

## **POSSIBILITY OF ELIMINATION OF ORGANIC MATERIAL TYPE HUMIC ADSORPTION ON DIFFERENT MATERIALS OF A WATER SURFACE AREA OF BEJAIA**

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### **1. INTRODUCTION**

In surface water to be processed, and distributed for consumption potabilisées, organic matter is a constituent feature of their physico-chemical quality. It can result from degradation of plant and animal products and human activities and emissions. Organic compounds of natural origin comprise the majority of the organic load of these waters. Among these compounds, we find humic substances (major fraction of natural organic matter) that are the subject of special attention in the field of water treatment due to their potential to form halogenated organic compounds are often toxic (mutagenic and carcinogenic effects) (Meier, 1988; and Guergazi Achour, 2002). It must be disposed of to meet the water quality required by regulations (Khirani, 2007).

Several treatment processes have been aimed at elimination of organic matter which adsorption can significantly contribute to the elimination of dissolved organic compounds, or even semi-colloid. The adsorbent materials may then take place at two levels, during the clarification phase or as polishing treatment, in filter beds before the disinfection phase, the end of treatment before distribution.

The main adsorbents used in water treatment are porous materials such as activated carbon, activated alumina, clays, and certain synthetic resins.

The objective of our work is to contribute to the study of the adsorption of organic matter of humic type surface water of the dam is Kherrata Bejaia and test its effectiveness on both materials porous adsorbents activated carbon powder and grain and a raw bentonite from deposits of Mostaganem and Maghnia. To achieve our goal, the first step of our experimental tests was conducted to follow the adsorption kinetics of organic matter (humic substances natural) water dam Kherrata. The second stage of testing focused on the effect of reaction parameters such as the change in mass of adsorbent and influence of the initial concentration of humic substance on yields of elimination.

### **2. EXPERIMENTAL PROCEDURE**

#### **2.1. Description of tests adsorptions**

The adsorption tests were performed in static reactor by adopting different operating conditions. The elimination kinetics of humic substance on activated carbon and bentonite are performed on water solutions of dam which we add 20 mg of adsorbent for a liter of water dam. The solutions were stirred for 4 hours of electromagnetic stirring, then centrifuged at 3000 rev / min for 60 minutes.

The evolution of removal efficiency of humic substances is followed by the parameter  $R (\%) = 100 \cdot (C_0 - C) / C_0$ ,  $C_0$  is the initial concentration of humic substance (mg / l) and  $C$  is the residual concentration of humic substance in solution (mg / l).

#### **2.2. Characteristic of adsorbents**

##### **2.2.1. Characteristic of Active Carbon**

Granular activated carbon

- Product used: Darco, Aldrich product.
- Grain size: 12-20 mesh (0.3 to 0.5 mm), pH: acid.
- Specific surface area: 550 m<sup>2</sup> / g.

Powdered activated carbon

- Product used: the chemical laboratory Riedel-de Haen.
- Grain size of 20 microns; mesoporous.

- Specific surface area: 658 m<sup>2</sup> / g.

### 2.2.2. Characteristic of bentonite

The characteristics of bentonite and Mostaganem Maghnia presented in Tables 1 and 2 are determined by the laboratory ENOF (1997) and show that the bentonite is a clay Mostaganem calcium at alkaline pH. While bentonite is a clay Maghnia sodium at acidic pH

**Table 1: Physico-chemical characteristics of bentonite Mostaganem**

Specific surface area (m <sup>2</sup> /g)	pH	Exchangeable cations (méq/100g)		
		Ca <sup>+2</sup>	Mg <sup>+2</sup>	Na <sup>+</sup>
65	9,0	43,6	4,8	25,2

**Table 2: Physico-chemical characteristics of bentonite Maghnia**

Specific surface area (m <sup>2</sup> /g)	pH	Exchangeable cations (méq/100g)		
		Ca <sup>+2</sup>	Mg <sup>+2</sup>	Na <sup>+</sup>
80	6,2	30,6	36,2	12,8

### 2.3. Characteristics of the water dam Kherrata

The main physicochemical parameters on the quality of surface water are shown in Table 3. The determination of these parameters is performed according to standard analytical methods (Rodier, 1996).

