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Characterization of Industrial Effluent and Their Treatment

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***Abstract*— The characteristics and composition of plant effluent is like trying to hit a moving target whose speed is increasing exponentially. It includes the measurement of the following parameters, color, odour, temperature. BOD, COD, TDS, TS, TSS, pH, chlorides, turbidity, conductivity etc. This effluent when discharged untreated will damage the water course and the color in the water persist for a long distance. That's why it is necessary to treat this effluent properly before discharge. The aim of the present study is to analyze the effluent from different industries and recommendation of the economical, viable treatment methods for respective industrial effluents. Therefore, it is necessary to treat the waste water, prior to disposal an analysis of the physico-chemical parameters of effluent is important in almost all aquatic pollution studies in order to evaluate the impact on the water bodies.**

I. INTRODUCTION

Describing the characteristics and composition of plant effluent is like trying to hit a moving target whose speed is increasing exponentially the rapid changes which have recently occurred have led to the appearance of large number of publications in which general effluent characteristics are reported particularly the amount of absorbable organic halogen (AOX) but little is known about effluent composition in terms of individual compounds.

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II. METHODOLOGY

The methodology includes the collection, preservation, analysis and recommendation of treatment methods.

Present work we are collected three samples for analyzing from three different industries,

1. **Karanja Duplex paper mill**
2. **Sriven Pharmaceuticals industry**
3. **Mahatma Gandhi sahakara sakkare karkhane limited, Bhalki**

- **Chemical Oxygen Demand**

Chemical oxygen demand is defined is an amt. of specified oxidant that react with the sample under control conditions the quantity of oxidant consumed expressed in term of its oxygen equivalence because of its unique chemical properties the dichromate ion is the specified oxidant it is reduced to chromic ion in this test both organic and inorganic component of sample are subject to oxidation, but in most cases organic component predominates. COD is often used as a measurement of pollutant in waste water and natural water.

- **Biological Oxygen Demand**

The BOD is a measure of the oxygen utilized by micro-organisms during the oxidation of organic materials. It is the most widely known measure for assessing the water pollution potential of a given organic waste. On an average, the demand for oxygen is directly proportional to the amount of organic waste which has to be broken down. Hence, BOD is a direct measure of biodegradable organic matter the seeding and dilution procedures an estimate of BOD at pH 6.5 to 7.5.

- **Solid Test**

Solids refer to matter suspended or dissolved in water or waste water. Solids may affect the water or effluent quality adversely in a no of ways, water with high dissolved solids generally are of inferior palatability and may induce an unfavorable physiological reaction in the transient consumer. For this reason a limit 500mg dissolved /lit is desirable for drinking waters. Highly mineralized water also is unsuitable for many industrial applications. Water high in suspended solids may esthetically unsatisfactory for such purpose for bathing.

Solids analyses are important in the control of biological and physical waste water treatment processes and for assessing compliance with regulatory agency waste water effluent limitations.

Chloride Concentration

Chloride in the form of (cl-) ion. One of the major inorganic ions in water and waste water the salty taste produce by chloride conc. is variable and dependent on the chemical composition of water some water containing 250mg of chloride ion /lit may have a detectable salty taste if the cat ion is Na. One the other hand the typically salty taste may be absent in water containing as much as 1000mg/lit when the

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predominant cat ions are Ca, Mg .the chloride conc. is higher in waste water than raw water because NaCl is a common article of diet and passage through the digestive system along the sea cost chloride may be present in high conc. Because of leakage of salt water in to sewer system it may be increased by industrial process. High chloride content may harm metallic pipes and structures as well as growing plants**.**

- **pH Measurement**

The pH is a dimensionless number that indicates the strength of acidic or basic solution. The pH scale ranges from 1 to 14. The middle of the range, pH =7, represents a neutral solution, or one that is neither acidic nor basic. Pure water is neutral because it contains the same no. of H+, as OH- . Solution with pH values less than 7 is acidic; those with pH values greater than 7 are basic or alkaline. In more technical terms, pH is defined as the negative logarithm of the hydrogen ion concentration.

- **Conductivity**

Conductivity is a capacity of water to carry an electrical current and varies both with the number and types of ions the solution contains, which in turn is related to the concentration of ionized substances in the water. Most dissolved inorganic substances in water are in the ionised form and hence contribute to conductance. Conductivity measurement gives rapid and practical estimate of the variations in the dissolved mineral contents of a water supply.

Turbidity Test

Turbidity is a measure of the transparency of water. It is the property of water because of which it offers resistance to passage of light. It is caused by suspended solid, living algae and other microorganisms. It depends on the type of soil over which water has run and the velocity of run-off. Insoluble particles of soil, organics, micro-organisms and other inorganic material, impede the passage of light by scattering and absorbing rays. It is expressed as the amount of suspended matter in liquid in ppm, determined by optical observations.

