Student field study project

ESTIMATION OF CHEMICAL OXYGEN DEMAND IN VARIOUS WATER BOODIES AT HANUMAKONDA REGION

SUBMITTED BY

N.Divya	BZC I	006203513
G. Vashista	BZC I	006203450
B. Akhila	BZC-I	006203414
G.Tharangini	BZC-I	006203456
P.Luarikesha	BZC-I	006203524
J. Shilender	BZC-I	006203472
P.Srikanth	BZC-I	006203521
Ch.Sai Kiran	BZC-I	006203428
K.Yogi	BZC-I	006203480
D.Akshaya	BZC-I	006203431

UNDER THE GUIDANCE OF:

Dr .RAVULA MOGILI

DEPARTMENT OF CHEMISTRY
KAKATIYA GOVERNMENT COLLEGE, HANAMKONDA

Kakatiya Government College
Hanamkonda, Warangal(U), T.S.

Date: 24.01.2021

CERTIFICATE

Certified that the work embodied in this study project entitled "ESTIMATION OF CHEMICAL OXYGEN DEMAND IN VARIOUS WATER BODIES IN HANUMAKONDA REGION has been carried out by **N.Divya , G.Vashista, B.Akhila, G.Tharangini,P.Laurikesh, J.Shailender,P.Srikanth,Ch.Sai kiran,K.Yogi,and D.Ananya.** under the guidance of   **Dr. Ravula Mogili** in the Department of Chemistry, Kakatiya Government College, Hanamkonda.

ESTIMATION OF CHEMICAL OXYGEN DEMAND IN VARIOUS WATER BODIES IN HANUMAKONDA REGION

Synopsis:

Water is one of the most essential items need by man, plants and animals for their survival. Without water, there can be no more life. Water maintains an ecological balance – a balance in the relationship between living things and environment in which they live. the use of water is increasing rapidly with growing population, thus water should not get polluted and should satisfy criteria. Certain organic substances present in natural water such as the impact of water quality on the environment and public health.

Aggregate organic pollutant load in water can be assessed by measuring the water quality parameter chemical oxygen demand (COD), which is widely used as a national discharge standard to investigate the organic pollution in water[1]. It is used widely as a measure of organic pollutant load in wastewaters[2,3]

The present work is an attempt to provide testing COD of the waste water samples are collected in different regions around Hanumakonda, Telangana state. About 5 samples have been collected from various selected points in Hanumakonda . The physicochemical characteristics revealed that about 10 percent variation in the concentrations. As high as 80mg/l of COD were recorded in water samples in two points .The water quality of certain points is not acceptable from the standpoint of Indian standards. Sufficient treatment is required for waste water has been sugested

Introduction:

Water pollution and its impacts on the environment are serious issues for present world. To limit the water pollution and improve the water quality, advanced wastewater treatment technologies are invented. These technologies are implemented by removing physical, chemical and biological contaminants from wastewater and producing an environmentally safe fluid waste stream (treated effluent) and a solid waste (treated sludge)[4,5]. It may then even be possible to reuse sewage effluent for drinking water with the help of more advanced technologies. If untreated wastewater containing contamination enters into the surface and ground water resources, it leads to a serious environmental and human health risk [6]. To minimize the potential risks from untreated wastewater entering freshwater resources, industrial wastewater plants go through a water quality assessment by moni- toring some parameters. Water quality professionals assess water quality by measuring the concentrations of these parameters and comparing with their standards [5,7]. Some of the unique analytical parameters of the water pollution control industry are biochemical oxygen demand, chemical oxygen demand, taste, odor, colour, chlorine demand, hardness, alkalinity and biodegradability tests [5,8]. Finding excessive levels of one or more of these parameters can serve as an early warning of potential pollution problems. One of these parameters are COD and BOD that indicate the amount of organic pollution and water degradation.

COD is defined as the amount of oxygen equivalents consumed in oxidizing the organic compounds of samples by strong oxidizing agents such as dichromate or permanganate. It is expressed in milligrams per liter (mg/L) that indicates the mass of oxygen consumed per liter of solution [9]. The higher the chemical oxygen demand, the higher the amount of pollution in the water sample [10]. COD is considered one of the most important quality control parameters of an effluent in wastewater treatment facility [11]. COD values are used to monitor wastewaters before (influent) and after (effluent) treatment, and, therefore, their reliability is important to protect the environment and to guarantee the economical sustainability of the treatment facility [12].