**Table 3: Physical-chemical barrier water container Kherrata**

Parameters	Values
pH	8.65
Conductivity (S / cm)	828
TAC (° F)	12
TH (° F)	24
Ca <sup>2+</sup> (mg / l)	60,8
Mg <sup>2+</sup> (mg / l)	21,12
Cl (mg / l)	59,98
SO <sub>4</sub> <sup>2-</sup> (mg / l)	240
SH (mg / l)	8,5
Oxidizability in KMnO <sub>4</sub> (mgO <sub>2</sub> / l).	5,44

### 2.4. Determination of humic substance

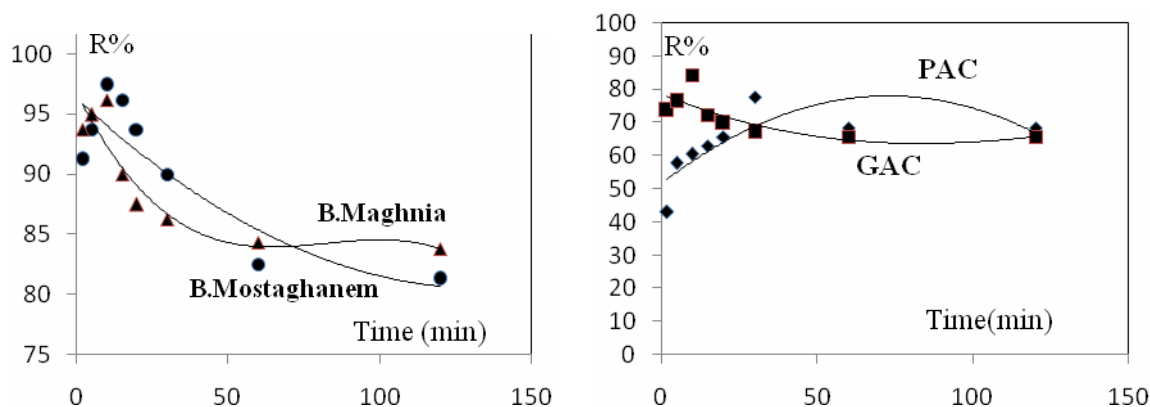
The residual concentrations of humic substance are determined from a calibration curve (absorbance (A) = f (concentration of humic substance), a wavelength  $\lambda = 254$  nm on a spectrophotometer type (Jenway 6405 UV / VIS). calibration is repeated before each test series.

## 3. RESULTS AND DISCUSSION

### 3.1. Kinetic tests of humic substance adsorption on activated carbon and bentonite of surface water

From the results presented in the curves of Figure 1, we can see that the removal efficiency of humic substances increases progressively with increasing contact time up to peak performance and then decrease. We can say that the kinetics exhibit two distinct stages. The first step is fast and corresponds to external mass transfer while the second is slow and is related to the phenomenon of diffusion (inner mass transfer). The strong adsorption of humic substance on powdered activated carbon is probably due to the pore size because the powdered activated carbon is mesoporous (Kifuani et al., 2004). This links the work of The Cloirec (1985) showing that aromatic compounds are adsorbed on the activated carbon well. Thus the results

obtained show that there is superiority in removal efficiency of humic substance by raw bentonite Mostaghanem compared with that of activated carbon and Maghnia whether powder or grain. Table 4 summarizes the maximum yields and the equilibrium time we have achieved.



