ADSORPTION REMOVAL OF ANIONIC SURFACE-ACTIVE AGENTS FROM THE WASTE FOUNTAIN SOLUTION

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Abstract

In the printing industry, surface-active agents are used in printing materials such as printing inks, adhesives and fountain solutions. In printing inks and adhesives, surface-active agents are used as anti-foams. By reducing surface tension, surface-active agents create a binder to better wet and disperse pigments during the production of printing inks [1]. Their primary role during the offset printing process is to reduce the surface tension of the fountain solutions and in such a way accommodate better wetting of the printing plate [2]. Also, surface-active agents can act as emulsifiers because they form and stimulate the production of emulsions between the fountain solution and offset printing inks and participate in the formation of printing and non-printing elements on the offset printing plate [3]. As surface-active agents are included in the emergent substances, according to the Network of reference laboratories, research centers and related organizations for monitoring of emerging environmental substances [4], it is necessary to remove them from the offset effluent and safely dispose of them in the sewage system or a natural recipient.

This paper aims to investigate the removal of the anionic surface-active agents from the waste fountain solution by using adsorption with activated carbon. The removal adsorption efficacy of anionic surface-active agents from the effluent with Norit w35 activated carbon was determined according to the standard SRPS H.Z1.149:1987 method [5] and ASTM D2330-02 method [6] by using a UV/VIS spectrophotometer (GENESYS 10S, Thermo Scientific, USA). At a wavelength of 618 nm, the initial absorbance of the starting effluent and the absorbance of the offset effluent after the adsorption treatment of the waste fountain solution with activated carbon were measured.

For the adsorption treatment, activated carbon masses of 0.375, 0.500, 0.625, and 0.750 g were selected, which corresponded to doses of 15, 20, 25, and 30 g L^{-1}, respectively. The stated masses of Norit w35 activated carbon and 25 mL of waste offset fountain solution were weighed into plastic cuvettes with a volume of 45 mL, respectively. At contact times of 5, 10, 15, 20, and 25 minutes, a mixture of a certain mass of Norit w35 and waste offset effluent was subjected to continuous mixing on a mixer (KS 501 Digital IKA-WERKE, Germany) with a mixing speed of 150 rpm.

After a given contact time, a mixture of a certain mass of Norit w35 (adsorbent) and waste offset fountain solution (adsorbate) was separated by filtration through quantitative cellulose filter paper (Macherei-Nagel, Germany). The absorbances of the filtered samples were measured spectrophotometrically at a wavelength of 618 nm.

The efficiency of adsorption removal (E) of anionic surface-active agents from the waste fountain solution with Norit w35 activated carbon was determined by using the equation:

$$E = ((A_o - A_t) / A_o)\ 100 \qquad (\%)$$

Where: E - adsorption removal efficiency of anionic surface-active agents (%), A_o - absorbance at 618 nm of anionic surface-active agents in the waste fountain solution before the adsorption treatment with Norit w35 activated carbon, and A_t - absorbance at 618 nm of anionic surface-

active agents in the waste fountain solution after the adsorption treatment with a certain dose of Norit w35 activated carbon at a certain adsorption time (t).
The obtained results of the removal of anionic surface-active agents from the waste fountain solution by using Norit w35 activated carbon show the following:

1. It is possible to remove anionic surface-active agents from a waste fountain solution **by** using Norit w35 activated carbon adsorption treatment.

2. With the increase of the dose of Norit w35 activated carbon and the time of adsorption, the efficiency of removing anionic surface-active agents from the waste fountain solution also increases.

3. From an economic point of view, it is desirable that the optimal dose and adsorption time be as low as possible.

4. The operative dose of Norit w35 activated carbon as adsorbent is 25 g L^{-1}.

5. The operative adsorption time of contact between the absorbent (activated carbon) and the adsorbate (anionic surface-active agent) is 10 minutes.

6. The adsorption removal efficiency of anionic surface-active agents from the waste fountain solution is greater than 95% for the defined operational adsorption parameters.

Therefore, the removal efficiency of anionic surface-active agents from the offset effluent of 95.5% is achieved at the adsorption time of 10 minutes, and the dose of 25 g L^{-1} of Norit w35 activated carbon.

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