4

COD measurements are commonly made on samples of wastewater treatment facility or of natural waters contaminated by domestic and industrial wastes. COD is measured as a standardized laboratory assay in which a closed water sample is incubated with a strong chemical oxidant under specific conditions of temperature and for a particular time. A commonly used oxidant in COD assays is potassium dichromate ($K_2Cr_2O_7$) which is used in combination with boiling sulfuric acid (H_2SO_4)[13,14].

Principle:

Chemical oxygen demand parameter has been introduced to measure the total oxidisable impurities present in the sewage. This includes both, biologically oxidisable and biologically inert but chemically oxidisable impurities in the water. It is the amount of oxygen equivalents of acidified potassium dichromate required to oxidize the organic and inorganic impurities in waste water. It is expressed in mg.dm-3 or ppm. A known volume of the wastewater sample is refluxed with excess of $K_2Cr_2O_7$ solution in sulphuric acid medium and in the presence of . Ag_2SO_4 and $HgSO_4$. $K_2Cr_2O_7$ oxidizes all oxidisable impurities. Ag_2SO_4 catalyses the oxidation of straight chain organic compounds, aromatics and pyridine. $HgSO_4$ avoids the interference of Clions by forming soluble complex with them. In the absence of $HgSO_4$, Cl^- ions precipitate silver ions as AgCl. The amount of unreacted $K_2Cr_2O_7$ is determined by titration with standard Mohr's salt (ferrous ammonium sulphate) solution. The amount of $K_2Cr_2O_7$ solution consumed corresponds to the COD of the water sample. To calculate the COD, a blank titration (without the water sample) is carried out.

Ferroin [(1, 10-phenanthroline-iron (II)] complex is used as the indicator in the titration to detect the end point. The indicator is intensely red in colour. Strong oxidizing agents oxidize the indicator to iron (III) complex, which has a bluish green colour.

$$[Fe\ (C12H8N2)3]^{3+} + e^- \leftrightarrow [Fe\ (C12H8N2)3]\ 2+$$
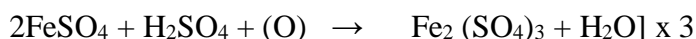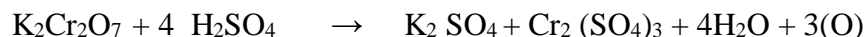
Bluish green   Deep red

As long as $K_2Cr_2O_7$ solution is present in the solution, the indicator is in the oxidized form, imparting bluish green colour to the solution. The solution becomes bluish green as the titration (with FAS) proceeds (due to the presence of untreated $K_2Cr_2O_7$ and when $K_2Cr_2O_7$ is completely

exhausted, the added FAS solution which is in oxidizing agents impart red-brown colour to the solution. Therefore, the end point is marked by the colour change from bluish-green to reddish-brown. Addition of conc. H_2SO_4 to $K_2Cr_2O_7$ facilitates the liberation of nascent oxygen required for oxidation of waste water. A test tube of dil. H_2SO_4 is added during dissolution of Mohr's salt (standard solution) to prevent the hydrolysis of the salt in the solution. The reaction between Mohr's salt and $K_2Cr_2O_7$ can be represented as follows.

$$K_2Cr_2O_7 + 4\ H_2SO_4 \quad \rightarrow \quad K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3(O)$$

$$2FeSO_4 + H_2SO_4 + (O) \quad \rightarrow \quad Fe_2(SO_4)_3 + H_2O]\ x\ 3$$

$$K_2Cr_2O_7 + 6FeSO_4 + 7\ H_2SO_4 \quad \rightarrow \quad K_2SO_4 + Cr_2(SO_4)_3 + 3\ Fe_2(SO_4)_3 + 7\ H2O\ 1$$

Procedure:

Part-A: Preparation of standard FAS (Mohr's salt) solution:

Weigh accurately the given FAS(Mohr's salt), transfer it in to a 250ml standard flask, dissolve in a little amount of distilled water and a 10ml of dilute H_2SO_4 and make up to the mark with distilled water. Shake well for uniform concentration.

Part-B : Preparation processes of the samples :

In this study, wastewater samples were collected from five different areas in Hanumkonda. Before analyse the sample to remove solid particles by ultra filtration method and proper labeling. These series of samples A, B, C, D and E .