- **Temperature**

We have collected composite samples from different industries viz paper, sugar, pharmaceutical etc, in plastic bottles of 5 liter capacity. After that we measure the temperature by using thermometer.The extraction rate increase with temp. the kinetic analysis shows that the rate of fast phase reaction both hydroxides and carbonate ions are increased to a greater extent by increasing temp then those of slow phase reaction, the cost of attaining higher temp.

- **Color**

We have collected three industrial sample which having the color of dark brown according to the paper industry, greenish color effluent for sugar industry, and green brownish color for pharma industry.

Table 1: Environment (Protection) Amendment Rule, 1996 notified by G.S.R.176[2]

Parameters	Sugar Industry	Paper Industry	Pharmaceutical Industry
PH	5.5-9.0	6.5-8.3	6-10
BOD	30	160	80
COD	60	610	150
Chlorine content	600	1000	1000
Total Solid	2700	3000	3500
Total Suspended Solid	2100	600	150
Total dissolved Solid	600	2100	3500

Table 2: Maximum permissible limits for Industrial effluent discharges

Parameters	Into inland surface water IS:2490(1974)	Into public sewer IS:3306(1974)
pH	5.50-9.00	5.50-9.00
BODs	30.00	350.00
COD	250.00	450.00
Suspended Solids	100.00	600.00
Total dissolved solids	2100.00	2100.00
Temp.	40.00	45.00
Chlorides	1000.00	1000.00

We have collected the samples from different industries for testing as follows.

A. Sampling

We have collected composite samples from different industries viz paper, sugar, pharmaceutical etc. in plastic bottles of 5 liter capacity. These bottles are sealed with numbered labels.

B. Preservation

Before preservation, certain parameter like PH, temperature was measured on site with potable instruments as they may change significantly during transportation. To minimum the potential for volatilization or biodegradation between sampling and analysis, samples were kept as possible as cool without freezing preferably packed in commercial ice substitutes before transportation. Methods of prevention are limited and are used generally to record biological action, retard hydrolysis of chemical compounds.

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C. Analysis

The samples were taken to the laboratory and physico-chemical parameters were analyzed within 36 hours by preservating samples below 4^0C in a refrigerator. Standard methods were adopted for the analysis of wastes water sample from above said industries (APHA AWWA-2000). After analyzing samples from paper, pharma & sugar industry, we have received following results:

Table 3: Result of effluent treatment plant in industry

Effluent treatment plant	COD(mg/lit)	BOD(mg/lit)	Chloride content(mg/lit)	PH
Karanja duplex paper mill	70	226	505.6	5.43
Sriven Pharmecenticals	130	161	643.6	8.3
Mahatma Gandhi sahakara sakkare karkhane sugar	91	59.8	457.7	6.5

III. TREATMENT BY USING PHOTO CATALYTIC REACTOR

Degradation of effluent in a photo catalytic reactor with titanium dioxide catalyst

Figure 1: Photo Catalytic Reactor

The TiO_2 photocatalytic degradation and mineralization of organic pollutants in water has been broadly demonstrated at the laboratory level for a wide number of organic pollutants. An experiment in decomposing phenol in an aqueous solution using this reactor was carried out. In consequence, it is shown that phenol can be decomposed in a relatively short time, not only under artificial ultraviolet light, but also under solar light. Heterogeneous photo catalytic oxidation forms part of a family of advanced water treatment technologies comprising the generation of reactive oxidizing species in water media and results in the complete oxidative degradation (mineralization) of organic pollutants to yield carbon dioxide and water.

Heterogeneous photo catalytic oxidation is a new technology for treatment of process water and waste water streams. Many familiar pollutants can be converted into more biodegradable compounds.

The photo catalytic oxidation of organic compounds by nano crystalline titanium dioxide (TiO_2) has received increasing attention since it can achieve the mineralization of a wide variety of organic compounds to nontoxic mineral products, including carbon dioxide and water. When anatase TiO_2 is illuminated with light of wavelength below 400 nm, electrons will be transferred from the valence band to the conduction band, leaving holes in the valence band. If these electron–hole pairs can be separated from each other quickly enough without significant recombination, they will migrate to the catalyst surface. Electron transfer can then take place from the conduction band electrons to an electron acceptor (molecular oxygen) and from an electron donor to the valence band holes concurrently, chemical radicals that are strong oxidizing agents are formed and the organic pollutants are oxidized by the radical attack photo-catalytic oxidation utilizes a catalyst with semiconductor properties, for example TiO2, and light of sufficiently short wavelength (usually ultraviolet radiation radicals are formed on the surface of the catalyst which degraded the substances or pollutants present photo catalytic oxidation, using titanium dioxide and UV-A radiation (310-400 nm), has several important.

Advantages:

- No auxiliary chemicals are required, the use of the oxygen in the air and a light source being sufficient.
- Organic substances in principle can be completely mineralized to CO_2, H_2O and possibly Cl-, NO ion organic compounds (CN- and S_2 -) can also be treated.
- No residues
- Low final concentrations.
- In the event of partial conversion of pollutants, more readily biodegradable pollutants, more readily biodegradable and/or less toxic products are generally formed and/or less toxic products are generally formed.

