Preliminary Research on the Removal of Organic Compounds from Leather Tanning Wastewater

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Abstract Leather tanning consists of many processes, most of which are carried out using water, in which variety of chemical compounds, mineral tannins (including chromium (III) salts) and vegetable tannins, dyes etc. are added. In combination with organic matter of animal origin it results in wastewater that is very difficult to treat. Coagulation and advanced oxidation processes are commonly used methods for the treatment of tannery wastewater.

The aim of this study was to pretreat tannery wastewater by removing organic compounds determined by COD. For their treatment, a coagulation process using iron ($FeCl_3$) and aluminium ($Al_2(OH)_5Cl$) coagulants and advanced oxidation processes (AOPs) used of Fenton reagents were applied. Studies using the Fenton process were conducted applying different doses of iron (VI) sulphate (II) $FeSO_4$ with a constant hydrogen peroxide H_2O_2 dose of 3000 mg/L. The type and the dose of the coagulant were the basic parameters of the coagulation process subject to optimization. Doses in the range of 1.0 - 6.5 mL/L were adopted. An even better reduction of organic compounds was obtained in a hybrid system: Fenton reaction and coagulation. In that case, the COD value in the pretreated wastewater was 4010 mg/L.

1. Introduction

Leather tanning consists of a number of mechanical and chemical steps, which can be divided into three basic sub-processes: preparatory steps (the wet workshop operation), tanning proper and leather finishing [1]. Tanning is the process that transforms the protein of raw leather into a stable material [1]. Mineral compounds are most commonly used as tanning agents, in particular chromium (III) salts. Alternatively, tannins of vegetable origin, e.g. coffee bean husks, are used. Coagulation and advanced oxidation processes are commonly used methods for the treatment of tannery wastewater.

2. Materials and Methods

Wastewater from leather tanning plant was tested. The raw wastewater was characterized by a pH value 4.1, black colour, COD of 14 000 mg/L, total suspended solids 2735 mg/L and dissolved matter 15 500 mg/L. The analysis of wastewater parameters was made according to standard methods. The experiment was divided into two main stages that would cover the following analytical tasks:

1) coagulation process using coagulants: PIX 111, PAX XL 19-F and PIX 113;
2) advanced oxidation process using Fenton reaction.

Coagulant doses with the range 1-6.5 mL/L were used in the process. The destabilization time was 1 minute, flocculation time was 15 minutes and sedimentation time was 30 minutes.

Tests, using the Fenton process, were carried out using different doses of iron (VI) sulphate $FeSO_4$ in the range of 300 - 2000 mg/L with a fixed dose of hydrogen peroxide H_2O_2 of 3000 mg/L. The oxidation process was carried out for 1 and 2 hours, the stirring speed during the oxidation was 50 rpm.

For this tannery, the required COD value in the treated effluent discharged to the sewer was 5000 mg/L.

3. Results

3.1. Coagulation process

COD removal efficiency using coagulation is shown in Figure 1.

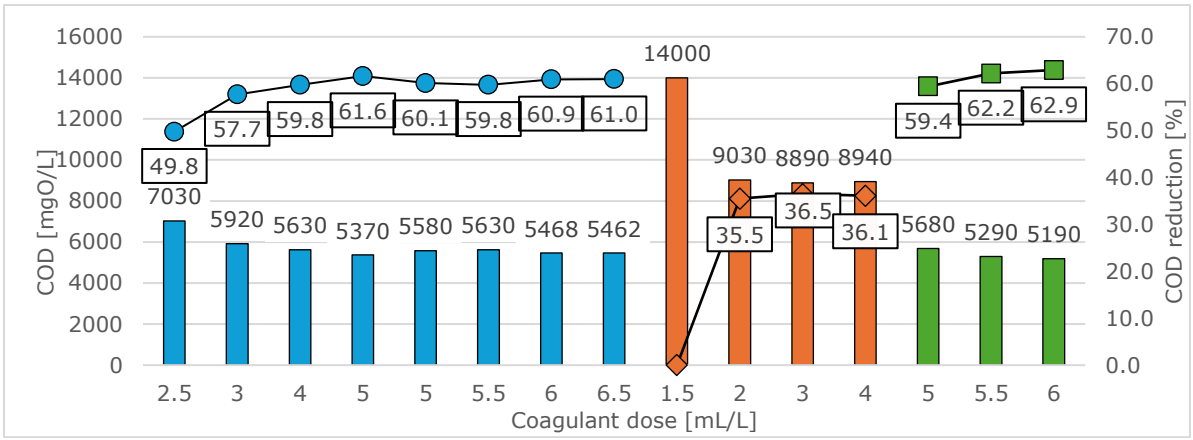

Fig.1 Efficiency of COD removal from tannery wastewater using a coagulation (PIX111, PAX XL19F, PIX 113)

3.2. Fenton process

COD removal efficiency using Fenton process is shown in Figure 2.

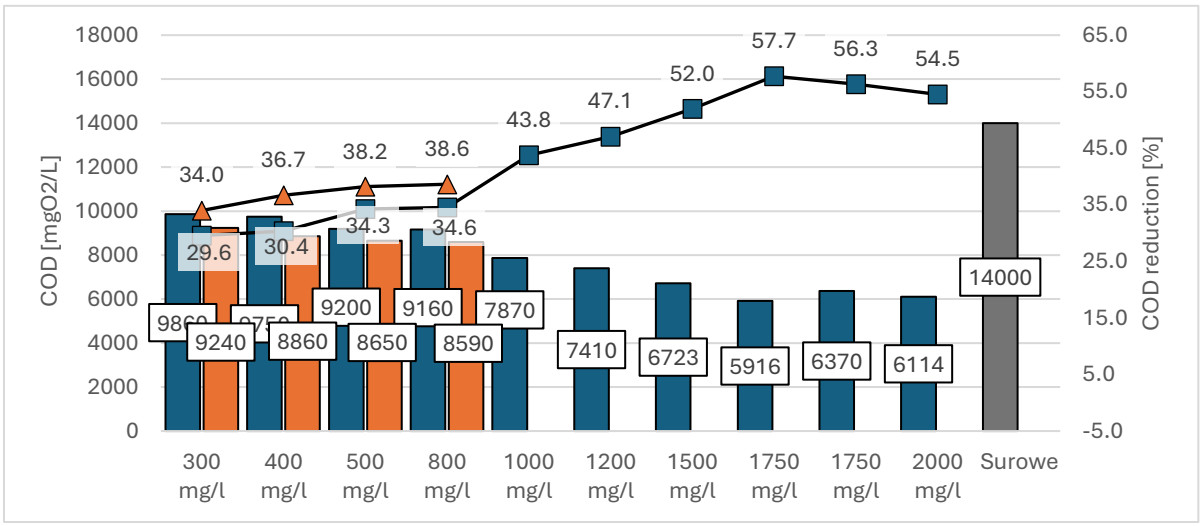

Fig.2 Efficiency of COD removal from tannery wastewater using Fenton process

4. Conclusion

The study concluded that it is not possible to achieve the contractually required COD value in the pretreated effluent (less than 5000 mgO_2/L) by running unit processes such as the Fenton process or coagulation.

The required efficiency of organic compound removal from wastewater can only be achieved by combining the unit processes into hybrid systems.

Reference

1. Famielec, S., & Wieczorek-Ciurowa, K. (2011). Waste from leather industry. Threats to the environment. *Czasopismo Techniczne. Chemia*, *108*, 43-48.