drying and evaporation method and other auxiliary techniques such as filtration, incineration for chemical processing and effluent treatment. Effluent Treatment Plant plays very important role in purification or for its reuse.

Rakesh Singh Asiwal [1] studied that lack of treatments are required for Waste water reuse, the main challenge is to find low-cost and friendly methods. Ioannis K. Kalavrouziotis and ProdromosKoukoulakis [2] found that more research needs to be done on long and short application effects of sludge, because reuse of WasteWater and specially sludge may cause health issues. K. Sundara Kumar, P. Sundara Kumar and Dr. M. J. RatnakanthBabu [3] found satisfactory performance evaluation of activated sludge process in (ETP) Effluent Treatment Plant including BOD (Biological Oxygen Demand), COD i.e. (Chemical Oxygen Demand) and TSS (Total Suspended Solid).Junjie TAO [4] studied composition of sludge from municipal waste and result showed was best as assistant material for sludge in optimal weight ratio. Hajira Haroon, Amir Waseem and Qaisar Mahmood [5] suggested that in beverage industry treated WasteWater can be re-used in boilers and bottle washing plant.

The main aim of this section is to find solutions to the problems at time of WasteWater treatment and also find components of sludge and the way to reuse it. Methodology is as shown in Fig.1.

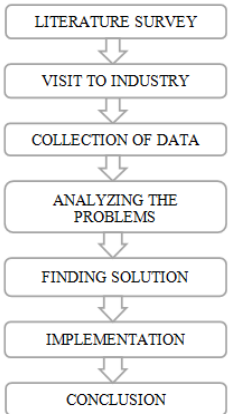

Fig.1. Overall Methodology Chart

II. EXPERIMENTATION AND WORKING

- General Layout of ETP

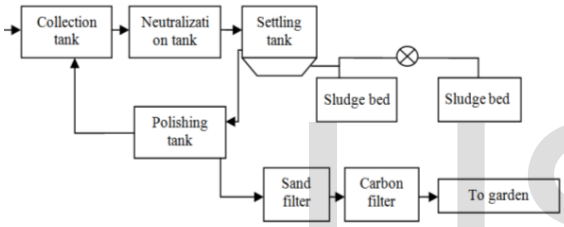

Fig.2. Layout of ETP

Components:
Main collection tank:- The Wastewater get collected into main tank.
Neutralization tank- The Wastewater contains strong pollutants and varies pH level time to time. Here, lime, alum and poly chemical added in Wastewater and stir.
Settling tank- The tank has provided some height from ground level and the neutralization water pumped to settling tank. The water stored in this tank for around 30min. the sludge get collected at bottom of tank and water at the top.
Polishing tank- The water from settling tank get collected in polishing tank where its pH level and other parameters get checked. If parameters are not within the limits then it again supplied to collection tank and if treated water parameters are in limits then it supplied to further uses like gardening, washing roads through Sand Carbon Filter and Sand Filter.
Sludge tank- The sludge gets collected in sludge bed.

The Wastewater parameters before treatment are as shown below:

Table.1. Experimental Details before Treatment

PARAMETER	RESULT	LIMITS
pH	10.81	5.5-9.0
COD	46	250mg/L
TSS	640	100mg/L
BOD	2409	100mg/L

The Wastewater parameters after treatment are as shown below:

Table.2. Experimental Details after Treatment

PARAMETER	RESULT	LIMITS
pH	7.7	5.5-9.0
COD	187	250mg/L
TSS	70	100mg/L
BOD	40	100mg/L
OIL GREASE	3	100mg/L

The problem of this system is smell generation near the Neutralization tank at time of processing or treatment. Smell can be identified by using various methods. One of the best method is Triangular Odour Bag Method. Where we may understand the smell is eliminated or not.

Triangular Odour Bag Method

In Japan, Offensive Odor Control Law was enacted in 1972, which includes following steps where the aim was to regulate emission of offensive odours.

Steps:

1. Panel selection (group of People who judge odour presence and their olfaction)
   Selection of people is based on aptitude test by using five standard odorants without having olfaction abnormalities. For precise and fair measurement of odour intensity, person should be in good health.
2. Sampling
   Taking samples from site in number of bags for measurement of odour index is in-door.
3. Sensory Test Performance
   Test is conducted by minimum 6 people of panel. Where 3 bags in which 2 without sample i.e. pure air and 1 bag of sample and asked to choose odour bag. If the selection of bag is correct, then odour is diluted. If it is impossible to identify, the it is accepted.
4. Calculations

Test result can be calculated by using stipulated methods to determine odour index.

- Calculations:
  - Threshold of each member

    $Xi = \frac{(\log m1 + \log m2)}{2}$

    Where, Xi= threshold of Panel
    M1= max. Dilution at answer is correct
    M2= min. Dilution at answer is incorrect
  - Calc. avg. threshold of panel

    $X = \frac{X1+X2+\ldots\ldots+Xn-2}{n-2}$

    where, X= Avg. threshold of Panel
    n= No. of panel members.
  - Calc. Odour by multiplying X factor to 10.

    Y= 10X
    Where, Y= Odour Index

From above method we understand about smell identification whether it is eliminated or not, but smell generates because of elements in WasteWater. The slurry contains various types of bacterias, elements and heavy metals. To reduce the smell there must be separation of sludge from WasteWater before it entering to Neutralization tank. We can modify the design of ETP by using Sludge Filter Press.