Part-C: Determination of COD:

Pipette out 25.0 ml of the wastewater sample (A) in to a 250ml conical flask. Pipette out 10.0 ml of $K_2Cr_2O_7$ solution into the flask and add 10 ml of 1:1 H_2SO_4 (containing silver sulphate and $HgSO_4$). Add 2-3 drops of Ferroin indicator and titrate against standard Mohr's salt solution till the colour changes from bluish green to reddish brown , note down the final reading of the

burette. Repeat the experiment to get concordant value. Same procedure followed for the sample B,C,D and E

Observation and Calculations:

Part-A:

Weight of the bottle + Mohr's salt =W1 = 25.40g.

Weight of the empty bottle =W2 = 15.6 g.

Weight of the Mohr Salt = (W1-W2) = 9.80g.

$$N_{FAS}E = (W1-W2)X4/Eq.wt.of FAS(392)$$

$$= 9.80X4/392$$

$$= 0.1 N$$

Part-B:

Estimation of Waste water sample -A

Sample titration Burette : Standard FAS

Conical flask : 25.0 ml of waste water sample + 10.0 ml of K2Cr2O7 + 5 ml of 1:1 H_2SO_4

Indicator : 2-3 drops of Ferroin indicator.

Colour change : Bluish green to reddish brown.

Burette Reading	I	II	III
Final burette Reading	0	9.8	19.5
Initial burette Reading	9.8	19.5	29.2
Volume of FAS	9.8	9.7	9.7

Concordant Value V1 = 9.7ml.

Waste water sample	A	B	C	D	E

Volume of FAS Back titer value(a)	9.7	9.4	8.1	8.8	8.5

Blank Titration:

Repeat the above procedure without waste water sample.

Blank titration

Burette : Standard FAS

Conical flask : 10.0 ml of standard K2Cr2O7 + 5ml of 1:1 Sulphuric acid

Indicator : Ferroin.

Colour change : Bluish green to reddish brown.

Burette Reading in ml	I
Final Burette Reading	0
Initial Burette reading	10.6
Volume of FAS consumed(b)	10.6

Waste water sample **A**

Blank titre value = b = 10.6 cm3

Back titre value (sample A)= a = 9.7cm3

Blank – back = b-a = = 0.9cm3

COD of a given waste water sample = NX (b-a)X8/25 =

$$=0.1X0.9X.8/25 = 0.028 \text{ g of oxygen}$$

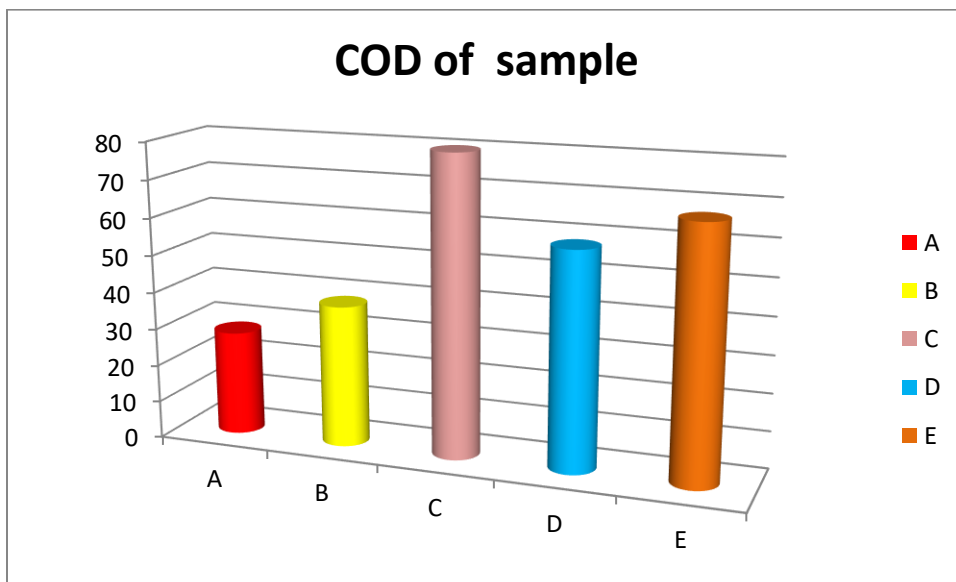$$=0.028 \text{ x } 1000 = 28 \text{ mg of oxygen}$$

COD of a given waste water sample = 28mg/dm3

\

Result: COD of given waste water samples

Waste water sample	A	B	C	D	E
COD of sample	28	38	80	58	67

Conclusion and future perspective:

This review has identified the main technological strategies of COD measurement, which is used as an indicator of the degradability of organic matter in water bodies. This review has focused on the technological aspect of the evaluation methods and their advantages and disadvantages.In an attempt to increase the oxidation efficiency, reduce the analytical time, and avoid environmental pollution, many alter- native methods have been investigated and reviewed. These methods mainly include the following: modified standard methods (e.g., improved digestion methods, alternative meth- ods of digestion reagents, optimized spectrophotometric methods, and

optimized COD determination methods prevailing over chloride interference) and new technologies or methods .