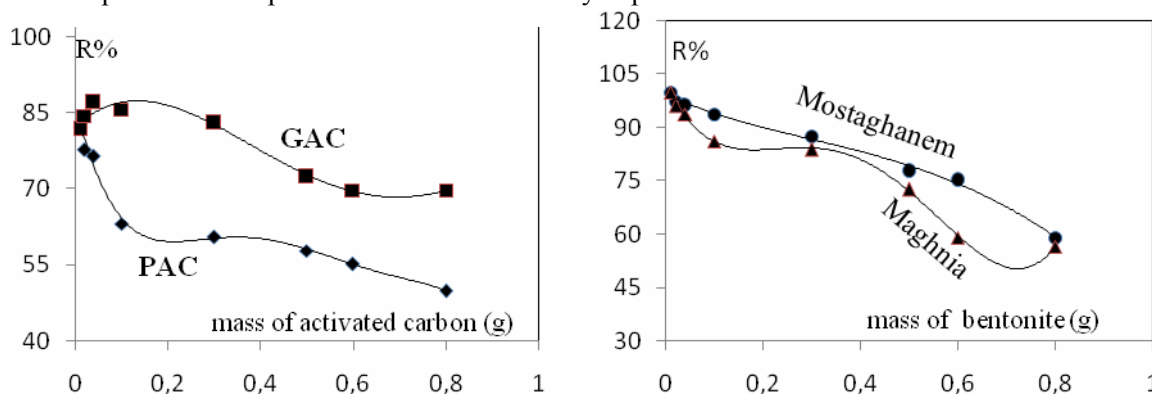
**Figure 1: Kinetics of adsorption of humic substances on activated carbon and bentonite in a raw water dam Kherrata. [CAP] = [CAG] = [Bentonite Mostaghanem] = [bentonite Maghnia] = 20 mg**

**Table 4: Yields maximum removal of organic matter (humic substance) and equilibrium time. [HS] = 8.5 mg / l [adsorbent] = 20 mg**

Adsorbent	Yield (R%)	Equilibration time (minutes)
Powdered activated carbon	77,69	30
Granular activated carbon	84,34	10
Bentonite of Maghnia	97,40	10
Bentonite of Mostaghanem	96,16	10

### 3.2. Effect of the mass of activated carbon and bentonite on the removal efficiency of humic substance in surface water (dam Kherrata)

The tests are performed on solutions containing naturally 4.64 mg / l of humic substances, the mass of activated carbon and bentonite ranges from 10 mg to 800 mg. The results appear in the balance on the curves in Figure 2. Through the results we obtained, we can say that good removal efficiency of humic substances are obtained for low mass of adsorbent ranging from 0 to 20 mg for both activated carbon powder or grain gross Mostaganem bentonite, and then they undergo a reduction accompanied by the increase in the mass of adsorbent. All our results are comparable to those obtained by Koussa et al (2004) and Yahiaoui (2010) during the adsorption of natural organic matter (humic substances) of surface water on raw bentonite and activated carbon . Given the results obtained, it is assumed that the mineral composition of water dam Kherrata tested may play an important role in the adsorption tests. The presence of large quantities of mineral compounds either promoters or inhibitors may explain the observed differences.



**Figure 2: Yields removal of humic substances on activated carbon and bentonite raw water dam Kherrata.**

### 3.3. Influence of teneure initial humic substance on the removal efficiency of humic substance tested surface water

By fixing the mass of adsorbent introduced at 20 mg, we enriched water dam Kherrata with variable contents of humic substances from 0 to 12 mg / l of sodium humate type. At equilibrium, the removal percentages obtained are presented in the curve in Figure 3.

It appears from these results that humic substances are more strongly adsorbed at concentrations between 0 and 10 mg / l. For activated carbon, the maximum yield of 92.59% is obtained for the powdered activated carbon for an initial concentration of humic substance equal to 2 mg / l. While for bentonite is obtained for the optimum bentonite Mostaganem with a yield of about 97.39% and that for 0 mg / l of humic substances added to water dam tested. It is important to note that it is likely that humic substances added to water dam Kherrata have characteristics different from those occurring naturally. So the behavior of humic substances may significantly vary depending on their chemical structure or their ability to interact with organic and inorganic matrices of their environment.

