

Characterization of Activated Sludge and Electroplating Effluent

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Abstract

Waste water treatment needs proper and accurate characterization. The properties of waste water such as chemical oxygen demand, biological oxygen demand, dissolved oxygen, suspended and dissolved solids and heavy metals (if any) etc. forms a set of characteristics required to study treatability of effluent. In the present paper the review of methods used for characterization of effluent is presented. Also the characterization of the waste sludge is included as it is intended to treat this effluent by using activated sludge. The current work is also aimed at preparing necessary ground work required for the effluent treatment by activated sludge process.

Keywords: Effluent, Activated sludge, COD, BOD, DO, Heavy metal.

1. Introduction

Waste water treatment is becoming important because of rapid industrialization. In developing countries, the ever increasing population calls for efficient use of available resources. This includes water reuse and recycle [1,2]. The waste water from various industries such as electroplating industries, mining industries, catalyst industries, food process industries, petroleum and refining industries etc. emit the effluent containing various pollutants such as organic matter measured as chemical oxygen demand (COD), dissolved oxygen, suspended and dissolved solids, heavy metals and many other trace impurities [3,4,5]. The treatment of these pollutants needs to be carried out efficiently from human health, ecological and regulatory perspectives. If disposed without treatment, these pollutants can cause health problems and also disturb ecological cycle [6,7,8]. This can be done by various physical, chemical and biological methods. Physical methods includes filtration, sedimentation etc. The biological methods such as activated sludge process (ASP), trickling filter (TF), aeration etc. can be used for organic matter removal. These methods recently have been studied by investigators for removal of heavy metals with considerable success [9,10,11]. Also Chemical methods such as flocculation, coagulation, precipitation have yielded encouraging results [12,13,14]. In the present work the characterization of effluent is studied. It intends to

explore the methods used for characterization and use them for determining characteristic values of the parameters. Since the researcher intends to treat the effluents containing two major heavy metals by using ASP, the characterization of the sludge to be used for treatment is also carried out.

2. Methodology

The methodology is divided into two parts:

I) Characterization of Effluent II) characterization of sludge

2.1 Characterization of effluent

2.1.1 Chemical Oxygen demand

Chemical oxygen demand is oxygen required for chemical decomposition of organic matter present in waste water. For this purpose Potassium dichromate is used as oxidizing agent and silver nitrate and mercury sulphate are used for avoiding interferences of other materials. The blank with 10 ml distilled water and sample with appropriate dilution (if required) was kept on digester (make spectra lab) for 150 minutes (fig.1). Then the samples and blank were titrated with Mohr's salt for estimation of COD.

➤ Preparation of dichromate solution (0.25 N) : 12.25 gm of $K_2Cr_2O_7$ was added to distilled water and volume was made upto 1 litre. Normality of solution was 0.1N.

➤ Preparation of Mohr's salt solution (0.1N): 39.2 gm of $Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$ was added to distilled H_2O . 20 ml of concentric H_2SO_4 (3.6N) was added to it and volume is made 1000 ml with distilled H_2O to make 0.1 N Mohr's solution.

➤ Standardization of Mohr's salt solution: 5 ml of $K_2Cr_2O_7$ solution (0.25N) was added to 45 ml of distilled water and 15 ml of conc. H_2SO_4 was added to it. This solution was cooled under tap water and titrated with Mohr's salt solution in burette. Ferroin was used as an indicator.

➤ Determination of COD of sample: Sample water was collected and taken in round bottom flask with glass joints. To the water sample following reagents are added in sequential order. (a). 0.5 gm of $HgSO_4$ (Mercuric

sulphate)(b)10 ml of $K_2Cr_2O_7(0.25N)$ (c)20 ml conc. H_2SO_4 (d) 0.5 gm Ag_2SO_4 (silver sulphate)(e) 10 ml of water sample.

➤ One blank set is arranged with same reagent added in the same order except that 10 ml of distilled water replaces 10 ml of sample water. The blank set and the sample were refluxed for 2.5 hrs in COD digester. The sides of condenser were then washed with approximately 10 ml of water and cooled. The excess of $K_2Cr_2O_7$ was titrated with std. Mohr's salt solution using few drops of ferroin as indicator.