The traditional detection methods are suitable for determining COD with the content range of 30–700 mg/L in slightly or moderately polluted water bodies. These methods have been extensively adopted by various environment monitoring laboratories due to the use of simple instruments. However, the limitations of long analytical time, utilization of toxic and high-cost chemical agents, and insufficient oxidation capability of organic pollutants have restricted their practical application. To overcome the shortcomings of the traditional methods, the improved and optimized methods extend their detection limits, significantly shorten their low-cost, and online monitoring determination of COD. Nevertheless, the reliability and stability of these new technologies still depend on the breakthrough of new theories and techniques detection time, and decrease their detection cost. However, the environmental pollution caused by chemical reagents could not be avoided, and the oxidation ability to the refractory organics was insufficient. FIA, CL, or a combination of several techniques have also been employed to determine COD in water bodies. Low detection limit could be achieved, detection time could be shortened again, and environmental pollution caused by the reagents could be dramatically reduced. With the development of science and technology, AOPs (e.g., O_3 oxidation, electrochemical oxidation, and especially as PcCOD and PeCOD technologies which utilize TiO_2 as a photocatalyst to replace the conventional oxidizing agent) have been recently developed. Given the superior oxi- dation abilities of illuminated TiO_2, advantages, such as low detection limit (i.e., 0.01 mg/L), environment friendly (i.e., toxic chemical reagents are not required), and rapid analyti-cal speed (i.e., 1 minutes), were achieved by these new meth- ods. The new techniques can provide a reference for the accurate, rapid, lo. A substantial amount of effort should be devoted to improving the development space of high COD concentration determination in wastewatersamples.

References

1. Latif U, Dickert FL. Chemical Oxygen Demand. *Nanostructure Science and Technology*. 2015;p. 719–728..
2. Kim BR. Effect of Ammonia on COD Analysis. *Journal WPCF*. 1989;61(5):614–617.
3. Vyrides I, Stuckey D. A modified method for the determination of chemical oxygen demand (COD) for samples with high salinity and low organics.
4. Naima Bradley, Henrietta Harrison, Greg Hodgson, Robie Kamanyire, Andrew Kibble, and Virginia Murray. *Essentials of Environmental Public Health Science*: A Handbook for Field Professionals. Oxford University Press, 2014.
5. KH Mancy. *Instrumental analysis for water pollution control*. Instrumental analysis for water pollution control, 1971.
6. George Tchobanoglous and Franklin L Burton. Wastewater engineering. Management, 7:1–4, 1991.
7. Suman Mor, Khaiwal Ravindra, RP Dahiya, and A Chandra. Leachate characterization and assessment of groundwater pollution near municipal solid waste landfill site. *Environmental monitoring and assessment,* 118(1-3):435–456, 2006.
8. Mogens Henze. Wastewater treatment: biological and chemical processes. *Springer Science & Business Media*, 2002.

9. Ashok Kumar, BS Bisht, VD Joshi, AK Singh, and Amitabh Talwar. Physical, chemical and bacteriological study of water from rivers of uttarakhand. *Journal of Human Ecology*, 32(3):169–173, 2010.

10. RK Trivedy and PK Goel. Chemical and biological methods for water pollution studies. Environmental publications, 1984.

11. Baisheng Chen, Huanan Wu, and Sam Fong Yau Li. Development of variable pathlength UV-vis spectroscopy combined with partial-least-squares regression for wastewater chemical oxygen demand (COD) monitoring. Talanta, 120:325–330, 2014.

12. Guoqing Wu, Weihong Bi, Jiaming Lv, and Guangwei Fu. Determination of chemical oxygen demand in water using near-infrared transmission and UV absorbance method. *Chiese Optics Letters*, 09(s1):310705, June 2011.

13. BP Rajbhandari and S Shrestha. An assay of rupa lake water from the perspectives of livelihoods. *NEPALESE JOURNAL OF AGRICULTURAL SCIENCES*, page 126.

14. Wayne Boyles. The science of chemical oxygen demand. Technical information series, Booklet, (9):24, 1997.

Collection of water samples by the students from water bodies in Hanumakonda region

Collected water samples

Estimation of COD in water samples by the students