Study of the electrocoagulation process applied to real effluent from the metalmecanics industry

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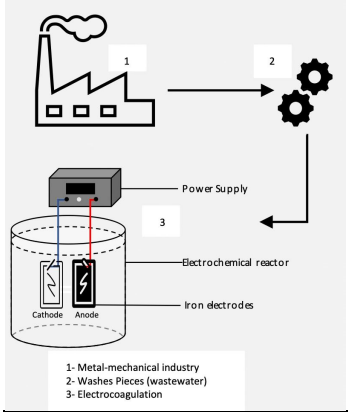


The electrocoagulation treatment process was applied to the treatment of effluent from washing parts in the metal-mechanical industry, due to the fact that this effluent has high conductivity, which would facilitate the electron transfer process, without the need to add electrolyte. Electrocoagulation applied to the effluent was carried out using Fe electrodes (cathode/anode). The results obtained showed that the current applied in the process affects both the conductivity and the removal of COD from the effluent; For toxicity analysis, the three variables (current, pH and time) together with their interactions affect the reduction of the toxicity of the medium for the *Artemia salina* organism. Thus, the present study made it possible to visualize the potential application of electrocoagulation in this industrial effluent as a primary treatment, thus it is suggested that a secondary treatment be used subsequently, focused on reducing electrical conductivity, since this parameter was not removed by the process.

Introduction

Improperly disposed liquid effluents can influence a wide range of interactions in the environment, resulting in chemical, physical, and biological alterations observed on various scales when considering the historical context of industrial evolution, typically located around or near water [1]. The metalworking industry, like all industries, generates large volumes of solid and liquid waste in the manufacturing process of it's parts. In the case of wastewater, although it's produced in smaller quantities compared to other industrial sectors such as textiles, has a high load of contaminants such as metals, hydroxide, surfactants, among others.

The effluent generated in the washing of surface preparation of mechanical parts is known for its high accumulation of oil and grease, color, conductivity and demand for chemical oxygen (COD), factors that make conventional treatment difficult. Therefore, the use of advanced technologies becomes an option to seek to minimize the presence of these contaminants.

Electrocoagulation is a methodology that uses metal electrodes in a solution conducting an electrical voltage, called sacrificial electrodes. The goal is to cause oxidation and wear, which triggers interactions in the solution and causes coagulation [2].

In this context, the objective of this work was to apply the electrocoagulation processes, using iron electrodes for the primary treatment of the industrial effluent generated by the washing process of mechanical metalworking parts in order to obtain improvements in the quality of this effluent.

Material and Methods

The effluent resulting from the parts of the cleaning process was characterized through analyzes of pH, chemical oxygen demand (COD), total and dissolved solids, electrical conductivity, and inorganic salts. (Standard Methods for the Examination of Water and Wastewater, 2012). After the electrocoagulation treatment, the following analyzes were made: color, turbidity, chemical oxygen demand (COD), electrical conductivity, sludge formed and toxicity analysis using *Artemia salina* according MEYER et al. (1982) adapted [3]. The presence of a large amount of salts in the effluent facilitated the interaction of electrical voltage in the solution, causing destabilization of the particles and favoring treatment, so an electrolyte was not added to the system. The experimental planning tool (DCCR) was used for three independent variables: time, electric current and pH. For statistical treatment, the ANOVA test was performed using Minitab 21 software.

Results and Discussion

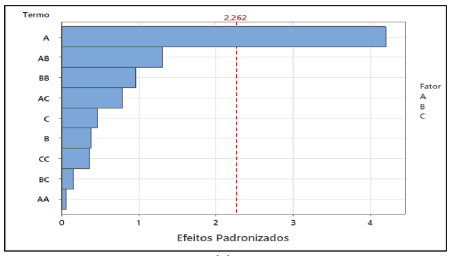
Table 1 presents the characterization of the effluent before treatment

Table 1. Physicochemical characterization of washing effluent

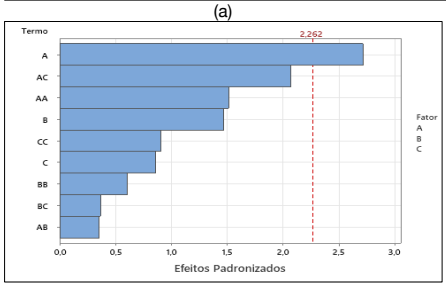
Parameter	Measure
pH	11.01
Color (mg Pt Co L^{-1})	1849.83
Electric conductivity (mS cm^{-1})	16.16
COD (mg O_2 L^{-1})	1309.24
Toxicity (%)	94.0
Oil and fat (g L^{-1})	5.8

The planning resulted in 20 tests with different combinations, 6 central points for determining the error. The results show that the effect of the applied current increases electrical conductivity, COD removal and sludge formation (Figure 1).

Figure 1. Pareto for the analysis of conductivity (a) and COD (b) in the electrocoagulation of parts washing effluent (A: current; B: pH; C: time.



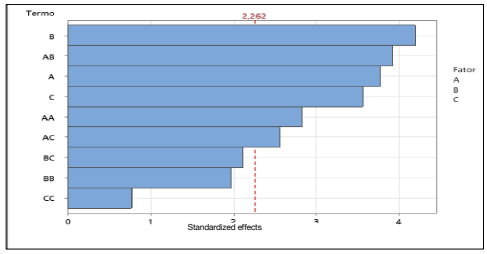
(a)



(b)

Regarding toxicity, the results demonstrated that there is a linear dependence on the three variables studied, as well as interactions between them (Figure 2).

Figure 2. Pareto for the toxicity analysis of the effluent after the electrocoagulation process using iron electrodes



The results obtained showed color removal of up to 98%, reduction in COD of up to 74% and reduction in effluent toxicity.The electrocoagulation process presented positive characteristics for the treatment of effluent, in addition to indicating an interesting potential for the reuse of this effluent in adjacent processes in the industry itself

Conclusions

The electrocoagulation process has potential for the treatment of effluent from washing parts in the metal-mechanical industry, and can be used as a pre-treatment (primary) to improve the quality of these waters, which through subsequent processes can be used in the company itself, industry, thus seeking to meet the concept of circular economy.

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References

[1] G. Giordano. Tratamento e controle de efluentes industriais. Departamento de engenharia sanitária e do meio ambiente. (2004), pp. 01-81.

[2] T. Benazzi. Otimização de um sistema de eletrofloculação em fluxo contínuo para o tratamento de efluentes líquidos da indústria de laticínios**.** Tese de doutorado. URI, 2013.

[3] B. N. Meyer, N. R. Frerrigni, J. E. Putnam, L. B. Jacobsen, D. E. Nichols, J. L. Mclaughlin. Brine Shrimp: A Convenient Geral Biosaay for Active Plant Constituents. Journal of Medicinal Plant Research, v.45, (1982), p. 31-34.