- Modified Layout of ETP:

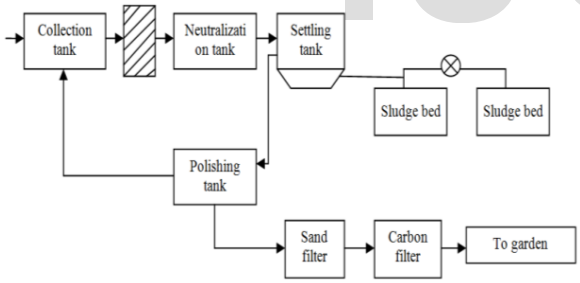

Fig.2. Modified Layout of ETP

Sludge Filter Press- A filter comprises set of juxtaposed,verticalplates, presses against each other by hydraulic jacks at one end of the set. Solid sludge accumulates in filtration chamber until compacted cake is formed. The filtrate is collected at back of filtration support and carried away by internal ducts. Each press operation includes following steps:

1. closing the press
2. Filling
3. Filtration
4. Filter opening
5. Washing

The Wastewater parameters before treatment are as shown below

Table.3. Experimental Details before Treatment

PARAMETER	RESULT	LIMITS
pH	7.7	5.5-9.0
COD	125	250mg/L
TSS	70	100mg/L
BOD	40	100mg/L
OIL GREASE	3	100mg/L

The Wastewater parameters after treatment are as shown:

Table.4. Experimental Details after Treatment

PARAMETER	RESULT	LIMITS
pH	7.7	5.5-9.0
COD	125	250mg/L
TSS	70	100mg/L
BOD	40	100mg/L
OIL GREASE	5	100mg/L

The Waste output of ETP i.e. sludge which gets collected in sludge bed and after modification at bottom of press filter too. Sludge has mainly two types-

1. Biological Sludge
2. Chemical sludge

Where, biological and chemical sludge contains Bacteria's like pathogen, spirillum, zoogloeal, sohaerotiles etc. Contents like carbon (50-70%), hydrogen(6.5-7.5%), oxygen(21-24%), nitrogen(15-18%), sulphur(0-2.4%)

Heavy materials like Chromium, Lead, Iron, Manganese, Alum etc.

This type of sludge has no use and it is toxic in nature but it can be used for Land filling.

The Waste sludge contains 80-88% moisture, after drying it contain 12-18% moisture.

The sludge is then crushed first by using crusher. Then by using ball mills its pulverised. It gets converted into Sludge powder.

As per the experimentation of sludge for Land filling we use sludge with sand and cement content.

Addition of Sand and cement i.e. Ordinary Potland Cement in sludge where mixing content is as follows:

Cement : Sand ⟶ 1 : 4

It is done by following procedure:

1. Mixing- mixing with dry materials and blend with water.
2. Filling to mould- putting that mixture and tamping rod to temp. mixture.
3. Moisture curing and Drying- drying to natural air and in sun for 5-6 days.

sludge	Weight/gm	Sand	Weight/gm	Cement
50%	850	50%	850	425
60%	1020	40%	680	425
70%	1190	30%	510	425

As per above experimentation, the content of sludge (850 weight/gm) 50%, sand (850 weight/gm) 50% and cement (425 weight/gm) gives efficient strength.

III. Results and Conclusions

1. The Wastewater gets purified by ETP process efficiently but the main problem was smell generation near Neutralization tank which can be eliminated by using Sludge Filter press.
2. After using Press Filter the work required for settling tank get reduced because around 70% sludge gets collected at the bottom of press filter.
3. Here, we understand one of the important odour measurement method i.e. Triangular Odour Bag Method.
4. We got to know Sludge contents and found that we can use it for Land filling by minimizing sand mixing. Sludge with (850 weight/gm) 50%, sand (850 weight/gm) 50% and cement (425 weight/gm) gives efficient strength.

References

[1] Rakesh Singh Asiwal, Dr. Santosh Kumar Sar*, Shweta Singh, Megha Sahu "Wastewater Treatment by Effluent Treatment Plants", SSRG International Journal of Civil Engineering (SSRG-IJCE) – volume 3 Issue12- December 2016.

[2] Ioannis K. Kalavrouziotis, Prodromos Koukoulakis "Wastewater and Sludge Reuse management in agriculture", EQA- Environmental Quality, 20 (2016) 1-13.

[3] K. Sundara Kumar, P. Sundara Kumar and Dr. M. J. Ratnakanth Babu"Performance Evaluation of Waste water treatment plant", International Journal of Engineering Science and Technology, vol. 2(12), 2010, 7785-7796.

[4] Junjie TAO, Shoulin WU, Linbo SUN, Xiaobo TAN, Shimiao YU, Zhibin ZHANG "Composition of Waste Sludge from Municipal Wastewater Treatment Plant", ProcediaEnvironmental Sciences 12(2012) 964-971.

[5] Hajira Haroon, Amir Waseem, Qaisar Mahmood "Treatment and Reuse of Wastewater from Beverage Industry", J. Chem. Soc. Pak., Vol. 35, No.1, 2013.