# Studying the effectiveness of comprehensive wastewater treatment

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**Abstract.** The thermal stability of the developed systems was studied, and a thermal analysis of bentonite from the Navbakhor deposit was carried out. Based on the results of derivatographic thermal analysis, it is shown that with increasing temperature, various physicochemical processes occur, which are accompanied by several endothermic effects. Endothermic effects indicate decomposition, combustion, destruction of the crystal structure of molecules in the composition. The kinetic characteristics of sorption, sorption-coagulation and sorption-coagulation-flocculation purification have been established.

## 1 Introduction

Currently, gas processing industries consume a significant amount of wastewater when carrying out various technological processes. The most important stage in the operation of treatment facilities is biological treatment. However, due to the high concentration of pollutants, as well as the presence of difficult-to-oxidize impurities, traditional biological oxidation does not always provide high quality wastewater treatment fresh water.

In this regard, the chemical outlines of the streaming and non -reservoir and non - reinforcing reinforcing reinforcements with a breakdown of the mineral rim, and the Complex, is a proceeded.

Development of reagent processing based on sorbent, coagulant and flocculant as a result of their activation and modification, study of their adsorption properties for the purpose of use for wastewater treatment, is an urgent task and has scientific and practical significance as one of the directions for minimizing production emissions and protecting environmental facilities environment.

Most often, for these purposes, a sorption purification method is used, the effectiveness of which depends on the properties of the sorbent, coagulant and flocculant used. Development and research of sorbents based on a wide variety of mineral and organic mineral raw materials, flocculants based on synthetic polymers and minerals that play in the process The role of coagulants in purification is of great interest from a scientific and practical perspective. Natural sorbents have a number of advantages over synthetic ones - low cost, radiation resistance, environmental safety [1-3].

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## 2 Formulation of the problem

Despite the conduct of a large number of studies on the processes of sorption, flocculation and coagulation related to the treatment of wastewater from gas processing plants, many questions still remain unclear: there is no theoretical There is no clear justification for the selection of flocculants and coagulants, there is no consensus on the mechanisms of processes occurring during the hydrolysis of flocculants and coagulants, and the properties of the resulting aggregates, the main reasons for the decrease in the effectiveness of coagulants and flocculants with decreasing temperature, etc. have not been determined. [4-8].

This work is devoted to the development of a modified method for treating wastewater from gas processing plants using solid composite reagents in a sorbent-coagul system yant-flocculant, providing increased quality of purified water while simultaneously simplifying and reducing the cost of its purification process. Kaolin and bentonite were used as a sorbent at a ratio of 1:1 to 2.0 g/l, Al2(SO4)3·18H2O and FeCl3·6H2O were used as a coagulant at a concentration of 0.5 and 0.75 g/l. responsible and flocculant PAA and KMC at a ratio of 1:1 in an amount of 0.15 g/l. We selected wastewater from the Mubarek gas processing plant in the Republic of Uzbekistan as the object of study.

Establishing the dependence of the characteristics of the reagents on the conditions of their formation, the chemical composition of the flocculant and coagulant and the nature of the particles of the dispersed phase sorbent allowed to properly develop new compositions based on sorbent, flocculant and coagulant, optimize the conditions for their introduction and achieve maximum efficiency of the water purification process.

In order to determine the thermal stability of the developed systems, a thermal analysis of bentonite from the Navbakhor deposit was carried out. The derivatogram and the results obtained are shown (Fig. 1. (a, b) and table. As can be seen from the derivatogram, the onset of decomposition occurs in the temperature range of 100 - 220$^0$C, the endothermic process refers to the release of adsorption waters. In the temperature range of 500-700$^0$C, also observed endothermic processes with low intensities; the decrease in mass corresponds to the decomposition of impurity carbonates.

In the derivatograms of the bentonite sample, the first endo-effect is observed at temperatures from 400 to 600 °C, the weight loss of the sample is 106.6 mg or 44.42%. In addition, internal thermal destruction of bentonite occurs with the release of adsorption water of crystallization.

In the temperature range of 600–690°C, the following endo-effect occurs: the weight loss is 53.3 mg or 22.21% of the sample weight. Partial decomposition of the components included in bentonite occurs.

