ADSORPTION OF NITRITE IONS ON NUT SHELLS ACTIVE CARBONS

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ABSTRACT

In the present research, nut shells active carbons have been used for adsorption of nitrite ions from water. Hydrochloric acid treatment was applied on activated carbon prepared from nut shells and the adsorption capacity of the chemically modified activated carbon (CAN-Cl) was evaluated in comparison with the untreated activated carbon (CAN).

The influence of various experimental parameters (pH value, amount of adsorbent, initial concentration and contact time) was evaluated in batch experiments. Adsorption equilibrium data were fitted to Langmuir and Freundlich isotherm models. The equilibrium data for both the untreated nut shells-based activated carbon and the chloride ions-treated activated carbon were best represented by the Langmuir isotherm. Obtained results reveal that modification of the nut shells -based activated carbon with hydrochloric acid has increased its adsorption capacity on nitrite ions from 0.05 to 2.50 mg/g (by about 50 times).

Keywords: nitrite ions, adsorption, active carbon

1. Introduction

Nitrite ion is one of the most important contaminants of aqueous environment being an indicator of natural water quality. The increasing level of nitrite in surface or ground waters results mainly from agricultural application of fertilizers as well as from many industrial processes (Boyd and Tucker,1998; Panduru-Balint *et al*., 2012; Sandu *et al*., 2013).

Concentrations of nitrite ions in surface and underground waters of the Republic of Moldova vary in a broad interval; from practically miss up to enough high values reaching 5 mg/L or more (Sandu *et al*., 2013). Currently, water treatment of underground sources is not applied in Republic of Moldova.

Reverse osmosis, ion exchange, electrodialysis, distillation and adsorption are methods that have been applied for nitrite removal from drinking water (Afkhami, 2003; Boumediene and Achour, 2004; Lin and Wu, 1996). The most efficient and commonly used adsorbent is activated carbon. In addition, it is possible to improve their adsorption properties by modification of surface chemistry.

In this study nut shells active carbons have been used for adsorption of nitrite ions from water. Hydrochloric acid treatment was applied on activated carbon prepared from nut shells and the adsorption capacity of the chemically modified activated carbon (CAN-Cl) was evaluated in comparison with the untreated activated carbon (CAN).

2. Experimental

In these studies active carbons obtained from nut shells (CAN) by the physical-chemical activation method and modified by treatment with hydrochloric acid (CAN-Cl) have been used. Particle size of carbonaceous adsorbents was between 0.8 and 1.3 mm. Prior to adsorption experiments active carbons were dried at 120 ºC for 3 h.

Adsorption of nitrite ions from water solutions onto active carbon samples was studied by batch experiments. A fixed amount of dry adsorbents (0.5 g) and 50 mL of sodium nitrite solution (10 mg/L) were placed in Erlenmeyer flasks and shaken at 150 rpm. After adsorption process the nitrite ions concentration have been determined with Griess reagent (APHA, 1999). In order to evaluate the influence of surface chemistry of carbonaceous adsorbents on adsorption process parallel experiments were done by using bidistilled water. The pH values as well as conductivity of initial and equilibrium solutions were determined by using multiparameter HI 121 (Hanna Instruments) and multiparameter C 305 (Consort).

3. Results

Kinetic studies of nitrite ions adsorption on chloride modified active carbon CAN-Cl are presented in Figures 1-3. After a period of time of about 450 min the adsorption equilibrium is achieved. This fact can be observed also on variation of pH and conductivity of equilibrium solutions, where no significant changes occur after 350 min of contact time (see Figures 2 and 3).

About 70% of nitrite ions are adsorbed on active carbon CAN-Cl in the first 120 min, then removal increase slowly (see Figure 1). Due to low adsorption capacity of untreated activated carbon (CAN), figures not shown. For nitrite ions adsorption isotherms on both active carbons the contact period was accepted as 24 h.

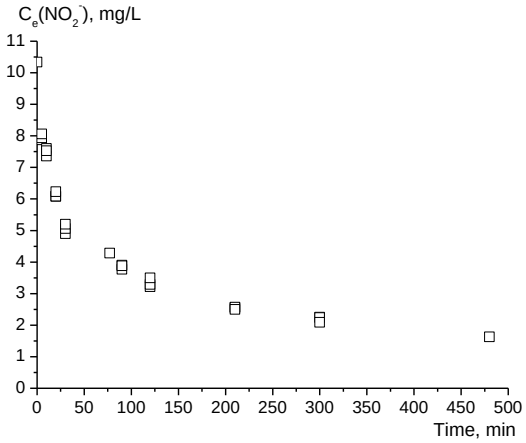

Figure 1: Kinetic of nitrite ions adsorption on modified active carbon CAN-Cl.

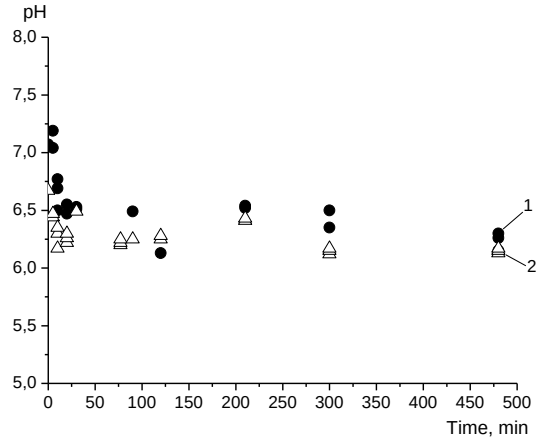

Figure 2: pH value of solutions after contact with modified active carbon CAN-Cl: (1)- bidistilled water, (2)- nitrite solution.

