STUDIES REGARDING DESORPTION OF FOOD DYE BY DIFFERENT SOLVENTS

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Abstract

In order to elucidate the interactions established between the sorbent and the sorbate desorption studies can be conducted using different polar and non-polar solvents. In the first part of the investigation 20 mg/L of food color Red No. 3 was sorbed on 1g beans hulls/50 mL solution, at room temperature. After the sorption equilibrium was reached, Sulphuric acid (0.2 M), chlorhydric acid (0.2 M), acetic acid (1 M), sodium chloride (1 M), distillate water and distillate water pH 10 (adjusted with NaOH) respectively was used to desorb the dye. Excepting the water with pH 10, where the percentage desorbed is around 17 %, desorption cycle indicated a low amount of dye released in the solution. The efficiency of the sorption-desorption process of 50 mg/L Red No. 3, in three cycles, using 50% acetone, 40% isopropanol, 40% ethanol and distillate water pH 11 (adjusted with NaOH) was conducted in order to evaluate the sorbent reutilization potential. Ethanol (84%) and isopropanol (89%) provided the higher efficiency for dye desorption. Acetone and ethanol keep a constant percentage, around 50-60%. The low amount of dye desorbed reflects a strong interaction between the agro waste surface and the dye molecules, with ion exchange interactions type.

Key words: quality indicators, refrigeration, sauces

The increased number of researched have proved that currently sorption is one of the most effective and attractive processes of dye removal from different effluents. The process is relatively inexpensive due to the possibility of applying appropriate renewable adsorbents and the recovery of the compound.

Depending on the dye used and the sites available for adsorption on the material, one or more forces will act in the adsorption process, which influences the possibility to reuse the material.

From the synthetic food colors, the coal-tar/petroleum colors, represent a special class of dyes in whose group enter Red No. 3, a xanthene dye (Apostol L.C., Gavrilescu M., 2013). Acid dye such us Red No. 3 can be lost in effluents in percentage varying from 5 to 20%.

Because of the high dye amount prezented in aqueous efluents, the environment cand be affected even at low concentrations. For the efluents decolorization physical, chemical, and biological processes were investigate. The adsorption process involves several attractive interaction forces such as van der Waals forces, hydrogen bonding, covalent, and ionic bonds (Silva F.C. *et al* 2015). In this context the desorption studies are used:

- to elucidate the nature of adsorption process and to recover the dye.
- to regenerate the sorbents so that it can be used again to adsorb the dye and develop the successful sorption process.

The most common materials used for dye removal is activated carbon. It has been extensively tested, yet relatively high costs of its operation and problems with its regeneration have restricted its large-scale application (Filipkowska U., Rodziewicz J., 2011). The studied alternative are the natural by products because of their properties: inexpensive, abundent and renewable material.

In this research beans were choose for our investigations because of its high grown and consumption East Europe. The massive amount of resulted hulls can be recovered and used as a low-cost sorbent. In order to elucidate the interactions established between the sorbent, beans hulls and the sorbate, Red No. 3, desorption studies were conducted using different organic and inorganic eluents.

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MATERIALS AND METHODS

Reagents and solvents

The acid dye used in this study, Red No. 3, the inorganic compounds (sulphuric acid, chlorhydric acid, sodium hydroxide, sodium chloride) and organic solvents (acetic acid, acetone, isopropanol, ethanol) were purchased from Sigma–Aldrich.

Sorbent

The agro waste beans hulls, obtain from a local farm, were washed several times with distilled water and dried at 40ºC. The hulls were crushed using a Retsch GM 200 laboratory mill, were sieved and classified. No other chemical or physical treatments were used prior to desorption experiments. The less 3 mm particles size of beans hulls (BH) were used in the experiments study.

Method

Bach desorption studies were conducted in an isothermal shaker (IKA KS 4000 IC) at 150 rpm for 24 h using in 250 mL Erlenmeyer flasks, containing 50 mL of Red No. 3 solution.

The sorption study was performed using 20 and 50 mg/L Red No. 3, respectively, and 1 g sorbent/50 mL. After sorption the solution was removed and analyzed at 524 nm.

After each sorption cycle the sorbents were washed gently with distilled water to remove any excess of dye solution.

For the desorption test different solution were used: acids, bases and organic solvents.

