

ADSORPTION OF ACTIVE CHLORINE AND TECHNOLOGY OF AN AQUEOUS SOLUTION DECHLORINATION BY MODIFIED ACTIVATED CARBON

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ABSTRACT

The influence of the modified activated carbon activation type on the degree of adsorption of active chlorine from the aqueous solution was studied. The influence of water flow rate and purification process duration on the adsorption of active chlorine by modified activated carbon was researched and the optimal parameters of the dechlorination regime were determined. The proposed method of extraction of active chlorine by modified activated coal obtained from peach shells can be used in natural and sewage treatment processes for the removal of the active chlorine and chlorine compounds. The design of the mass transfer apparatus with a fixed layer of adsorbent has been developed. The technology of dechlorination aqueous solution by modified activated carbon allows to increase the efficiency of purification up to 99%.

Keywords: Adsorption, Active Chlorine, Sewage, Dechlorination, Modified Activated Carbon, Peach Shell.

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INTRODUCTION

The development and search for effective, relatively cheap sorbents for natural and sewage treatment processes are of undoubted scientific and practical interest.¹⁻³ Natural water and sewage contain residual active chlorine. Highly toxic effluents of chemical, coke-chemical, and chemical-pharmaceutical industries are especially dangerous for water objects, as they contain mainly dissolved substances. Small doses of residual chlorine in water have a toxic effect and provoke the emergence of various diseases.^{4,5} Activated carbon is used to purify water from residual chlorine. Studies have shown that the obtained samples have quite a good sorption and structural characteristics (specific surface area - 1630 m²·g⁻¹ (including the surface of mesopores - 200 m²·g⁻¹), the volume of micropores is $W_0=0.59$ cm³·g⁻¹, the total volume of micro- and mesopores is 0.8 cm³·g⁻¹, the adsorption energy is $E_0=19.8$ kJ·mole⁻¹, half-width of micropores for a slit-like model $-X_0 = 0.64$ nm).⁶ One of the main parameters that affect the characteristics of the resulting products is the degree of formation of its particles and properties of the porous structure, such as the specific surface area, total pore volume, and pore diameter. The choice of physical and chemical methods, in particular the

sorption method, is based on its advantage over other methods, consisting of the possibility of using various sorbents with certain characteristics and properties, the optimal combination of which contributes to the achievement of certain properties. The widespread use of active carbons as adsorbents is provoked by the fact that they have a highly developed porous structure, strength, and the possibility of repeated application.⁷⁻¹⁰ As a result of carbon activation on the surface of prismatic faces and edges of crystallites the number of valiantly unsaturated and therefore highly reactive carbon atoms is formed. Such peripheral carbon atoms, having free, unsaturated valences, quite easily interact with atoms of sulfur, chlorine, nitrogen, hydrogen, and some other elements. Carbon sorbents are widely used in various processes of purification from harmful impurities and recuperation of valuable substances from liquid and gaseous media. Activated carbon is used in oil refining, petrochemical, wine, oil, and, fat and other industries.¹¹⁻¹⁴ The main difficulty of synthesis of the sorbent is the formation of the uniform structure of carbon material with a certain micropores radius, since the main properties of the sorbent, such as selectivity and adsorption rate, depend on the size of the micropores. The aim of this work is to study the adsorption of active chlorine on adsorbents obtained from peach shells and its application in wastewater treatment processes. Based on experimental data, a technological scheme and practical recommendations for the modernization of adsorption equipment will be proposed, which will allow generalizing of experimental data for the development of the basics of water treatment technology.

EXPERIMENTAL

Materials

The reliability of the results is provided by the use of modern physical and chemical research methods, reproducibility of experimental results within the specified accuracy, their coherence with the literature data, and the use of statistical methods for processing experimental data. All the reagents (H_2SO_4 , HCl , H_3PO_4 , ZnCl_2 , C_6H_6 , RArSO_2OM) were purchased from Sigma-Aldrich (USA) and used without further purification. Acid concentrations were studied in the range of 5-40%. The coefficient of zinc chloride impregnation (ZnCl_2) (the ratio of the mass of the anhydrous activator to the mass of the dry source natural material) is taken in the range of 0.1 - 0.6.