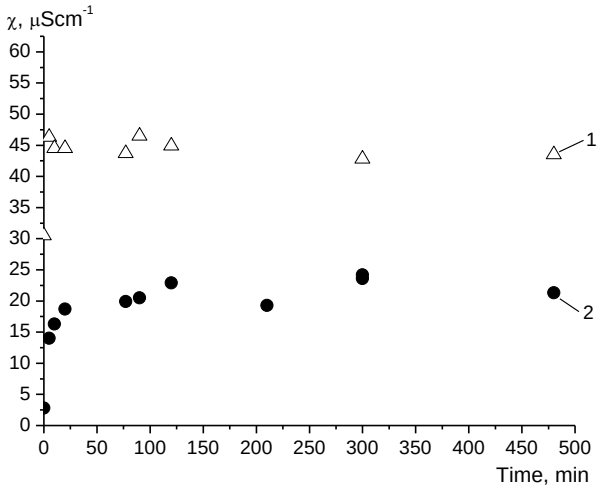

Figure 3: Conductivity value of solutions after contact with modified active carbon CAN-Cl: (1)- nitrite solution, (2)- bidistilled water.

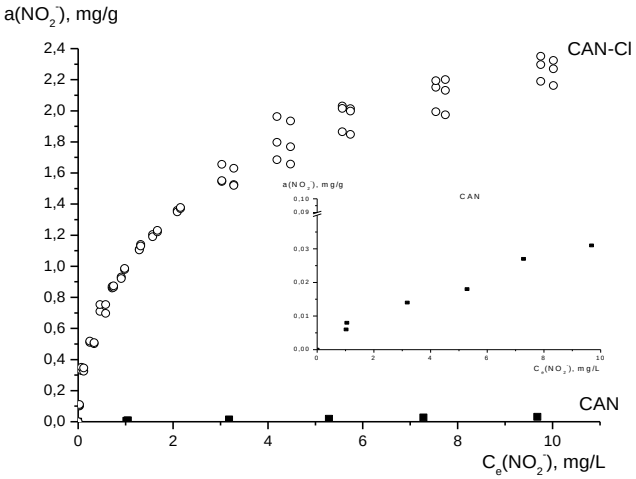

Figure 4: Nitrite ions adsorption isotherms on active carbons CAN and CAN-Cl.

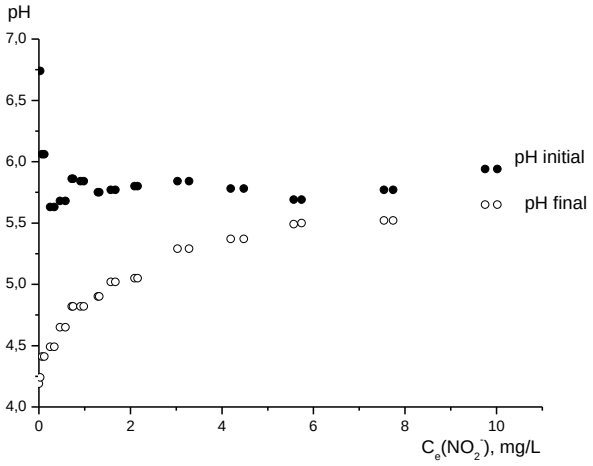

Figure 5: pH value of nitrite solutions, initial and equilibrium (final) solutions for adsorption isotherm on CAN-Cl.

Nitrite ions adsorption isotherms on both active carbons, CAN and CAN-Cl are presented in Figure 4. Modification of surface chemistry of CAN with hydrochloric acid has increased adsorption capacity on nitrite ions from 0.05 to 2.5 mg/g (by about 50 times). Adsorption process of nitrite ions on nut shells active carbons is pH dependent (Figure 5).
Adsorption equilibrium data were fitted to Langmuir and Freundlich isotherm models. The equilibrium data for both the untreated nut shells-based activated carbon and the chloride ions-treated activated carbon were best represented by the Langmuir isotherm.

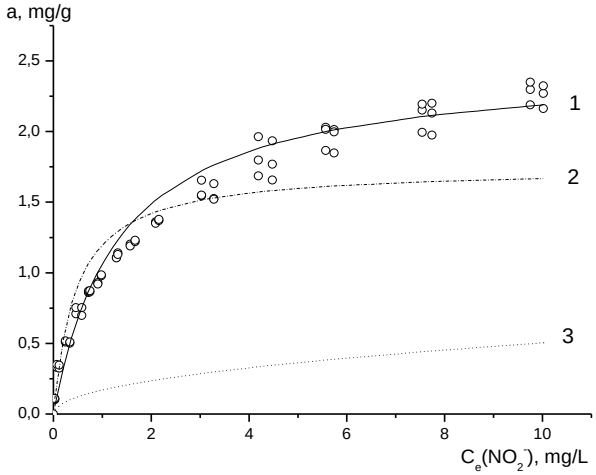

Figure 6: Experimental data isotherm models of adsorption of nitrite ions on modified active carbon CAN-Cl. (1)- Langmuir 1; (2)- Langmuir 2; (3)- Freundlich.

4. Conclusions

Modification of surface chemistry of CAN with hydrochloric acid has increased adsorption capacity on nitrite ions from 0.05 to 2.5 mg/g (by about 50 times). Adsorption equilibrium data were fitted to Langmuir and Freundlich isotherm models. The equilibrium data for both the untreated nut shells-based activated carbon and the chloride ions-treated activated carbon were best represented by the Langmuir isotherm.

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