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ADSORBȚIA BACTERIILOR BACILLUS CEREUS, BACILLUS SUBTILIS ȘI PSEUDOMONAS FLUORESCENS ÎN DIFERITE CONDIȚII FIZICO-CHIMICE PE CĂRBUNI ACTIVI OBTINUȚI DIN COJI DE CAISE

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Rezumat: *Articolul prezintă date despre proprietățile de adsorbție ale cărbunelui activ obținut din coji de caise în strat fluidizat față de bacteriile Bacillus cereus, Bacillus subtilis și Pseudomonas fluorescens la diferite condiții fizico-chimice. A fost stabilită valoarea maximă a adsorbției (McF*10^8/g) a bacteriilor pe adsorbanții carbonici la temperaturile 27ºC și 37ºC la timpul de contact de 30-120 minute între faze. De asemenea, s-au stabilit valori de adsorbție la pH acid -1,9 pentru toate bacteriile testate.*
Cuvinte-cheie: *cărbune activ, bacterii, adsorbție, condiții fizico-chimice.*

ADSORPTION OF BACILLUS CEREUS, BACILLUS SUBTILIS AND PSEUDOMONAS FLUORESCENS BACTERIA AT DIFFERENT PHYSICO-CHEMICAL CONDITIONS ON ACTIVATED CHARCOAL OBTAINED FROM APRICOT HUSKS

Summary: *The article presents data on the adsorption properties of activated charcoal obtained from apricot peels in a fluidized layer against the bacteria Bacillus cereus, Bacillus subtilis and Pseudomonas fluorescens under different physico-chemical conditions. The maximum value of adsorption (McF * 10^8/g) of bacteria on carbon adsorbents was set at 27ºC and 37ºC at the contact time of 30-120 minutes between phases. Acid pH adsorption values were also set at -1.9 for all bacteria tested.*
Keywords: *activated carbon, bacteria, adsorption, physicochemical conditions.*

Introduction

The pollution with microrganisms is a dangerous condition of the water and solving this situation is very beneficial to human and animal health. Adsorption is often used at the end of a treatment sequence for pollution control due to a high degree of purification that can be achieved. Activated carbon is one the most used adsorbent for this kind of application and is favored for water supplies because adsorbs a wide range of microorganisms [1]. This material can be obtained from different vegetal sources with its adsorptive properties mainly influenced by the porous, surface area and chemical structure of the surface. Granular activated carbon has an extremely large amount of adsorption surface area, that offers an exceptional ability to adsorb many kinds of materials on to its surface.

The present study was conducted to test the ability of activated charcoal obtained from apricot husks to adsorb bacteria from gram-positive and gram-negative groups at different physico-chemical conditions.

Materials and methods

For the evaluating of the bacterial adsoption properties of the activated carbons the bacteria from 3 different species (*Bacillus cereus, Bacillus subtilis* and *Pseudomonas fluorescens*) were cultivated on peptone agar solid medium. Subsequently were prepared 3 different bacterial sollutions with the intial optical densities of 1,5 after McFarland. It was made the dillution of the tested bacteria in 10 different flasks, so in the end it were obtained 10 solutions with different concentrations of bacteria, so that the calibration curve was possible to be established. In each solution was put the same amount of activated carbon-100 mg. The contact time of carbon and bacteria varied from 30-120 min. The experiments were performed at 2 different temperatures (27 and 37ºC degrees) and at the acid pH of 1.9. After each measurement the adsorption isotherms for each selected bacteria were established.

Results and conclusions

The activated carbons used have a specific area of about 1500 m^2/g and a total sorption volume of the pores equal to 1,05 cm^3/g. The study of the kinetics of the adsorption processes of the bacteria within the above mentioned species showed that the value of the maximum adsorption of the bacteria is established within 2-2,5 hours, depending of the bacteria used in the sorption.

After 2-2,5 hours of mechanical stirring, the concentration of bacteria begins to increase exponentially. After 12-13,5 hours of contact, the concentration of bacteria increases so rapidly that the bacteria coagulate forming microfuges in solution. The obtained results allow us to conclude that the bacteria in the first 2-2,5 hours are adsorbed in the macropores of the activated carbon.

After the saturation of the macropores, the activated carbon has the role of mechanical surface, which allows the rapid multiplication of bacteria. This fact is also confirmed by the research results, which are related to the study of the behavior of bacteria when stirring in aqueous solutions in the absence of activated carbon, especially the linear decrease in the concentration of bacteria depending on the contact time.

The influence of temperature on the adsorption processes of different species of bacteria on activated carbons obtained from plant sources was studied. The adsorption processes were studied at 27ºC and 37ºC temperatures. The results are presented below.

Table 1. The maximum value of adsorption of different species of bacteria on activated carbon at different temperatures, determined according to the stirring time

Bacterial species	The maximum value of the adsorption of bacteria on carbon adsorbents at the temperature of 27ºC established at different contact time between phases (McF*10^8/g)				The maximum value of the adsorption of bacteria on carbon adsorbents at the temperature of 37ºC established at different contact time between phases (McF*10^8/g)			
B. cereus	30 min	60 min	90 min	120 min	30 min	60 min	90 min	120 min
	0,225	0,330	0,450	0,46	0,075	0,100	0,145	0,165
Ps. fluorescens	0,290	0,555	0,560	0,660	0,300	0,540	0,560	0,625
B.subtilis	0,325	0,375	0,385	0,460	0,225	0,250	0,260	0,275

The analysis of the results presented in the table allow us to conclude that temperature influences the adsorption process differently. With the increase of the temperature by 10ºC the value of adsorption for the bacterial species *B.cereus* decreases on average 3 times. In the case of *Ps.fluorescens*, the increase in temperature practically does not influence the adsorption process. Increasing the temperature in the case of *B.subtilis* species leads to a decrease of the adsorption value on average by 1.5 times.

For the evaluation of the bacterial adsorption at 1.9 acid pH was used the contact time of the carbon and bacteria from 30 to 120 min. After each measurement, the adsorption isotherms were established for each selected bacterium. The obtained results are shown in the table bellow.

The results in the table show that the adsorption process at acid pH has a specific character, the strongest adsorption being manifested for *B. subtilis* bacteria at the value of 0,470 McF*10^8/g at the contact time of 120 min.

Table 2. The maximum value of the adsorption of bacteria on carbon adsorbents at acid pH 1,97

Bacterial species	The maximum value of the adsorption of bacteria on carbon adsorbents at acid pH 1,97 (McF*10^8/g)			
B.cereus	30 min	60 min	90 min	120 min
	0,095	0,112	0,19	0,26
Ps.fluorescens	0,075	0,14	0,17	0,20
B.subtilis	0,330	0,340	0,450	0,470

Conclusions

1.Temperature specifically influences the adsorption process of bacteria on activated carbon. In the case of *Ps. fluorescens* temperature practically does not influence the adsorption process, while in the case of *B.subtilis* and *B.cereus* the increase in temperature leads to a decrease in the value of adsorption of bacteria on charcoal of vegetal origin.

2. The results in the table show that the adsorption process at acid pH of 1.9 has also a specific character, the strongest adsorption being manifested for *B. subtilis* bacteria.

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Reference

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