Preparation of Modified Sorbent

Preparation of activated carbon was carried out by Tribochemical activation of peach shells in a two-chamber impact mill in the presence of surfactant – alkyl aryl sulfonate RArSO_2OM . Tribochemical activation leads to multiple increases in porosity and the formation of a fresh surface. After activation in the first chamber of the mill in the air, the pore volume of the shell reaches $0.5 \cdot 10^{-4} \text{ m}^3/\text{kg}$, after activation in the second chamber of the mill in the presence of surfactant (alkyl aryl sulfonate) the pore volume reaches $1.8 \cdot 10^{-4} \text{ m}^3/\text{kg}$.¹⁵⁻¹⁸ Thermal activation of peach shells was carried out in a furnace for activation (Carbolite furnace type CTF 12/65/550, Italy) in the atmosphere of carbon dioxide (purity – 99.8%, «NII KM» LLC, Russia). The temperature of the furnace was measured by a platinum-rhodium-platinum thermocouple (TPP10 - type S, Deange Industry Co. Ltd., Taiwan), regulated by a thermoregulator of the type ERM-47 («Energopromautomatics» LLC, Russia). Activation was researched out in the temperature range 573, 673, 773, 873, 973, 1073, 1173, and 1273 K with heating at each temperature for 1, 2, 3, and 4 hours. The elemental composition was determined by X-ray fluorescence analysis using an INCA Energy-350 analyzer (OxfordInstruments, Great Britain) installed on a scanning electron microscope JSM-6490 LV (JEOL, Japan). The radiation energy was 0-20 keV. The sensitivity of the method for the component was 0.1 mass%. The relative accuracy did not exceed 10%.^{19,20} Thermally and chemically activated peach shells are used to study chlorine adsorption.

RESULTS AND DISCUSSION

In the food industry of the Central Asian region in the production of fruit products peach shells are multi-tonnage waste. Waste of plant origin can serve as a cheap raw material for obtaining sorbents that have sufficiently good adsorption and physical-chemical properties. The use of effective methods of activated carbon porous structure regulation suggests its' application as adsorbents for the purification of natural, wastewater is possible and economically feasible.

The process of obtaining active adsorbents from peach shells involves its grinding and Tribochemical activation (mechanical activation) at the mill plant. The quality of the adsorbents obtained by us significantly depends on the stability of the granulometric composition and the active surface of the powder produced by the mill plant. The efficiency and reliability of the mill plant ensure the quality and required physical and mechanical characteristics of the adsorbents. During Tribochemical activation (dispersion), powder formation is accompanied by the appearance of a new surface, an increase in the specific surface area of materials by a thousand or more times. Therefore, obtaining dispersed systems requires energy expenditure. In order to destroy the peach shells and get a new surface, it is necessary to overcome the forces that cause the integrity of the body volume. When dispersed under the influence of external forces, the peach shells first undergo volumetric deformation (elastic and plastic), and only after that, with a certain mechanical force, it collapses. During grinding, the peach shells were destroyed primarily in places of strength defects (macro and microcracks). Therefore, as the particles are crushed, the strength of the particles increases. An increase in the strength of the peach shells as they are crushed leads to a large expenditure of energy for their further dispersion. Mechanical processing of solids, in order to activate them, on an industrial scale is one of the most energy-intensive stages of processing raw materials. However, this process is superior to other, classical, standard processing in the sense that additional energy costs for mechanical activation, which worsen energy performance, are more than compensated by other technological advantages. Some by-products that could not be used in classical technological schemes can be processed into high-quality industrial materials by mechanical activation. The destruction of the peach shell can be facilitated by using the Rebinder effect—an adsorption reduction in the strength of solids. This effect consists in reducing the surface energy with the help of surfactants, as a result of which the deformation and destruction of the solid are facilitated. The study of the effect of Tribochemical activation on the surface activity and dispersion of the peach shells was carried out in an impact mill and a ball mill in air, and water, as well as in the presence of surfactants. The study of the process of dispersing the peach shells, as well as the analysis of the results, allowed us to establish (Table-1) that a greater porosity occurs in the impact mill than when grinding in a ball mill, in which a higher density of the crushed shell of the seeds is the result of compression of the powder between the grinding bodies when they collide.²¹ As can be seen, when grinding the peach shells in an impact mill in an aqueous medium, there is a change in the surface, its rapid increase at the beginning of processing and reaching, after a certain period of grinding, the final stationary value.