In the derivatograms of the sample after purification, a change in the TG, DTG and DSK curves is observed, respectively, with increasing temperature.

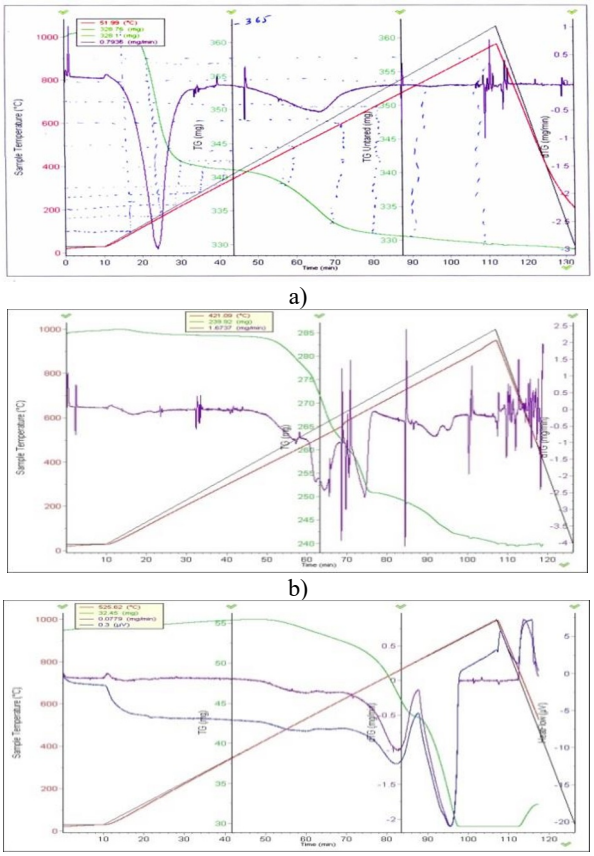
Initially, a weak endoeffect is observed at a temperature of 420–580°C, the weight loss at which is 2.5 mg or 7.70% of the total mass of the sample taken for analysis. This is explained by the fact that decomposition products or water of crystallization are partially removed from the sample.

At temperatures from 580 to 820 °C, noticeable decomposition occurs with an endoeffect, the mass loss of which is 9.5 mg or 29.28% of the mass of the sample taken. Decomposition products of the corresponding constituent components of the sample are formed. Further, with an increase in temperature from 820 to 910 $^0$C, complete decomposition of the sample occurs with a weight loss of 1.3 mg or 40.0% of the weight of the sample taken.

**Table 1.** Decomposition start intervals

| Bentonite | Temperature $^0$C / Weight loss. % | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. | 100 | 150 | 200 | 250 | 300 | 400 | 500 | 600 | 700 | 800 | 900 |
| Once-position | 362 | 357 | 342 | 340 | 340 | 340 | 338 | 333 | 331 | 330 | 329 |
| 95 $^0$C | 99.1 | 97.8 | 93.7 | 93.5 | 93.15 | 93.15 | 92.6 | 92.3 | 90.68 | 90.4 | 90.1 |

Thermal analysis studies revealed the thermal properties of composite systems, temperature ranges for the decomposition of intermediate products, a decrease in mass accordingly with increasing temperature, endothermic and exothermic effects were noted on the DTA curve.



a)

b)

v)

**Fig.1.** Derivatogram of bentonite from the Navbakhor deposit (a), composition before purification (b), composition after purification (v).

The study of the thermal stability of composite systems showed that, as a result of an increase in temperature in the range of 80 – 280 $^0$C, adsorbed water molecules in the composition of bentonite, aluminum sulfate, sodium bisulfite are completely removed by evaporation.

On the curve in the derivatogram of the composition based on the above composition, endo-effects are observed at temperatures from 60 to 390 $^0$C, which correspond to the removal of the adsorbed amount of water.

Based on the results of derivatographic thermal analysis, it is shown that with increasing temperature, various physicochemical processes occur, which are accompanied by several endothermic effects. Endothermic effects indicate decomposition, combustion, destruction of the crystal structure of molecules in the composition.