Fig.1:COD Digestion Apparatus

2.1.2 Biological oxygen demand

Biological oxygen demand is oxygen required for biological decomposition of organic matter present in waste water. For this purpose initial dissolved oxygen (DO) of blank (distilled water) and diluted waste water is measured before and after five days incubation at $18^{\circ}C$. Difference in DO is measure of biological oxygen demand. If sufficient sludge food is not available then seeding is done which is called as seeded BOD test.

2.1.3 Dissolved oxygen

Dissolved oxygen is oxygen present in waste water. It is calculated by titrating the sample with stoichiometrically equivalent amount of silver nitrate.

2.1.4 Total suspended solids

To determine total suspended solids a piece of filter paper was weighed accurately. One liter of sample was filtered through the weight filter paper. The filter paper was allowed to dry completely. The filter paper was weighed again. The change in weight is the weight of the total suspended solids.

2.1.5 Heavy metals (Nickel)

The amount of heavy metal (Nickel) is estimated by using UV spectrophotometer (ELICO -159) using appropriate reagents.

2.2 Characterization of Sludge

2.2.1 Determination of MLSS

In order to test the mixed liquor suspended solids (MLSS) a well-mixed sample was filtered through a weighed standard glass-fiber filter. The residue left on the filter was dried to a constant weight at a temperature between $103^{\circ}C$ and $105^{\circ}C$. The increase in weight of the filter represented the total suspended solids of the sample. Large floating particles or submerged agglomerates of nonhomogenous materials from the sample may be excluded in the total suspended solids measurements if it is determined that their inclusion is not representative of the entire sample.

2.2.2 SVI[Sludge volume index]

Settleability of sludge may be measured as sludge volume (SV) in a 1000 ml measuring cylinder (height of 36 cm) after 30 minutes sedimentation and is expressed for a known initial sludge concentration as sludge volume index (SVI)

3. Results and Discussion

3.1 Effluent

The chemical oxygen demand of the effluent was estimated by using spectrophotometer (Fig-1) Spectra lab. The effluent was collected at different times during the day and at various locations. It was mixed to obtain representative sample for treatability study. The COD of the sample observed to be 305.7mg/litre. The BOD of the same sample was 99.6 mg/litre. It indicates that the biological treatment is a possibility for this effluent. The dissolved oxygen was observed to be 1 mg/litre, which is very low value for disposal in reservoir/ river or any other disposal site. The minimum DO for survival of aquatic life is 5 mg/litre. The Total suspended solids were observed to be 15 mg/litre and the nickel content was 42.2 mg/litre. So the effluent needs to be treated for nickel removal.

3.2:Sludge

In case of activated sludge MLSS varied from 1800 to 3700 mg/litre and the thick sludge mass implies sufficient microbial population for activated sludge. The SVI value was observed to be 127.8 mg/litre indicating good settling properties.

4. Conclusion

The COD of the sample was above 250 mg/litre which is limit for disposal in reservoir or river. The waste water needs to be treated for COD reduction. Also since COD is 305.7mg/litre, it can be brought within the limit required for washing and other non potable applications. It is expected that with removal of organic matter, the DO will increase above 5 mg/litre. The special treatment may be the necessity for nickel removal from the sample.

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Biography

Mrs. Sonali R. Dhokpande has completed her Masters in Food Technology from Nagpur University in 2003. She is working as Assistant Professor in Chemical Engineering Department of Datta Meghe College of Engineering, Airoli, Maharashtra, India. She has published and presented more than 10 international papers. Her area of interest includes food technology and biological treatment for various pollutants.

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Dr. Jayant Prabhakar Rao Kaware, Chemical Engineer, pursued his education from Laxminarayan Institute of Technology, Rashtra Sant Tukdoji Maharaj Nagpur University. He was Professor-in-charge for the Biodiesel Research Laboratory associated with the department of chemical engineering. He was Member of Board of Studies for Chemical & Polymer Technology at Sant Gadge Baba Amravati University since 2000 and Chairman from 2008 till 2012. He is a Member of



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