Table-1: Change in the Specific Surface of the Peach Shells Depending on the Time of Tribochemical Activation

Tribochemical Activation Time, min	Specific Surface Area S, m ² /g			
	in the impact mill		in the ball mill	
	Air	Water	Air	Water
20	5	42	2	10
40	13	56	4	16
60	25	67	7	20
80	34	71	9	18
100	36	72	9.5	19

Figure-1 shows the change in the volume of the pores V_p peach shells when activated in a two-chamber impact mill. It can be seen from the figure that after activation in the first chamber of the mill in the air, the volume of the pores of peach shells reaches $0.5 \cdot 10^{-4}$ m³/kg. After activation in the second chamber of the mill in the presence of surfactants (alkyl aryl sulfonate), the pore volume reaches $1.8 \cdot 10^{-4}$ m³/kg. The data of the conducted experiments are important and have significant value in solving problems of creating active adsorbents with specified properties. The proposed method of Tribochemical activation in the presence of the surfactant alkyl aryl sulfonate is highly preferable for obtaining a high active surface and the required dispersed composition of the peach shells in order to carry out further stages of modification, thermal and chemical activation used to obtain porous bodies with a very high specific surface area. The main method of preparing a powder with a developed surface is mechanical deformation and destruction. The various stages of these processes play an important role in the technology because only the mechanical

activation of the peach shells provides a sufficiently high, from an economic point of view, reactivity. The peach shell is a promising source for obtaining sorption materials, which are characterized by a number of advantages in comparison with traditionally used sorbents. The advantages of new sorption materials are environmental purity, low cost, availability of raw materials, and high physical and chemical, and sorption-desorption characteristics. The possibility of improvement of the main characteristics of the obtained sorbents samples, such as specific surface area, and porosity due to their sequential activation by chemical and thermal methods, has been experimentally shown.^{22,23}

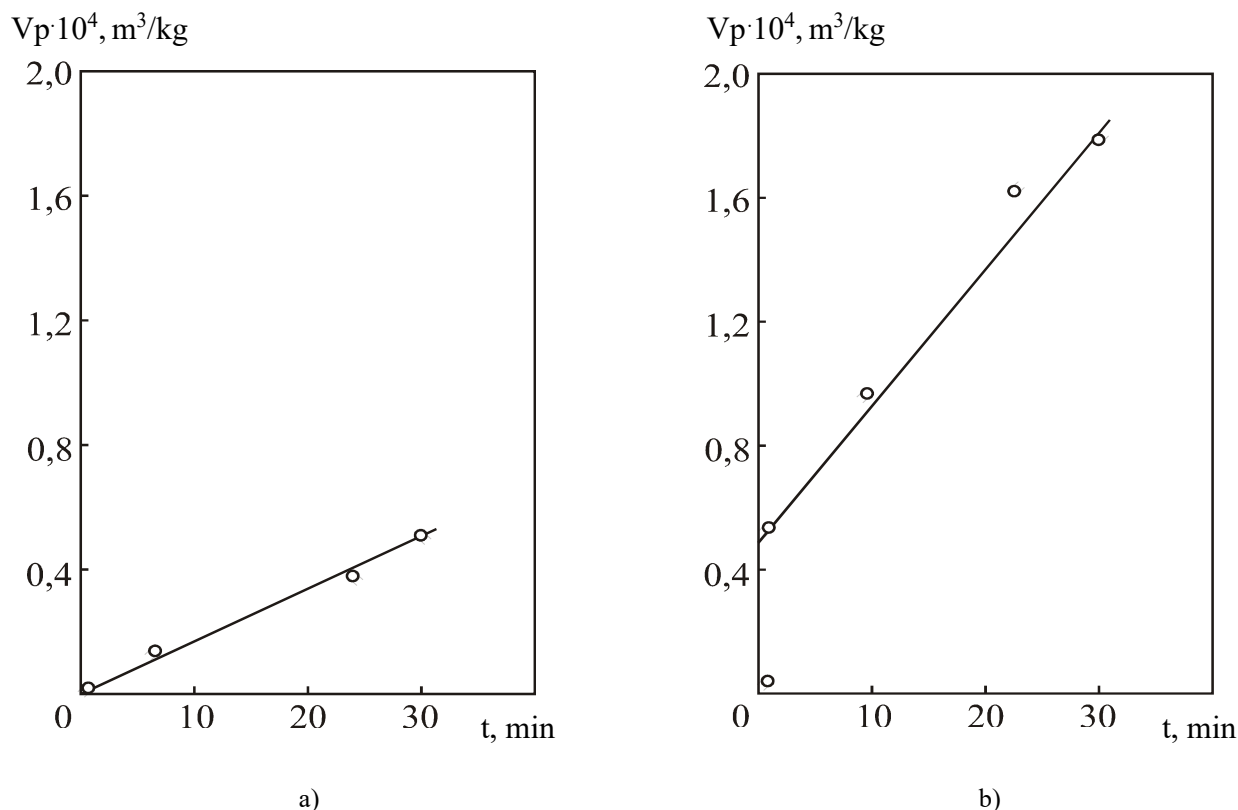
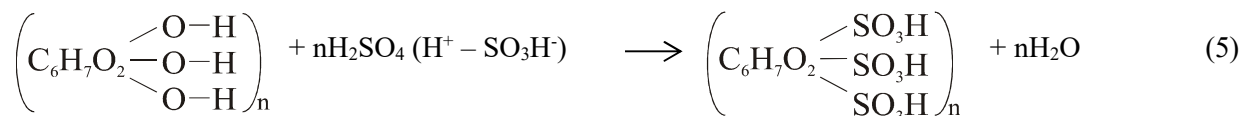


