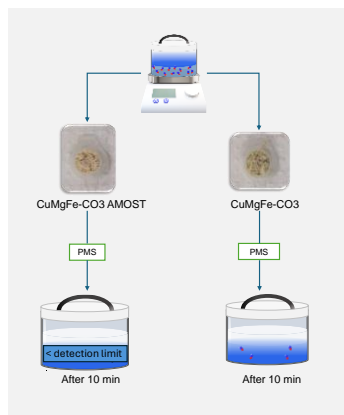


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Layered Double Hydroxides (LDHs) used as catalysts have been applied in the Fenton process for the treatment of wastewater [1]. The influence of AMOST treatment on a CuMgFe-CO₃ LDH was evaluated in the Fenton process degradation. LDH was synthesized by the coprecipitation method, however, instead of using water in the washing steps, acetone was used with the aim of improving morphology, particle dispersion and surface area. Subsequently, the instant drying process was carried out at ~ 80 °C. This procedure promoted an increase in the specific area and consequently improvement of the catalytic activity of the material [2]. Concentrations of sulfamethoxazole (SMX) were below detection limit after 10 min of reaction in water using peroxymonosulfate (PMS) as oxidizing agent and LDH AMOST, while 40% degradation were achieved after 120 min in the experiment carried out in sewage treatment plant wastewater.

Introduction

Catalysts based on Layered Double Hydroxides (LDHs) have attracted a lot of attention for application in the heterogeneous Fenton process for the treatment of wastewater [1]. Due to their interesting structural properties, such as high stability, diversity of available active sites, and easy synthesis, they have potential to remove contaminants using the Fenton process [1,2]. The application of aqueous miscible organic solvent treatment (AMOST) on the LDHs can improve the catalytic properties of these materials, which consists of using organic solvent instead of water in the washing steps after synthesis by coprecipitation. This procedure improves morphology, particle dispersion and increase specific surface area, and consequently, the catalytic activity of the material [2]. Thus, the aim of this study is to investigate the influence of AMOST treatment with acetone on CuMgFe-LDH characteristics and its activity for the degradation of the antibiotic sulfamethoxazole (SMX) in a Fenton type process using peroxymonosulfate (PMS) as oxidizing agent.

Material and Methods

CuMgFe-LDH was synthesized by the coprecipitation method at pH = 11.0 ± 0.5 according to the methodology of Costa-Serge et al. [3]. After precipitation of the material, the suspended solid was divided into two portions: 1) washed with deionized water and dried at 80 °C for 4 h; 2) washed with acetone and dried instantly at 80 °C. The materials obtained were characterized by different techniques: DRX, SEM, FTIR-ATR and BET area. The efficiency of the catalysts was tested for the degradation of 500 µg L⁻¹ SMX, using 0.5 g L⁻¹ of the LDHs and 0.25 mmol L⁻¹ PMS in deionized water or wastewater from

a sewage treatment plant effluent (STP). The decay of SMX concentration was monitored using HPLC. The iodometric spectrophotometric method was applied to determine the residual concentration of PMS during reaction [4].

Results and Discussion

LDH with and without AMOST treatment showed phase purity and crystallinity. The two catalysts presented similar X-ray diffractograms, with (003), (006), and (009) basal plane peaks corresponding to the stacking of the lamellae. It was found that the AMOST treatment increased the specific area of the LDH by 2 times (from 57.5 to 121.3 m² g⁻¹). In addition, the images obtained by SEM showed that the LDH obtained with AMOST treatment (CuMgFe-LDH AMOST) presents greater particle dispersion with less agglomerates when compared to the conventional synthesized LDH (CuMgFe-CO₃).

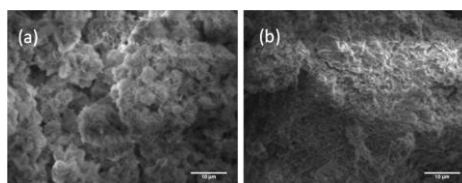


Figure 1. (a) SEM of LDH with AMOST treatment, (b) SEM of LDH without AMOST treatment.

The comparison of SMX degradation in water with both materials showed a strong beneficial effect of AMOST treatment on the catalytic activity of CuMgFe-CO₃, achieving 99% SMX degradation after 5 min, while only 38% were achieved using LDH without AMOST treatment after the same time, much

higher than that obtained by direct oxidation with PMS alone (9% removal after 5 min and 70% after 120 min) (Fig. 1a). Considering the different specific areas of both materials, the amount of SMX degraded per area of each material was calculated. The normalized results by the area showed that the increase in area provided by the AMOST treatment was decisive for the degradation efficiency, since the results showed similar degradation of $0.82 \times 10^{-5} \text{ g m}^{-2}$ and $1.0 \times 10^{-5} \text{ g m}^{-2}$ for the LDH with and without the AMOST treatment, respectively. Thus, it is possible to confirm the positive effect of this treatment, in which acetone replaces water in the interlayer space and is removed by instant drying, which reduces particle agglomeration, consequently improving catalytic properties. The experiments carried out in wastewater from a Sewage Treatment Plant (STP) with LDH AMOST using the same conditions resulted in 40% SMX degradation after 120 min, denoting a strong matrix effect, as other species compete for the oxidizing agent, in addition of radical scavengers probably present (Fig. 2b).

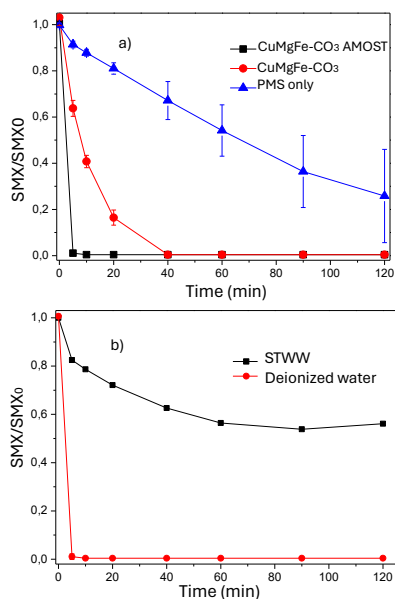


Figure 2. (a) Influence of AMOST treatment on catalytic activity of LDH for SMX degradation (b) and comparison of LDH with AMOST in the removal of SMX in STWW and in deionized water. Conditions: $500 \mu\text{g L}^{-1}$ SMX; $0,5 \text{ g L}^{-1}$ LDH; $0,25 \text{ mmol L}^{-1}$ PMS, in the dark.



Conclusions

The AMOST treatment promotes a significant effect on CuMgFe-CO₃-LDH resulting in an increase of specific area and a lower particle agglomeration that contributed to accelerate SMX degradation. The AMOST treatment promoted 99% SMX degradation in 8 times shorter period when compared to the LDH without AMOST treatment, suggesting that this type of treatment can be very promising to improve the catalytic performance of LDHs.

Acknowledgments

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