Reduced Graphene Oxide Nanomaterial: Highly Efficient on Non-ionic Surfactant Removal from Water

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Abstract

The work refers to reduced graphene oxide (rGO) synthesis, characterization and its application on TX-100 surfactant removal. After adsorption, rGO/TX-100 loaded was submitted to desorption step and reused two times, reducing the process costs.

Key words: *Sufactant, nanomaterials, water purificaction.*

Introduction

Currently, one of the biggest challenges in the world is about the water quality and its distribution to the population. In this context, graphene oxide (GO) derivatives are interesting alternatives for the water purification. These nanomaterials have been extensively investigated in the last decade due to their unique properties such as high surface area. Thus, these nanomaterials have been applied in many fields such as catalysis, drug delivery and water purification.[1] Thus, the objective of this work is to synthesize the reduced GO (rGO) and to apply it as reusable adsorbents in TX-100® surfactant removal.

Results and Discussion

GO was synthesized by Hummers Method[2] and reduced by hydrazine monohydrate.[3] The synthesized rGO was characterized by several analyses, such as X-ray diffraction (XRD) and SEM (Scanning Electron Microscopy) (Figure 1).

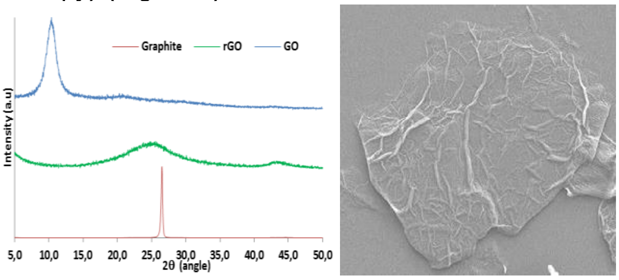

Figure 1. XRD patterns of GO, graphite and rGO in the left and SEM of rGO in the right.

The optimization of TX-100 removal tests were performed by changing the following parameters: pH, temperature, contact time, ultrasonic assistance, nanomaterial concentration and surfactant concentration, as follows:

pH variation: the best pH was 6, providing around 69% of Tx-100 removal.

Temperature: At 25º and 35 ºC, higher adsorption capacities were observed. Above these temperatures, rGO decreased the performance.

Contact Time: The time for equilibrium concentration was very short, only 25min.

Ultrasonic assistance: Sonication during 60 minutes was the best result (75% of TX-100 removal).

GO concentration: TX-100 removal increases proportionately with the increment of GO load (Figure 2).

TX-100 concentration: rGO presented a pronounced rising slope until TX-100 initial concentration of 500 mg/L, reached adsorption capacity of 1470 mg/g (Figure 3). Under more concentrated solutions, the q_e remained stable.

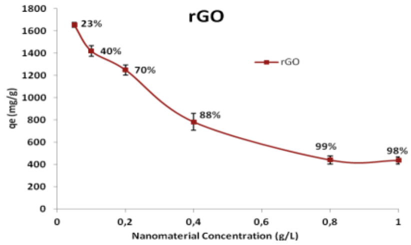

Figure 2. Variation of rGO concentration.

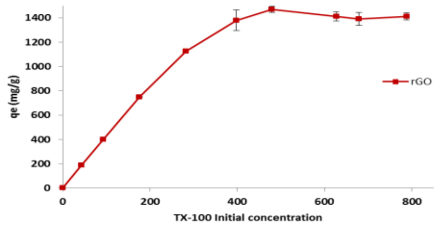

Figure 3. Variation of TX-100 concentration.

After that, the nanomaterial was reused in consecutive cycles, by a desorption process at pH of 2, 7 and 12 (Figure 4). After two cycles, the calculated removal capacities (q_e's) were around 1100 mg/g, only 13% efficiency loss per reusing cycle.

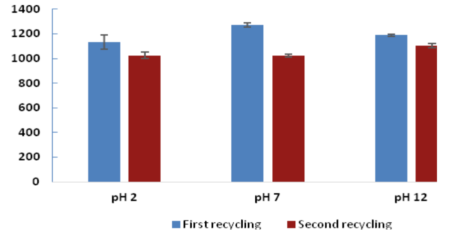

Figure 4. First and second recycling experiments.

Conclusions

In this work, rGO has been synthesized, fully characterized and applied to TX-100 surfactant removal. The results obtained showed that rGO possess higher adsorption capacities when compared with others materials.

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[2] Hummers, S. *et al. J. Am. Chem. Soc.* **1958**, *80*, 1339.
[3] Ruoff, R. S. *et. Al. Carbon*, **2007**, *45*, 1558.