

COD Removal Efficiency of Activated Carbon Adsorbent for Tannery Wastewater Treatment

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ABSTRACT: Tannery is one of the leading industries which produce contaminated effluents. The tannery effluent contains lot of organics and inorganics as well as heavy metals. Hence the treatment of tannery effluent before its disposal should be done. The COD of the tannery effluents are higher in nature, because it has high organic and inorganic loads. Therefore the treatment of tannery effluents is challenging one. Generally, many treatment techniques are available. Among them, activated carbon adsorbent treatment of such heavy metal was already explored in many studies. Hence in this study the COD removal efficiency of activated carbon and the optimum condition for maximum removal was studied. The batch experiments were conducted with different dosage (0.2, 0.4, 0.6, 0.8 & 1g/L) of activated carbon, contact time (20, 40, 60, 80, 100 & 120 minutes) and varying pH (2, 4, 6, 8, 10 & 12) to achieve the maximum COD removal efficiency. The optimum condition and their maximum percentage of COD reduction were identified.

KEYWORDS: Activated carbon, COD reduction, Tannery, Adsorption.

I. INTRODUCTION

Water is precious for living organisms for their survival and for the industries involving wet operations. Among these industries, tannery needs water for its entire process such as beam-house, tan-yard and finishing. Chromium is seen abundantly in the tannery effluent, because the chrome tannins are cheaper than others. The hexavalent form of chromium is considered to be a group "A" human carcinogen because of its mutagenic and carcinogenic properties [1]. The presence of such heavy metal will also contribute the increased COD nature of tannery effluent. The tannery effluent with higher COD causes environmental impacts while disposed without proper treatment. Removal of metals from wastewater is achieved principally by the application of several processes such as adsorption, sedimentation, electrochemical processes, ion exchange, biological operations, cementation, coagulation/flocculation, filtration and membrane processes, chemical precipitation and solvent extraction [2]. The biological materials usage as adsorbents in treatment of tannery effluent has been focussed during recent years. The usage of activated carbon as adsorbent reduces the concentration of Cr (VI) ions was already reported in many studies. Hence its relationship with the COD reduction of the tannery wastewater was explored in this study.

II. MATERIALS AND METHODS

The samples of the wastewater were collected from a tannery located at Ranipet in Vellore district. The collection of samples was carried out using suitable containers by adopting the standard sampling procedures. The effluent was stored under freeze before analysis in order to prevent the degradation of organics before analysis. Required volume of samples was withdrawn from the sample container periodically. Initially, effluent characteristics viz., pH, Total Dissolved Solids (TDS), COD, BOD, Total Suspended Solids (TSS), N, P and chromium were determined in the collected raw tannery waste water following the procedure given in Standard Analytical Procedures for Water Analysis, 2003.

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After characterisation the tannery effluents were treated with activated carbon adsorbent in order to reduce the chemical oxygen demand (COD). The commercially available activated carbon of size 20X50 mesh is used throughout this study. Initially the batch experiments were conducted by applying varying dosage of the adsorbents such as 0.2, 0.4, 0.6, 0.8 & 1g to 1 litre of the tannery wastewater in separate glass beakers. Then the wastewater in the beakers was kept under mixing paddles till the maximum reaction period. During this period, the intermediate samples were also collected at particular time intervals(20, 40, 60, 80 & 100 minutes) and the COD of them were determined. From the results the optimum dosage of adsorbent and time duration for the maximum COD removal of tannery wastewater was identified. In order to determine the COD removal efficiency with the effect of pH, set of experiments were also conducted with varying pH values (2, 4, 6, 8, 10 & 12). Only the optimised dosage and time duration was used for varying pH experiments. Finally the suitable pH condition for the maximum COD removal was identified.

III.RESULTS AND DISCUSSION

The characteristics of the tannery wastewater collected was found as: COD – 7450 mg/L; BOD – 2660 mg/L; TDS – 6120 mg/L; TSS – 2370 mg/L; pH – 7.9; N – 135 mg/L; P – 21 mg/L, and chromium 68 mg/L. The COD removal efficiency of the different adsorbent dosages at different time intervals was given in table-1.