Fig.-1: Change in the volume of the Pores V_p Peach Shells When Activated in a Two-Chamber Impact Mill:
a) activation in the First Chamber of the Mill; b) activation in the Second Chamber of the Mill

The parameters of the porous structure of peach shells activated by H_2SO_4 with concentrations of 5, 10, 15, 20, 30, and 40% for 1-4 hours were determined. An increase in the activator concentration to 20% leads to a slight increase in the total pore volume of $4.7 \cdot 10^{-4} \text{ m}^3/\text{kg}$ and the porous structure. An increased concentration of sulfuric acid to 30% is accompanied by an increased volume of micropores $2.3 \cdot 10^{-4} \text{ m}^3/\text{kg}$ and mesopores $2.6 \cdot 10^{-4} \text{ m}^3/\text{kg}$. A further increase of concentration slightly affects the total pore volume of $6.6 \cdot 10^{-4} \text{ m}^3/\text{kg}$ and the porous structure. With an increased treatment time of sulfuric acid with a concentration of 30 % to 2 hours, the total porosity increases from $5.0 \cdot 10^{-4} \text{ m}^3/\text{kg}$ to $6.5 \cdot 10^{-4} \text{ m}^3/\text{kg}$, and a further increase in the treatment time from 3 to 4 hours weakly affects the total pore volume of $6.6 \cdot 10^{-4} \text{ m}^3/\text{kg}$.

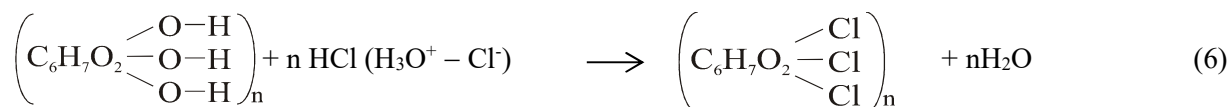
Chemical transformations of peach shells under the action of H_2SO_4 (chemical activator), with a concentration of no more than 40%, can be represented by the following chemical reaction:



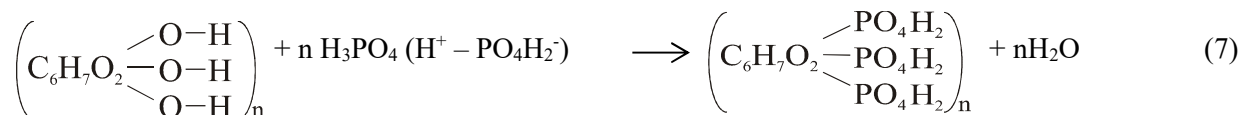
Fibre, which makes up the bulk of the peach shells, shows a weakly basic property that interacts with sulfuric acid, where nucleophilic substitution (SO_3H) occurs. Probably, the formed chemically active complex leads to an

