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THE POSSIBILITIES OF PRACTICAL USE OF THE CLAY- HYDROXIDE SORBENTS FOR PURIFICATION OF EFFLUENTS FROM THE TEXTILE INDUSTRY

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Abstract. *In this work the research that was used for obtaining clay-hydroxide sorbents on the basis of bentonite and Mg $(OH)_2$ is presented. The investigation of the possibilities of applying the resulting products for the purification of effluents from textile industry was also carried out. Various color trade marks were inspected closely from the point of their elimination by way of sorbing the clay-hydroxide product.*

Key Words: *Clay-hydroxide sorbent, textile industry waste waters purification*

1. INTRODUCTION

Colors can be removed from textile industry wastewaters by various methods such as: oxidation (by ozone, chlorine, ClO_2); reduction (by anaerobic biological treatment, chemical reduction); adsorption (on activated carbon, zoolites and other materials); chemical coagulation and flocculation (by inorganic salts and organic polymers); and other methods (electrolysis, etc). Ozone is the most powerful means of oxidation of a thermodynamic and kinetic manner, which means great effectiveness in waste waters purification. It is very interesting fact that ozone application is completely represented in the textile industry in the USA, with 100% rate of water recycling in the technological process [1]. The pH influence on oxidation by ozone is insignificant and that is why it is favorable for the purification of used colors solution, as well as of the wastewaters obtained from rinsing. This method of oxidation is partially undesirable because it forms toxic organic chlorine compounds. Chemical reduction is used in terms of increasing the adsorption capacity of activated carbons. Azo colors can be broken by anaerobic biodegradation in order to decrease colourness of the effluent [2]. The activated carbon is the most frequent adsorbent in adsorption methods. In regards to the kind of activated carbon and the kind of color adsorption, capacities are of a wide range: for acid color 83 mg/g and for alkaline color 385 mg/g [3]. There is need for activated carbon to be replaced with cheaper

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natural adsorbents (natural alum silicates, tree bark, peat, etc). It is confirmed that the molecules of colors in the process of coagulation and flocculation can bind to particles of ferro oxide and aluminum and they also coagulate and precipitate in the solid phase in conventional wastewaters purification in the textile industry [4].

2. METHODS OF EXPERIMENTAL RESEARCH

This paper analyses the existing methods for color removal from textile industry waste waters based on obtainable data and it experimentally shows the further possibilities for a more effective removal [1,2,3,4,5]. The experiment was realized in such a way that Mg $(OH)_2$ was obtained by sedimentation of a 1 M $Mg(SO_4)$ solution and a 1M NaOH solution up to a pH of 12-12,5. Bentonite was added to the sediment. The sorbing properties of Mg $(OH)_2$ with a 5%, 10% and 15% content of bentonite were studied. The used colors acidsulfonic blue, CHLORANTINLICHAT BLAU 3RLL, indigo carmin, methyl blue and methyl violet are applied in the textile industry. The research was carried out by continual mixing. The liquid and solid phases were separated by centrifuging. The efficiency of obtaining a colorless substance was examined by use of UV-VIS spectrophotometry.

3. SURVEY AND DISCUSSION OF THE RESULTS

The experiments were carried out with a clay-hydroxide sorbent with a 5% content of bentonite and various color solutions with an initial concentration of 100 mg/dm^3 for determining the necessary time for contact. The basic amount of separated color in the first 5-10 minutes and the adsorption balance were achieved after approximately 15 minutes according to table 1. A further increase in the time of contact increased the purification degree, and in some cases a desorption of colour particles was noticed, which is why the next experiments were carried out in a time of contact of 15 minutes. The experiments were carried out for the sorption capacity of Mg $(OH)_2$ with a bentonite content of 0%, 5%, 10% and 15% and a color concentration from 100 to 1000 mg/dm^3.

In the second part of table 1 the only sorption capacity of Mg $(OH)_2$ is given with a 5% content of bentonite and a purification solution with a color concentration of 100, 400 and 1000 mg/dm^3. The experimental results show that cations of methyl blue and methyl violet are kept through $Mg(OH)_2$ less than the color anions. The clay-hydroxide sorbents capacity with a 5% and 15% content of bentonite, in relation to methyl blue and methyl violet is 2 and 3,5 times bigger than the $Mg(OH)_2$ capacity, which does not contain bentonite. It would be the result of adsorption through bentonite due to the presence of a non-compensated negative charge in the montmorilonite structure which is present in bentonite and the ionic exchange process between colors and the mineral ionic exchange. According to the fact that color concentration in textile industry waste waters is not over 100 mg/dm^3, experiments for the purification of solids with that concentration were carried out using a sorbent with a 5% content of bentonite, as well as a different loss of sorbent.

