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REMOVAL OF A CATIONIC SURFACTANT FROM THE WASTEWATER USING POWDERED ACTIVATED CARBON

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Introduction

Cationic surfactants is widely used in household and industrial products, namely pharmaceutical and cosmetic formulation due to its bactericidal and fungicidal properties and its relatively low toxicity to human beings.

Cationic surfactants have a toxic action on the environment, due to the attachment of their positive charge to the predominantly negatively charged particles from the sewage sludge, soil and sediments. Due to their bactericidal properties, cationic surfactants have negative influences on the environment by increasing the eutrophication of lakes or by disrupting the wastewater treatment process by reducing the microbial community and subsequently disrupting the biochemical reactions of activated sludge.

After use, cationic surfactants as well as their degradation products are mainly discharged into sewage treatment plants and dispersed into the environment through effluent.

The treatment of water polluted with surfactants using adsorbent materials, offers a better performance compared to conventional techniques. A variety of adsorbent materials such as zeolites, resins, biomaterials and clays have been developed to remove surfactants from wastewater. Activated carbon is the most suitable adsorbent for removing surfactants from wastewater. The advantage using activated carbon are that advanced treatment is possible, and it is possible to reuse the adsorbent by regeneration.

Dodecil dimethylbenzylammonium chloride (C12-BAC) is used as a disinfectant and also as a wood preservative. It is added as a germicide to household wipe and towelette cleaners.

Materials and methods

Dodecil dimethylbenzylammonium chloride (C12-BAC), the cationic surfactants, were purchased from Sigma-Aldrich, the powdered activated carbon (PAC) used were obtained from commercial sources (Merck).

The adsorption studies were performed in presence of various amounts of PAC. 200, 250, and 500 mg PAC were added to 500 mL of C12-BAC (25 mg/L). The samples were mixed at 200 rpm for 2 h. After centrifugation, the C12-BAC concentration was analyzed using disulfine blue method- DIN 38409:1989.

Results and conclusions

The removal efficiency of C12-BAC on various amounts of PAC adsorbent showed a significant effect of the removal efficiency which increased with the amount of PAC adsorbent (Figure 1).

The adsorption capacity *a* (mg/g) at equilibrium was determined experimentally and it was calculated with the following equation:

$$a = \frac{(c_i - c_e) * V}{m}$$

where C_i and C_e were the C12-BAC concentrations in the initial wastewater and at equilibrium (mg/L), m was the mass of PAC (g), V was the C12-BAC volume initially used in the study (L).

The adsorption capacity of PAC increased with the increase of PAC amount used in the experiments (Figure 2).

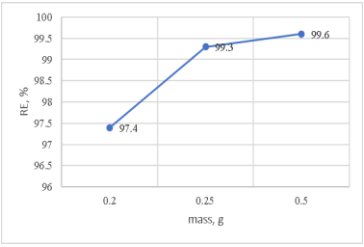

Fig.1. The removal efficiency (RE) of C12-BAC during 30 minutes on various amount of PAC (0.2, 0.25 and 0.50 g)

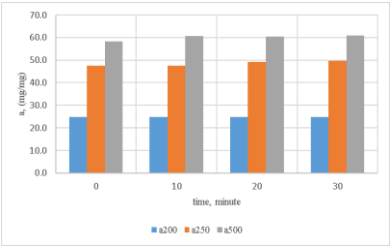

Fig.2. C12-BAC adsorption capacity by 200 mg, 250 mg and 500 mgPAC versus time (minute)

The maximum C12-BAC removal efficiency obtained was 99.6% on PAC after 30 minutes interaction. Discharges of large amounts of cationic surfactants into the environment can lead to serious health and environmental problems. Therefore, surfactants must be removed from wastewater before being discharged into surface waters. The use of powdered activated carbon (PAC) as an adsorbent and the separation of particles by centrifugation can be an effective technique for the removal of surfactants.

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