Sulphuric acid (0.2 M), chlorhydric acid (0.2 M), acetic acid (1 M), sodium chloride (1 M), distillate water and distillate water pH 10 (adjusted with NaOH) was used to desorbs 20 mg/L Red No. 3; 50% acetone, 40% isopropanol, 40% ethanol and distillate water pH 11 (adjusted with NaOH), respectively was used to desorbs 50 mg L^{-1} Ery B.

Desorption efficiency was estimated using the Eq. (1):

$$D(\%) = \frac{q_0 - q_d}{q_0} * 100 \quad (1)$$

where q_o is mg of the Red No. 3 sorbet onto BH; q_d is the amount of Red No. 3 in the eluent used for dye desorption.

RESULTS AND DISCUTIONS

The preliminary study concerning the Red No. 3 desorption was conducted using distillated water as eluent. In the first part of the investigation 20 mg/L of food color Red No. 3 was sorbed on 1g bean hull/50 mL solution, at different temperature. After the equilibrium was reached desorption study was performed at the same temperature as the sorption process. As it can be seen from *figure 1* the temperature has a large influence on the desorption process. Red No. 3 is despot in high amount (0.28 mg/g) at 303 K.

For the first part of the investigation regarding the eluents affinity for dye desorption, the experiments were conducted at room temperature. Sulphuric acid (0.2 M), chlorhydric acid (0.2 M), acetic acid (1 M), sodium chloride (1 M), distillate water and distillate water pH 10 (adjusted with NaOH) respectively was used to desorb the dye. Excepting the water with pH 10, where the percentage desorbed is around 17 %, desorption cycle indicated a low amount of dye released in the solution (*figure 2*).

A second study was conducted using organic solvents. For the test of sorbents regeneration four solutions were chosen to test the efficiency of the sorption-desorption process in three cycle of dye-sorbent.