increase in the adsorption capacity of the shell, which is achieved during experiments.²⁴ The parameters of the porous structure of peach shells activated by HCl with concentrations of 5, 10, 15, 20, 30, and 40% for 1-4 hours were determined. An increase in the concentration of hydrochloric acid from 5% to 20% entails a slight development of the porous structure (the total pore volume increased from $2.7 \cdot 10^{-4} \text{ m}^3/\text{kg}$ to $4.2 \cdot 10^{-4} \text{ m}^3/\text{kg}$). An increase in concentration from 30% to 40% also entails a weak development of the porous structure and the total pore volume from $4.9 \cdot 10^{-4} \text{ m}^3/\text{kg}$ to $6.2 \cdot 10^{-4} \text{ m}^3/\text{kg}$. An increase in treatment time with hydrochloric acid from 3 to 4 hours almost does not affect the pore volume.

The increased porous structure of peach shells, activated by HCl can be represented by the following transformation:

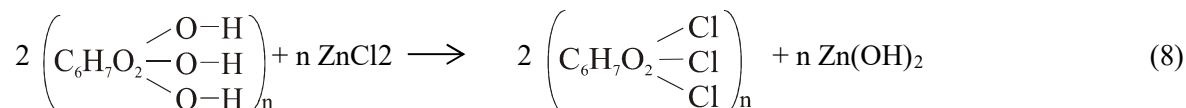


where the formation chemically active complex of hydrochloric acid ester occurred, which led to an increased adsorption capacity of activated carbon. The parameters of the porous structure of peach shells, activated by H_3PO_4 with a concentration of 5, 10, 15, 20, 30, and 40% for 1-4 hours were also determined. As a result of the research, it was found that the development of porous structure occurs in the same way as when treated with sulfuric and hydrochloric acids, but with a smaller pore volume. An increase in the concentration of phosphoric acid from 5% to 20% slightly affects the total pore volume of $2.5 \cdot 10^{-4} \text{ m}^3/\text{kg}$, and an increase in concentration from 30% to 40% also weakly develops the total porosity of $4.5 \cdot 10^{-4} \text{ m}^3/\text{kg}$. An increase in treatment time with phosphoric acid $3.1 \cdot 10^{-4} \text{ m}^3/\text{kg}$, at the end of $4.5 \cdot 10^{-4} \text{ m}^3/\text{kg}$). The increased porous structure of the peach shells under the influence of phosphoric acid, according to the available literature data, can be represented by the following chemical reaction:

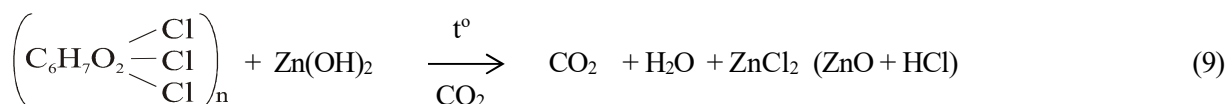


The parameters of the porous structure of peach shells activated by ZnCl_2 with an impregnation coefficient (IC) - the ratio of the mass of an anhydrous activator to the mass of the dry source natural material 0.1; 0.2; 0.3; 0.4; 0.5 and 0.6 for 1-4 hours were determined (Table-2). The parameters of the porous structure of peach shells activated by ZnCl_2 with an impregnation coefficient of 0.2, 0.3, 0.4, 0.5, and 0.6 with subsequent activation in a furnace in an atmosphere of carbon dioxide (CO_2) at temperatures from 573 K to 873 K were determined (Table-3). The influence of the zinc chloride activator (ZnCl_2) and thermal activation in the CO_2 stream on the parameters of the porous structure of peach shells, where the porosity of carbon develops, can be explained by the following assumed chemical transformation:

I stage:



II stage:



Activated carbons, according to the development of the porous structure, formed the following series: treated ZnCl_2 and CO_2 > treated ZnCl_2 > treated H_2SO_4 > treated HCl > treated H_3PO_4 .

