**EXPERIMENT REPORT**

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| **Student Number** | **Name-Surname** | **Group Number** | **Date** |
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**EXPERIMENT NAME:** CHEMICAL OXYGEN DEMAND (COD)

1. **INTRODUCTION**

(Purpose, Mechanisms (reactions will be written if needed))

Chemical oxygen demand (COD) is the amount of oxygen required to chemically oxidize the organic substances in water [1]. COD parameter is one of the most important parameters to determine the organic matter content of the wastewater in environmental engineering applications. COD is also a fast method to analyze organic matter in the stream and industrial wastes. Since the ratio of BOD/COD is about 0.4-0.6, COD value can be used to estimate the BOD. The COD value of a municipal wastewater is about 400 mg/L [2]. The discharge standards are about 90-140 mg/L changing with the population [2]. For industrial wastewaters COD is much higher, i.e. COD is about 450-650 mg/L for a textile industry wastewater [3][4].

There are three methods for the determination of COD parameter: Open Reflux Method; Closed Reflux, Titrimetric Method; Closed Reflux, Colorimetric Method [5]. In this experiment Closed Reflux Colorimetric method was used.

The aim is to determine the oxygen quantity based on the reduction of a dichromate solution under certain conditions. In the COD determination, an organic matter (CnHaObNc) is digested with potassium dichromate (K2Cr2O7) according to the following reactions:

$$C\_{n}H\_{a}O\_{b}N\_{b}+dCr\_{2}O\_{7}^{2-}+(8d+c)H^{+} \rightarrow nCO\_{2}+\left[\frac{a+8d-3c}{2}\right]H\_{2}O+cNH\_{4}^{+}+2dCr^{3+}$$

$$d=\left[\frac{2n}{3}\right]+\frac{a}{6}-\frac{b}{3}-\frac{c}{2}$$

Excess dichromate concentration is determined by titrating it with ferrous ammonium sulfate (FAS). The reaction is given by:

$$6Fe^{2+}+Cr\_{2}O\_{7}^{2-}+14H^{+}\rightarrow 6Fe^{3+}+2Cr^{3+}+7H\_{2}O$$

$$d=\left[\frac{2n}{3}\right]+\frac{a}{6}-\frac{b}{3}-\frac{c}{2}$$

1. **MATERIALS AND PROCEDURES**

(All materials needed for experiment, chemicals, equipment and used standard experiment methods will be explained)

**Materials**

* Spectrophotometer was used to measure the amount of light absorbed.
* Heating block was used to heat the sample.
* COD tubes were placed in the heating bock after the sample poured in them.
* Micropipette was used transfer the samples to COD tubes.
* Potassium hydrogen phthalate solution was used as stock solution.
* Standard potassium dichromate solution was used to digest the samples.
* Silver sulfate solution was used as catalyzer.
* Sulfuric acid was used to acidify the reaction medium.
* Mercury (II) sulfate was used to avoid interferences.

**Procedure**

1. The calibration standards and samples were analyzed with the same procedure.
2. All the tubes were labeled and 1 spoon of HgSO4 was added to each tube.
3. 1 ml of deionized water or standard was added to proper tubes.
4. 500 μl of K2Cr2O7 solution was added to the tubes.
5. 1.5 ml of H2SO4-Ag2SO4 solution was added to the tubes.
6. The lids of the tubes were closed and shaked.
7. The tubes were put on the heating block and the COD program was selected.
8. After 2 hours of heating at 150°C all the tubes were taken and inverted carefully.
9. The outside of the tubes were cleaned and waited until they reach to room temperature.
10. They were analyzed with a spectrophotometer at the wavelength of 600 nm.
11. **RESULTS AND CALCULATIONS**

(Data that gained from experiment and calculations)

**Table 1.** The values of calibration curve

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name of the sample | COD concentration (mg/L) | Volume of deionized water (ml) | Volume of KC8H5O4solution (1000 mg O2/L) (ml) | Absorbance at 600 nm |
| Blank  | 0 | 10 | 0 | 0.000 |
| Standard 1 | 200 | 8 | 2 | 0.075 |
| Standard 2 | 400 | 6 | 4 | 0.145 |
| Standard 3 | 600 | 4 | 6 | 0.216 |
| Standard 4 | 800 | 2 | 8 | 0.288 |
| Standard 5 | 1000 | 0 | 10 | 0.362 |

**Figure 1.** Calibration curve for COD

COD of the sample is calculated according to the following equation;

$$\frac{ABS\_{600nm}-b}{a}×DF$$

COD: chemical oxygen demand (mg/L)

ABS600nm: absorbance at 600 nm of the sample

a: a-value in the calibration curve

b: b-value in the calibration curve

DF: dilution factor; this is one in case the sample was not diluted

**Table 2.** Results of the samples

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name of the sample | Volume of deionized water (ml) | Volume of sample | Absorbance at 600 nm | Calculated COD concentration (mg/L) |
| Sample 1 | 0 | 10 | 0.327 | 815 |
| Sample 2 | 2 | 8 | 0.236 | 734 |
| Sample 3 | 5 | 5 | 0.115 | 570 |
| Sample 4 | 8 | 2 | 0.075 | 925 |

1. **DISCUSSION**

(Consistency of the results gained from experiments and importance of them in terms of environmental engineering comparing with important regulation values)

The COD values of the samples are too high according to the related regulation [2]. The maximum COD value belongs to sample 4 while the minimum concentration was calculated for sample 3. The high COD values show that the samples might be originated from industrial sources [3][4].

Colorimetric determination of COD is quicker and easier to run, and does not require additional reagents. However, the calibration curve must be checked regularly in order to sustain the accuracy of the results. Hazardous wastes occurred during the experiment. They must be disposed properly.

**REFERENCES**

[1] C. N. Sawyer, P. L. McCarty, and G. F. Parkin, *Chemistry for environmental engineering*, vol. 4. McGraw-Hill New York, 1994.

[2] “Su Kirliliği Kontrolü Yönetmeliği.” [Online]. Available: http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.7221&sourceXmlSearch=&MevzuatIliski=0. [Accessed: 15-Nov-2018].

[3] M. M. Aslam, M. A. Baig, I. Hassan, I. A. Qazi, M. Malik, and H. Saeed, “Textile wastewater characterization and reduction of its COD and BOD by oxidation,” *EJEAF Che*, vol. 3, no. 6, pp. 804–811, 2004.

[4] G. Ciardelli and N. Ranieri, “The treatment and reuse of wastewater in the textile industry by means of ozonation and electroflocculation,” *Water Res.*, vol. 35, no. 2, pp. 567–572, 2001.

[5] Standard Methods Committee, “5220 Chemical Oxygen Demand ( Cod )\* 5220 B,” *Open Reflux Method*, no. 5000, pp. 14–19, 1997.

**Notes:**

1. All lab reports must be typed single spaced, 11 pt font, and Times New Roman or Cambria typefont.
2. True plagiarism is an automatic zero.
3. Any paper turned in past 12:00 on the due date is an automatic zero.