Table 1. Dependence between the amount of sorbed color and time of contact and the sorption capacity of the studied examples in the final solution compared to the initial concentration

Kind of color	Time of contact (min)	Amount of sorbed color (mg/l)	Color concentration in the solution (mg/l)	Bentonite content in $Mg(OH)_2$ %	Amount of sorbed color (mg/l)
Acidsulfonic blue	5	37,7	100	5	59,9
	10	51,3	400		64,3
	15	58,9	1000		69,0
Chlorantinlichat blau 3rll	5	42,3	100	5	63,7
	10	54,7	400		71,3
	15	63,7	1000		75,1
Indigo carmin	5	40,2	100	5	59,4
	10	51,9	400		65,2
	15	59,4	1000		70,3
Methyl blue	5	32,4	100	5	45,6
	10	39,5	400		54,2
	15	45,6	1000		65,8
Methyl violet	5	31,7	100	5	43,9
	10	38,7	400		53,8
	15	43,9	1000		63,2

Table 2. Dependence of the discolouring solution degree on the loss of the degree to which the sorbent is %

Kind of color	Loss of sorbent	Freshly prepared sorbent	Sorbent that stayed 24 h	Drained and hushed sorbent
Acidsulfonic blue	0,5	90,1	88,9	88,6
	1,0	94,6	92,8	91,6
	2,0	97,3	96,5	96,0
	3,0	98,5	98,0	97,5
	4,0	99,2	98,9	98,0
Chlorantinlicht blau 3rll	0,5	97,8	94,3	92,7
	1,0	98,8	96,2	94,5
	2,0	99,1	97,9	95,5
	3,0	99,4	98,5	97,8
	4,0	99,8	99,3	98,7
Indigo carmin	0,5	95,2	94,2	93,7
	1,0	97,4	95,7	94,2
	2,0	98,3	96,9	95,8
	3,0	98,9	97,8	96,9
	4,0	99,3	98,5	97,7
Methyl blue	0,5	95,6	94,8	94,3
	1,0	96,5	96,0	95,9
	2,0	99,0	98,7	98,5
	3,0	99,5	99,2	98,9
	4,0	99,9	99,3	99,0
Methyl violet	0,5	94,8	94,5	94,0
	1,0	95,2	94,7	94,3
	2,0	98,7	97,2	96,7
	3,0	99,4	98,7	97,9
	4,0	99,8	99,1	98,5

According to table 2 the loss of 0, 5% freshly prepared sorbent removes over 95% of the color, except in the case of acidsulfonic blue color, where the removal was 90%. Almost complete, a discoloration of over 90% is achieved with the loss of 3-4% of sorbent. The sorption capacity of drained and hushed sorbent that stayed is insignificantly lower than the sorption capacity of fresh sorbent. The results show that clay-hydroxide sorbent can be used immediately, as well as after some time.

4. CONCLUSION

According to the experimental results it can be concluded that a clay-hydroxide sorbent, formed on the basis of bentonite and Mg $(OH)_2$, can be used with success for textile industry wastewaters purification. This work has made a contribution to a more economic and more effective purification of industrial waste waters.

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MOGUĆNOST PRAKTIČNE PRIMENE GLINASTO – HIDROKSIDNIH SORBENATA ZA PREČIŠĆAVANJE OTPADNIH VODA TEKSTILNE INDUSTRIJE

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U radu su prikazana istraživanja koja imaju za cilj dobijanje glinasto-hidroksidnih sorbenata na bazi bentonita i Mg $(OH)_2$. Izvršena su i ispitivanja mogućnosti primene dobijenih produkata za prečišćavanje otpadnih voda tekstilne industrije. Razmatrane su različite trgovačke marke boja sa aspekata njihovog eliminisanja sorpcijom na glinasto-hidroksidnom produktu. Sorpcija boje na Mg $(OH)_2$ je eksperimentalno ispitivana sa različitim koncentracijama bentonita (5%, 10%, i 15%) i variranjem koncentracije boje od 100 do 1000 mg/dm3.

Ključne reči: *glinasto-hidroksidni sorbent, prečišćavanje otpadnih voda tekstilne industrije*