Duration in minutes	% of COD removal for varying adsorbent dosages				
	0.2g/L	0.4g/L	0.6g/L	0.8g/L	1g/L
20	14.6	33.2	34.6	22.1	21.4
40	22.8	30.8	39.6	23.4	22.3
60	23.8	61.2	45.3	21.3	32.3
80	22.4	59.3	57.8	32.4	34.2
100	21.2	60.4	58.3	34.7	31.9
120	22.5	54.7	56.1	36.5	32.8

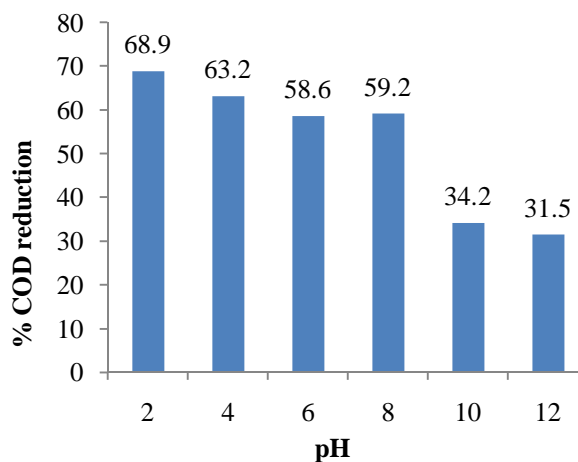
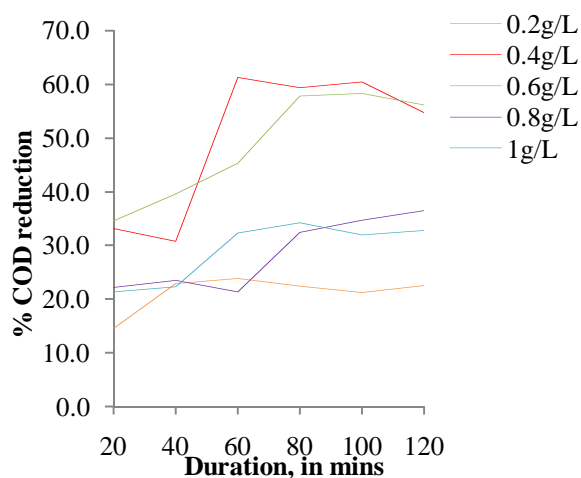


Figure-1: COD reduction percentage for different dosages of activated carbon with respect to time.

Figure-2: COD reduction percentage for different pH with 0.4g/L dosage of activated carbon.

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From the experiments it was identified that there was no significant change in the COD reduction after 120 minutes time duration. The figure-1 shows the kinetics of the COD removal at different time duration by various dosages. For the dosage of 0.2g/L, it shows that the percentage removal of COD gradually increases and the maximum 23.8 % was attained at 60 minutes, and then there was no significant change. While treating with dosage of 0.4g/L, the maximum COD removal 61.2% was attained at 60 minutes and finally there was decrease in COD reduction when the time increases. The reaction kinetics of dosage 0.6g/L shows that the maximum was obtained at 100 minutes duration with COD removal of 58.3%. The dosage of 0.8g/L & 1g/L shows poor results in terms of COD reduction. The graph shows that both the reaction kinetics is unstable.

The optimum dosage of the activated carbon to achieve the maximum COD removal was identified as 0.4g/L from the figure-1 and the contact time of 60 minutes was also identified. In order to increase the COD removal efficiency, the experiments were conducted under varying adjusted pH values (2, 4, 6, 8, 10 & 12) with optimized dosage and contact time. From the results it was identified that the increase in pH value shows poor COD reduction. The wastewater contains lower pH values shows good result when compared to alkaline condition. And finally, a maximum of 68.9% COD reduction at pH 2-3 range was found from the figure-2.

IV. CONCLUSION

From the results it was identified that the treatment of tannery wastewater for the maximum COD reduction 61.2% was obtained for the dosage of 0.4g/L. The other dosages shows poor result and unstable. The suitable pH condition was identified as the range of 2-3. From the results it was concluded that as per various studies the adsorbents are good for heavy metal removals. But it shows some lag in the reduction of COD. Hence the adsorbents can be used only with combined treatment process for the purpose of reducing the load to next steps by heavy metals removal.

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