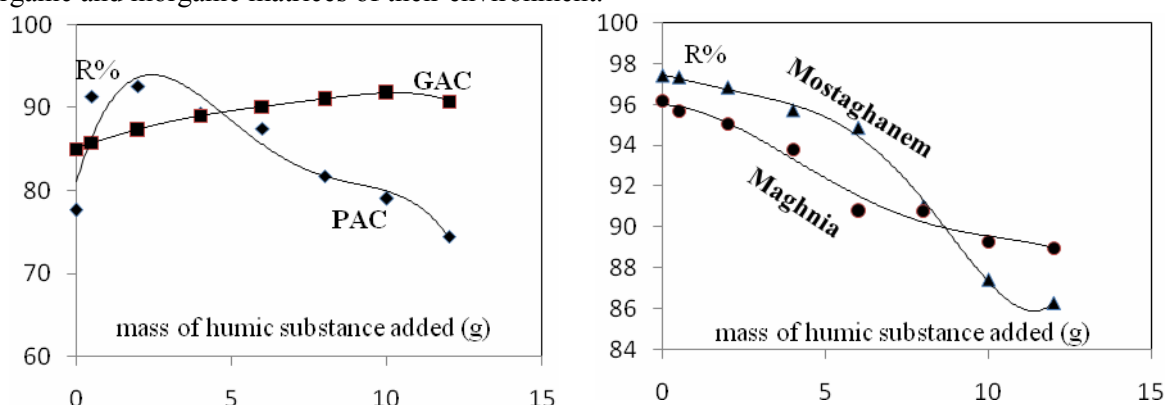


Figure 3: Effect of initial humic substance teneure on yields of humic substance removal of surface water tested.

$$[CAP] = [CAG] = [Bentonite Mostaganem] = [Bentonite Maghnia] = 20 \text{ mg}$$

### 3.4. Determination of adsorption isotherms

The operating results of each case (activated carbon and bentonite gross) by the law of Freundlich and Langmuir law are presented in Table 6. Recall that this law is expressed by (Legube, 1996):

Freundlich law:

$$q = x / m = k \cdot C_e^{1/n}$$

Where: k and n are constants characteristic.

q: The amount of compound adsorbed.

C<sub>e</sub>: Concentration of the substance remained in solution at equilibrium.

Langmuir law:

$$q = \frac{x}{m} = q_m \times \frac{b C_e}{1 + b C_e}$$

q<sub>m</sub>: is the maximum adsorption capacity (mg. g<sup>-1</sup>).

b: Constant related to the adsorption equilibrium (mg<sup>-1</sup>).

C<sub>e</sub>: the solute concentration at equilibrium.

Table 6: Constants of Freundlich for the adsorbents (activated carbon and bentonite gross)

Adsorbent	Freundlich		Correlation coefficient	Langmuir		Correlation coefficient
	n	k		q <sub>m</sub> (mg/g)	b (mg <sup>-1</sup> )	
Powdered activated carbon	4,21	525,65	0,978	833,33	1,71	0,977

Granular activated carbon	0,21	119,12	0,991	166,66	0,50	0,973
Bentonite of Maghnia	3,59	674,52	0,960	909,09	3,66	0,994
Bentonite of Mostaghanem	2,63	627,48	0,986	909,09	2,20	0,979

With respect to the isotherms (Table 6), obtaining good correlation coefficients in the linearization law can assert on the one hand, the Freundlich equation can adequately describe the adsorption of humic substances of natural surface water regardless of the nature of the adsorbent that we tested and that the retention of humic substances obeys an adsorption phenomenon.

#### 4. CONCLUSION

The objective of this study is to contribute to the study of the adsorption of organic matter like humus found naturally in a water dam Kherrata (Bejaia) and test its effectiveness on two porous materials adsorbents. This is the powdered activated carbon and bentonite and a gross grain from the fields of Mostaghanem and Maghnia. The results obtained showed that the adsorption kinetics were conducted in two stages. The first step is fast and corresponds to the external mass transfer, while the second step is slow and corresponds to the phase distribution of humic substance in the pores of the adsorbent either activated charcoal or bentonite. The results we have concluded that the removal percentages of humic substance are more important for raw bentonite and activated carbon powder in comparison with granular activated carbon. The variation of the initial concentration of humic substance affects the yields for both the activated carbon as bentonite that humic substances added to water dam have characteristics different from those occurring naturally. The efficiency of these adsorbents and the increase in adsorption capacity have been evident through the use of Freundlich isotherms and Langmuir.

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