In the process of research, the effectiveness of wastewater treatment based on the dose of added sorbent was studied. Quantitative measurements of the composition of clarified waters were carried out from samples after the secondary settling tank in terms of COD, BOD5, concentration of sulfates, chlorides and phosphates. A comparison of the results of sorption (1), sorption-coagulation (2) and sorption-coagulation-flocculation (3) purification is presented in Fig. 1 (a-c).

Kinetic dependences of changes in the studied impurities are presented in Fig. 2 (a-v).

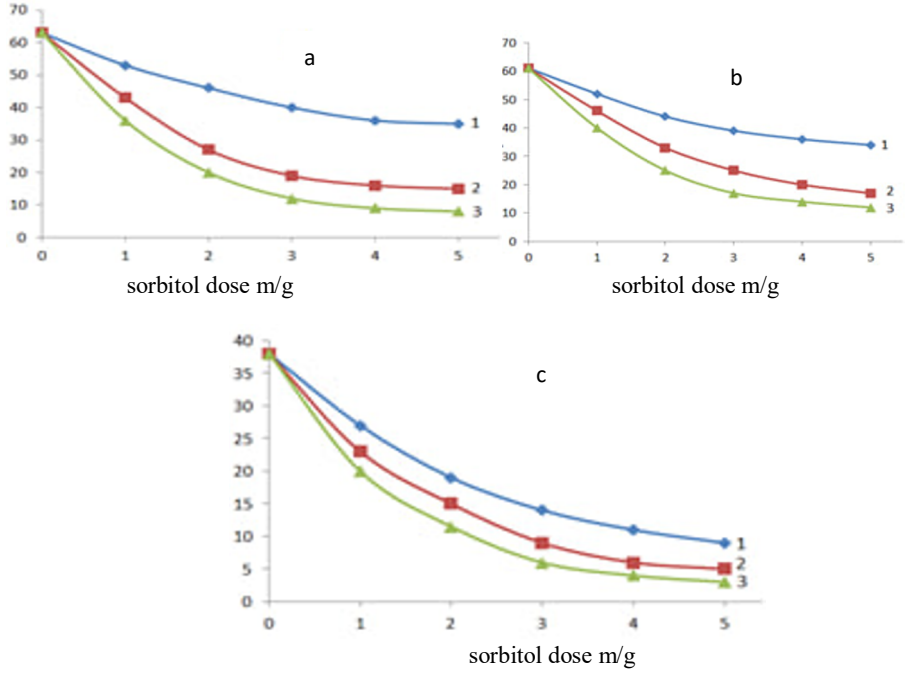



**Fig.2.** Changes in quality indicators of treated water. a) COD; b) BOD; c) CSO42-
1 – sorption; 2 – sorption-coagulation; 3 – sorption-coagulation-flocculation purification

The parameter values were determined every hour during the first 2 hours and after 6 hours from the start of the experiment. The process of sorption-coagulation-flocculation (3) purification is carried out in the first 2 hours of contact of the sorbent with wastewater and then the parameter values change slightly but. A sharp decrease in the concentration of organic impurities in wastewater in the first hours indicates the occurrence of physical sorption. A further gradual decrease is due to biological oxidation. The kinetic curve of changes in the COD indicator shows that in the first 2 hours of contact with wastewater, sorption-coagulation purification proceeds with maximum intensity responsivity, which is associated with the sorption of bioresistant components by the sorbent. Intensive cleaning in terms of BOD during the first two hours changes more smoothly, since during complex cleaning a biofilm is formed. Effective purification from sulfate ions occurs due to more complete and rapid removal of organic impurities, the presence of solid porous mineral

material and changes in pH changes towards a slightly alkaline environment, which affects the intensive growth of purification.

The sizes of coagulant particles were determined using the optical unit of a MasterSizer 3000 laser dispersion analyzer connected via a pump to a vessel equipped with a mechanical stirrer in which the coagulation process was carried out. At the first stage of the experiment, distilled water was passed through a membrane filter with a pore size of 0.2 μm under a pressure of 0.1–0.2 MPa. The pH of the system was 8.5±0.1 using $KHCO_3$ (8 mmol/dm3), and NaCl (8 mmol/dm3) was used to regulate the ionic strength. The calculated amount of coagulants $Al_2(SO_4)_3 \cdot 18H_2O$ and $FeCl_3 \cdot 6H_2O$ was added to the resulting solution.