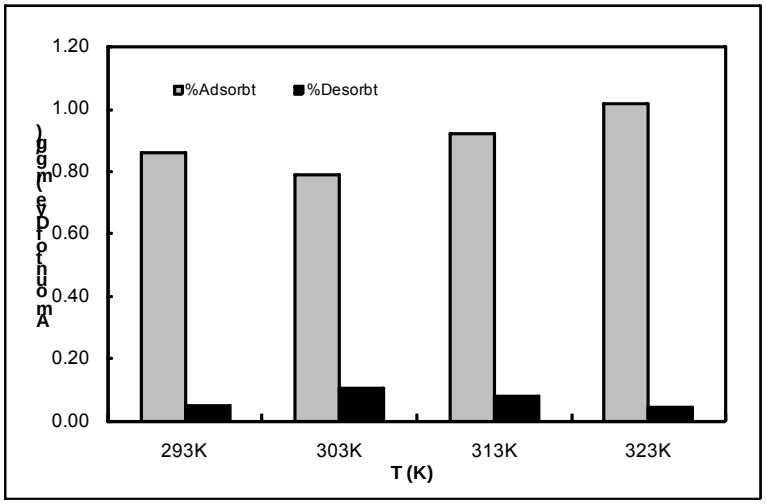

Figure 1 **Amount of Red No. 3 desorpt at different temperature**

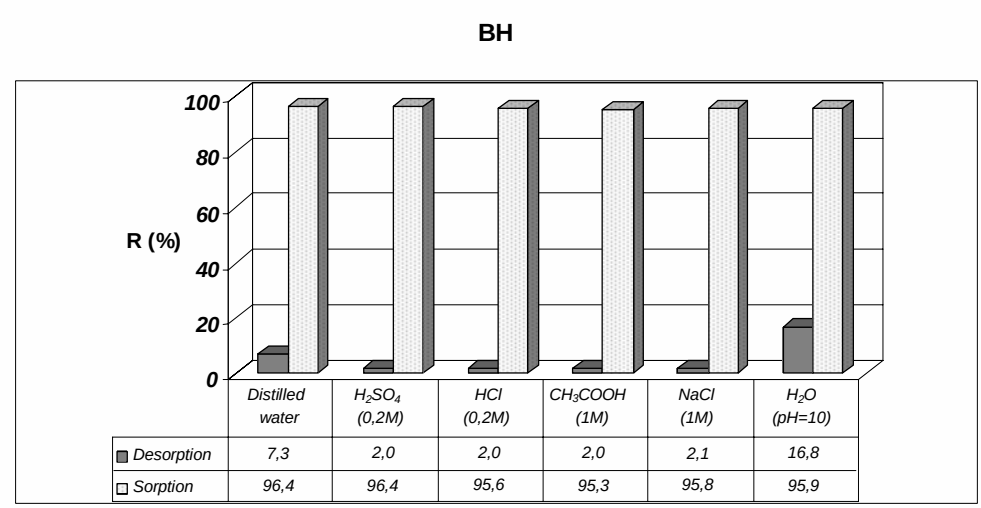

Figure 2 **Desorption percentage for different solution on Red No. 3 desorption**

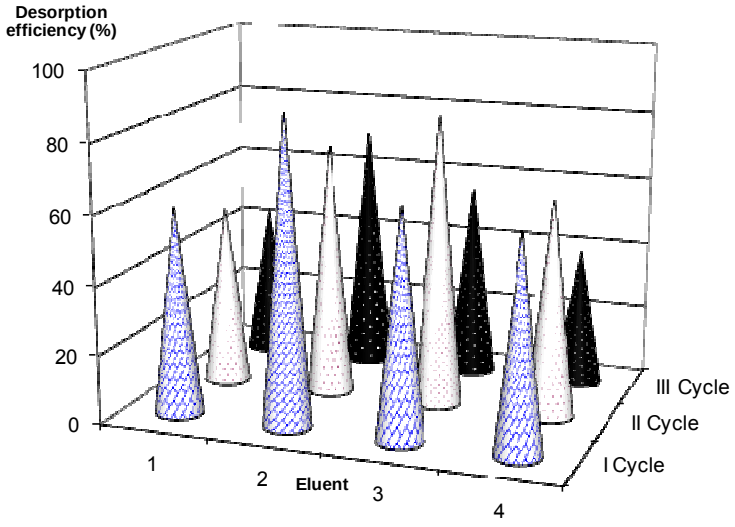

Figure 3 **Efficiency of Red No. 3 desorption using organic solution**
(1) 50% acetone; (2) 40% isopropanol; (3) 40 % ethanol; (4) H_2O pH 11 (adjusted with NaOH)

Table 1

Desorption efficincy obtained in different studies for Red No. 3

Sorbent	Desorption efficincy (%)	Reference
Pumpkin seeds hulls	72	Apostol L.C. *et al* (2016)
Chitosan coating on the surface of magnetite	85	Eser A. *et al* (2015)
Bottom Ash	94	Mittal A. *et al* (2006)
De-Oiled Soya	96	

The efficiency of the sorption-desorption process of 50 mg/L Red No. 3, in three cycles, using 50% acetone, 40% isopropanol, 40% ethanol and distillate water pH 11 (adjusted with NaOH) was conducted in order to evaluate the sorbent reutilization potential. Ethanol (84%) and isopropanol (89%) provided the higher efficiency for dye desorption. Acetone and wather- pH 11 keep a constant percentage, around 50-60% for the three cycle sorption - desoption process (*figure 3*). The low amount of dye desorbed reflects a strong interaction between the agro waste surface and the dye molecules, with ion exchange interactions type. As a comparison *table 1* presents the

desorption efficincy obtained for Red No. 3 in different studies.

CONCLUSIONS

In order to elucidate the interactions established between the sorbent, beans hulls and the sorbate, Red No. 3, desorption studies were conducted using different organic and inorganic eluents.

In the first part sulphuric acid (0.2 M), chlorhydric acid (0.2 M), acetic acid (1 M), sodium chloride (1 M), distillate water and distillate water pH 10 (adjusted with NaOH) respectively was used to desorb the dye. Excepting the water with pH 10, where the percentage desorbed was around 17 %, desorption cycle indicated a low amount of dye released in the solution.

In the case of solvents tested ethanol (84%) and isopropanol (89%) provided the higher efficiency for dye desorption. Acetone and wather-pH 11 keep a constant percentage, around 50-60% for the three cycle sorption - desoption process.

The low amount of dye desorbed reflects a strong interaction between the agro waste surface and the dye molecules, with ion exchange interactions type.

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