Table-2: Parameters of the Porous Structure of Modified Activated Carbon Obtained by Chemical Activation with Zinc Chloride (ZnCl₂)

Coefficient of impregnation	Time activation, hour	$V_{\text{total}} \cdot 10^4$, m ³ /kg	$V_{\text{micro}} \cdot 10^4$, m ³ /kg	$V_{\text{meso}} \cdot 10^4$, m ³ /kg	$V_{\text{macro}} \cdot 10^4$, m ³ /kg
0.1	3	4.9	1.3	2.8	0.8
0.2	3	5.7	1.4	3.3	1.0
0.3	3	9.5	2.5	6.0	1.0
0.4	1	6.3	1.0	4.2	1.1
0.4	2	7.2	1.3	4.8	1.1
0.4	3	9.8	2.5	6.0	1.3
0.4	4	9.8	2.5	5.7	1.6
0.5	3	8.4	2.2	4.0	2.2
0.6	3	8.0	2.0	3.9	2.1

Table-3: Parameters of the Porous Structure of Modified Activated Carbon Obtained by Activation with Zinc Chloride (ZnCl₂) Followed by Activation in a Furnace an Atmosphere of Carbon Dioxide (CO₂)

Temperature, K	Coefficient of impregnation	$V_{\text{total}} \cdot 10^4$, m ³ /kg	$V_{\text{micro}} \cdot 10^4$, m ³ /kg	$V_{\text{meso}} \cdot 10^4$, m ³ /kg	$V_{\text{macro}} \cdot 10^4$, m ³ /kg
773	0.2	6.8	3.7	2.5	0.6
773	0.3	8.0	4.0	2.7	1.3
573	0.4	7.0	2.1	3.2	1.7
673	0.4	9.0	3.0	4.5	1.5
773	0.4	12.0	4.2	6.5	1.3
873	0.4	11.0	4.0	5.7	1.3
773	0.5	11.0	4.0	5.5	1.5
773	0.6	10.0	3.0	5.0	2.0

The content of active chlorine and the degree of extraction in the percent from the initial content are shown in Table-4. The table shows that the degree of removal of active chlorine (>99.9%) has the shell activated in a mixture of 5% HCl and ZnCl₂ (IC=0.2) in the CO₂ stream at a temperature of 723 K and activated by ZnCl₂ (IC=0.4) in the CO₂ stream at a temperature of 773 K (94.0%). The sorbents thermally activated in the CO₂ stream, chemically activated by 30% H₂SO₄ and ZnCl₂ with the impregnation coefficient equal to 0.4 are less effective.

Table – 4: The content of active chlorine and degree of its removal in percent from the initial content

Adsorbent (peach shell)	The concentration of active chlorine		The degree of removal of active chlorine (α), %
	In the initial solution C _{init} , mg/L	In purified solution C _{purif} , mg/L	
Thermally activated in a stream of carbon dioxide at a temperature of 973 K for 4 hours	10.0	1.5	85.0
Activated in 30% H ₂ SO ₄ during 2 hours	10.0	5.4	46.0
Activated in ZnCl ₂ (IC=0.4) during 3 hours	10.0	0.9	91.0
Activated in ZnCl ₂ (IC=0.4) in CO ₂ stream at a temperature of 773 K	10.0	0.6	94.0
Activated in a mixture of 5% HCl and ZnCl ₂ (IC=0.2) in a CO ₂ stream at a temperature of 723 K	10.0	n/d	>99.9
Industrial activated carbon BAC (birch activated carbon)	10.0	0.1	99.0

In further studies, the shells activated in a mixture of 5% HCl and ZnCl₂ (IC=0.2) in a CO₂ stream at a temperature of 723 K are used. The influence of water flow rate and the purification process duration on the absorption of active chlorine by modified activated carbon are presented in Tables-5 and 6.

Table-5: The Influence of Purification Process Duration on the Absorptivity of Active Chlorine

Purification process duration, min	The concentration of active chlorine		The degree of removal of active chlorine (α), %
	In initial solution C_{init} , mg/L	In purified solution C_{purif} , mg/L	
5	10.0	6.5	35.0
10	10.0	2.5	75.0
20	10.0	n/d	99.9
30	10.0	n/d	99.9
40	10.0	n/d	99.9

Table - 6: Influence of Water Flow Rate on Active Chlorine Absorption

The water flow rate v , m/h	The concentration of active chlorine		The degree of removal of active chlorine (α), %
	In the initial solution C_{init} , mg/L	In purified solution C_{purif} , mg/L	
8	10.0	n/d	99.9
10	10.0	n/d	99.9
12	10.0	n/d	99.9
14	10.0	1.2	88.0