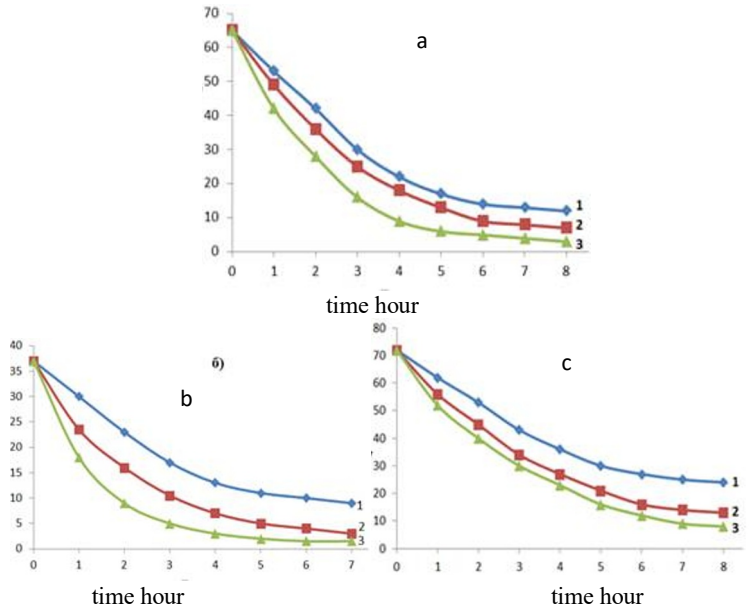



**Fig.3.** Kinetic curves: sorption (1), sorption-coagulation (2) and sorption-coagulation-flocculation purification (3). a) COD; b) BOD; c) $C_{SO4}^{2-}$

The system was stirred for 1.5 min at a speed of 500 rpm, then the pump was turned off and after 30 min the particle sizes were determined. Since there was no movement of liquid through the measuring cell, particle growth occurred under static conditions. The size of aggregates formed during flocculation increased with increasing content of polyacrylamide and KMC in the speed gradient range of 110-230 s-1 (Fig. 4).

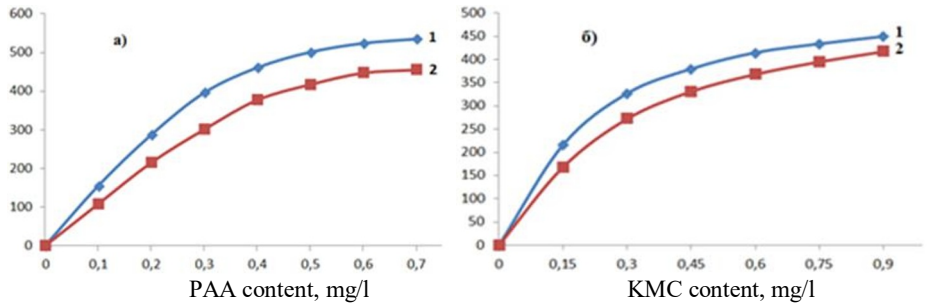



**Fig.4.** Dependence of the average diameter of flocculants on the content: polyacrylamide (a) and KMC (b). 1 – G = 110 s-1; 2 – G = 290 s-1.

It has been established that polyacrylamide forms the largest flocculation aggregates, which settle at a higher rate than aggregates from CMC (sedimentation rate 0.004-0.005 m/s and 0.002-0.003 m/s, respectively). It is this fact that can explain the greater efficiency of the polyacrylamide compound compared to CMC in most processes for removing contaminants from water [9, 10].

## 3 Conclusion

The thermal stability of the developed systems was studied, and a thermal analysis of bentonite from the Navbakhor deposit was carried out. Based on the results of derivatographic thermal analysis, it is shown that with increasing temperature, various physicochemical processes occur, which are accompanied by several endothermic effects.

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The kinetic characteristics of sorption, sorption-coagulation and sorption-coagulation-flocculation purification have been established.

The dependence of the average diameter of flocculants on the content of polyacrylamide and KMC was revealed.

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