Goals and Overview

The form of photo catalysis that has been studied extensively for its potential as a method of choice is TiO_2 because it is inexpensive, non-toxic, and does not undergo photo corrosion. TiO_2 may be regarded from the point of view of semiconductor theory. Absorption of a near uv photon (wavelength < 385 nm) can be regarded as exciting an electron from the valence band to the conduction band (see diagram). A surface trapped electron standard potential ~ 0V on the hydrogen scale) is readily captured by molecular O_2 and the hole standard potential ~ 0V on the hydrogen scale) is readily captured by molecular O_2 and the hole is a very non-selective oxidant. It can even oxidize water to give the □OH radical that hole is a very non-selective oxidant. It can even oxidize

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water to give the □OH radical that attacks a very wide range of organic molecules. Thus, irradiation of TiO_2 can initiate the oxidation of most organic molecules by O_2. It is in that sense that the slight "misnomer" photo catalyst" is applied. The final product of such oxidation is normally CO_2, water, and inorganic ions.

The first objective of this project was to determine whether the major components of pulp mill waste streams are efficiently photo catalytically oxidized to CO_2 and inorganic ions.

The TiO_2 photo catalytic degradation and mineralization of organic pollutants in water has been broadly demonstrated at the laboratory level for a wide number of organic pollutants. However, there are still some problems that need to be addressed in order to make this technology more practical. The design of heterogeneous photo catalytic reactor systems, still in the infancy their development, is facing different problems such as light scattering, oxygen starving, particle separation and mass transfer. Additionally, there has also been a lack of a general method to evaluate the performance of the different reactor systems.

Heterogeneous photo catalytic oxidation forms part of a family of advanced water treatment technologies comprising the generation of reactive oxidizing species in water media and results in the complete oxidative degradation (mineralization) of organic pollutants to yield carbon dioxide, water and inorganic ions. The photo catalytic degradation was characterized by pseudo-first order reaction kinetics.

Although low pH (pH 3) marginally improved, reaction rates.

IV. APPLICATION OF THE PROJECT

- Which determining the toxicity of pollution in the field.
- After treatment the following advantages are occur**:**
  - ✓ No residues
  - ✓ Low final concentrations.
  - ✓ In the event of partial conversion of pollutants, more readily biodegradable pollutants, more readily biodegradable and/or less toxic products are generally formed and/or less toxic products are generally formed.

V. CONCLUSION

After collecting the sample from the above said industry and analyzing, we have gone for treatment of the said industries effluent by photo catalytic reactor, which is more effective and efficient in effluent treatment technology. With above said effluent treatment technology, we have come to the conclusion as follows:

- ✓ Less amount of residues
- ✓ Very low solid concentration.
- ✓ In the event of partial conversion of pollutants, more readily biodegradable pollutants, more readily biodegradable and/or less toxic products are generally formed.
- ✓ After treatment it can be reuse for the general purposes
- ✓ It does not produce any harmful effects on the body or on the environment
- ✓ After treatment effluents can be use for irrigation purpose.

VI. REFERENCES

[1]. Dryden's Outline Of Chemical Technology(Third Edition,348,350,1975)
[2]. Dryden's Outline Of Chemical Technology(Third Edition),360
[3]. Shereve's Chemical Process Industries,115
[4]. Pulp & Paper Manufacture , Tappi Volume-5,281
[5]. Pulp Bleaching Principal & Practice By : Coslton W. Dence
[6]. Environmental Pollution & Control in Chemical Process Industries By: S.C.Bhatia
[7]. Environmental Pollution Control Engg. By : C.S.Rao,327
[8]. Basic Environmental Technology(Fourth Edition) By: Jerry A. Nathanson,97
[9]. Hand Book For Pulp & Paper Technology By : G.A.Smook
[10]. Pulp & Paper Manufacture , Tappi Volume-3
[11]. measurement of conductivity of different sample from internate site(google search "procedure of conductivity" & catch for internate site www.primeindia.com/manav/mangt35.html
[12]. Temperature versus pH measurement from internate site(google search " ph meter used in lab for measurement of ph for different sample & it procedure." & catch for internate site www.ne-wea.org/LabManual/ph
[13]. Pollution Control In Process Industries By : S.P Mahajan
[14]. Environmental Technology For Sustainable Development By: Dr. Upender Pandel , Dr. M.P.Poonia
[15]. SAKET—Environmental Hand Book By : Jay Narayan Vyas, R.Parthasarthy SAKET—Environmental Hand Book By : Jay Narayan Vyas , R.Parthasarthy
[16]. Photocatalytic thin film cascade reactor for treatment of organic compounds in wastewater, A.H.C. Chan, J.F. Porter, J.P. Barford and C.K. Chan
[17]. A.P.H Standard methods for the exam. Of water and waste water (20th Edition)1998