The influence of the duration purification process on the absorption of active chlorine in the time interval of 5-40 minutes has been studied. With a short time interval of 5-10 minutes, the degree of removal of active chlorine was 35-75%, and with an increase in the purification process time to 20-40 minutes, the degree of removal of active chlorine reaches a maximum value of 99.9%. When studying the influence of the water flow velocity in the range of 8-14 m/h, it was shown that at a flow velocity of 8-12 m/h, the most effective degree of removal of active chlorine is observed, reaching a maximum value of 99.9%, with an increase in the water flow velocity to 14 m/h, the degree of removal of active chlorine decreases to 88%. The results show that the optimal mode factors are: purification process duration– 20-40 minutes; water flow rate – 8-12 m/h. The examinations of modified activated carbon obtained from peach shells activated in a mixture of 5% HCl and $ZnCl_2$ ($IC=0.2$) in a CO_2 stream at a temperature of 723 K are carried out. The aqueous solution with the initial concentration of active chlorine equal to 10 mg/L is passed through the layer of modified activated carbon in the adsorption column, after which the traces of active chlorine does not leave (the concentration of active chlorine in the purified solution is not detected). The efficiency of the degree of purification at using modified activated carbon obtained from the fruit shells in the process of aqueous solutions purification from active chlorine reaches 99.99%. This method of extraction of active chlorine by using modified activated carbon obtained from peach shells can be used in natural and wastewater treatment processes to remove active chlorine, as well as chlorine compounds. The main type of adsorption equipment is the periodic adsorption device, in which the absorber with a stationary layer of adsorbent after the completion of the purification or separation stage switches to the desorption stage. Another promising method, which has a number of significant advantages, is the method of purification and separation of mixtures in a moving adsorbent layer. Unfortunately, the problem of developing durable ball adsorbents with a moving layer has not been solved yet, and therefore the wide industrial implementation of this method is difficult. The disadvantages of the used absorbers are low efficiency of the apparatus, incomplete use of the adsorbent capacity, insufficiently uniform distribution of the adsorbed phase in the activated coal layer, bulkiness, and complexity of the adsorbent regeneration and servicing of the apparatus, a low degree purification of the aqueous solution. The efficiency of drinking water purification from active chlorine has been tested at the water treatment plant. On the basis of the conducted tests, and also on the basis of the analysis works various researchers for the achievement of the necessary purification efficiency of the aqueous solution from active chlorine the technological scheme is developed. For the removal of disadvantages of existing methods of aqueous solution purification from active chlorine, into the technological scheme of dechlorination (Fig.-2) the mass transfer apparatus - absorber is included, which allows to carry out the process of dechlorination of aqueous solution with the greatest efficiency, improve the condition of contact of the adsorbent with the liquid phase, evenly distribute the liquid phase in the adsorbent layer, simplify the regeneration of the adsorbent and reduce labor costs. The dechlorination process is carried out in the mass transfer apparatus with the fixed adsorbent layer. Mass transfer apparatus

consists of body frame, the contact chamber with the layer of adsorbent, the perforated partition, bottom grid, distributing device, fittings for the input of the liquid phase, for the output of purified liquid phase, for input and output of coolant and for input and output of the regenerating agent.²⁵ The aqueous solution containing active chlorine is fed into the lower section of the apparatus, filtered through the adsorbent layer in the contact chambers, and removed from the apparatus through the appropriate nozzle. A flowing of solution from the lower section of the apparatus into the contact chambers, the volume density of the flow becomes uniform along the section of the apparatus and the solution is evenly distributed. At the decrease of the aqueous solution purification degree by the adsorbent, the filtering layer (activated shell) is subjected to regeneration. For regeneration of the adsorbent, the supply of the initial aqueous solution is switched off then the regenerating agent (alkali solution and calcium hypochlorite) is introduced into the contact chambers of the aqueous solution with the adsorbent. The active chlorine separated from the activated shell in a mixture with the regenerating agent is removed through the appropriate nozzle. Further, the regeneration solution can be used in treatment plants for the disinfection of industrial sewage. The efficiency of the adsorbent increases due to the high use of useful volume apparatus, uniform distribution of the initial liquid phase in the adsorbent layer, the possibility of regeneration adsorbent without unloading, the stability of the quality of treated solution, the uniformity of the temperature adsorbent layer, as well as compactness of the apparatus, which reduces capital and operating costs. The use of activated peach shells in the technology dechlorination of aqueous solution allows for an increase in the purification efficiency by up to 99%.

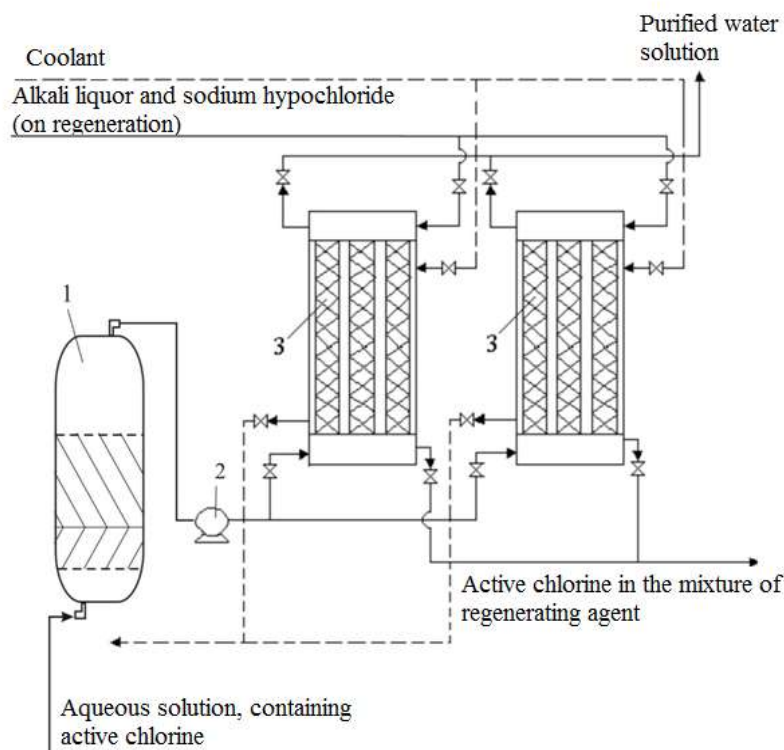


Fig.-2: Technological Scheme of Aqueous Solution Dechlorinating In Horizontal Absorbers:

1-Ion-Exchange Device with Mixed Layer; 2-Pump; 3-Adsorbers

The continuity of the process in the liquid phase is provided by the connection of two identical adsorbers. When one of the adsorbers is working in the process of water purification, the other adsorber is in the regeneration stage. Table-7 shows the main parameters of the water solution dechlorination technology on the basis of obtaining a pilot batch of activated carbon from the peach shell at «Kainar» LLP and pilot tests at «Vizit» LLP (Shymkent).

Table – 7: The Main Parameters of Technology of Aqueous Solution Dechlorination

Parameters	Quantity
Productivity, m ³ /h	350
The initial concentration of active chlorine in water, kg/m ³	10
The final concentration of active chlorine in water, kg/m ³	0
Height of absorber, m	2.5
Diameter of the absorber, m	1.1
Adsorbent weight, kg	1283
Duration of the one cycle of adsorbent layer, month.	1
The water flow rate, m/h	12

CONCLUSION

Thus, the influence of the activation type of the modified activated carbon on the degree of adsorption of active chlorine from the aqueous solution was determined. The highest adsorption capacity according to active chlorine has the shell activated in a mixture of 5% HCl and ZnCl₂ with the impregnation coefficient equal to 0.2 and subsequently activated at a temperature of 723 K in the CO₂ stream (the degree removal of active chlorine from the initial solution is 99.9%), as well as activated by ZnCl₂ with the impregnation coefficient equal to 0.4 and subsequently activated at a temperature of 773 K (94.0 %) in the CO₂ stream. The influence of water flow rate and purification process duration on the absorption of active chlorine by modified activated carbon was studied. Optimal mode factors are purification process duration– 20 minutes; water flow rate–12 m/h. optimal conditions for removal of active chlorine from aqueous solution by modified activated carbon obtained from peach shells have been industrially tested at the soft drinks plant – «Visit» LLP (Shymkent). The efficiency of the degree of purification reaches 99.9. This method of removal of active chlorine with using of modified activated carbon can be used in natural and wastewater treatment processes to remove active chlorine and chlorine compounds.

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