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Oripova Lobar	Assistant
Xayitov Ruslan	Professor
Xudayberdiev Abdusalom	Professor

Karshi Engineering and Economic Institute

Bukhara Institute of Engineering and Technology

Namangan Institute of Engineering and Technology

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TESTING NEW ACTIVATED COALS AU-T AND AU-K FROM LOCAL RAW MATERIALS WHEN FILTRATION OF THE WASTE MDEA AT GAZLIN GAS PROCESSING PLANT

ORIPOVA LOBAR

Assistent of Karshi Engineering and Economic Institute
E-mail: oripovalobar@gmail.com

XAYITOV RUSLAN

Professor of the Bukhara Institute of Engineering and Technology
E-mail: leo-bexa@mail.ru, phone.: (+99891) 776-75-00

XUDAYBERDIEV ABDUSALOM

Professor of the Namangan Institute of Engineering and Technology
E-mail: jarayon@mail.ru, phone.: (+99899) 117-28-57

Abstract:

Background of the problem. At present, the production of activated carbons (AC) is steadily growing, and the areas of their industrial application are continuously expanding. There are four main gas processing plants in Uzbekistan, where spent amine solutions, such as diethanolamine (DEA) and methyldiethanolamine (MDEA), are filtered using activated carbons of the AG-3, HX-30, Chemveron grades at natural gas amine purification plants from acidic components. etc. The latter are of foreign origin and are imported for currencies.

Objective. In this work, the goal was to test new activated carbons AU-T and AU-K from local raw materials during filtration of spent MDEA.

Method. To obtain samples of activated carbons, carbonization of mulberry and maple wood was carried out in a laboratory tubular reactor with electric heating without air access, and the obtained carbonizates were activated with water vapor for 4–6 hours. To test the obtained samples of activated carbons during the filtration of the spent MDEA solution, as well as the analysis of the physicochemical and technical properties of the purified solution at the Gazlinsky gas processing plant (GPP), analysis methods were applied in accordance with State standards and factory regulations.

Scientific novelty. New samples of activated carbons based on mulberry (AU-T) and maple (AU-K) showed the best results in terms of adsorption properties and cleaning abilities when compared with the characteristics of factory-made, imported activated carbon grade AG-3 (Russia).

Received data. Carbonization of mulberry and maple wood was carried out in the temperature range of 300÷500°C in a reactor placed in an electric furnace with controlled heating. The resulting carbonizates are activated with water vapor for 4÷6 hours at temperatures of 700÷800 °C. After the activation process, the physicochemical and adsorption properties of the obtained samples of activated carbon were determined: bulk density - 377÷187 g/dm3, iodine activity - 30.2÷50.6%, ash content - 8.45÷9.67%, adsorption benzene activity - 1.45÷2.11 g/100 g.

After filtering the spent (saturated) and regenerated MDEA solution with activated carbons AU-T and AU-K, the physicochemical and technical characteristics of the purified solution were determined and the following results were obtained: solution concentration (%) - 26.7 ÷ 34.0, amount H2S (mol / mol) - 0.02 ÷ 0.04, the amount of CO2, (mol / mol) - 0.01 ÷ 0.27, pH - 9.35 ÷ 10.41, the amount of minerals (mg / l) - 6373 ÷ 7942, density, (kg/m3) - 1029÷1058.

Conclusion. New types of activated carbons were obtained from mulberry and maple wood; activated carbons AU-T and AU-K showed the best results in terms of adsorption properties and cleaning abilities when compared with the characteristics of factory-made, imported activated carbon of the AG-3 brand.

Keywords: foaming, foaming agents, methyldiethanolamine, filtration, activated carbon, mulberry, maple, carbonizate, activator, steam generator, regeneration.

Introduction. In recent years, the production of natural gas and gas condensate has been intensively increasing in Uzbekistan. At gas processing plants of the republic, the absorption method of purification using various amine solutions, such as diethanolamine (DEA) and methyldiethanolamine (MDEA) [1-3], is widely used to purify natural gas from its acidic components.

During the operation of alkanolamines, problems associated with their foaming are often observed [4–7]. Such problems were observed at all gas processing plants of the republic, where several thousand tons of used and obsolete alkanolamines were accumulated. It should be taken into account that these alkanolamines are not produced in the Republic. According to JSC Uzbekneftegaz, 312 tons of DEA and 3,522 tons of MDEA were imported for natural gas purification in 2021, worth 1,780 and 1,950 US dollars per ton, respectively [8,9].

To regenerate and prevent foaming of used alkanolamine solutions, they are purified by adsorption using activated carbon [10–12]. Activated carbons are used for adsorption treatment of regenerated amine solutions at natural gas amine purification plants from acidic components of the gas processing plant of the republic: grades AG-3 (Russia), HX-30 (China) and Chemveron. The demand for these coals in Uzbekistan is about 300 tons/year. These activated carbons are also not produced in the republic and are imported at a price of 2500÷3000 US dollars per ton. Along with this, cotton is grown annually on the territory of Uzbekistan, as a result of which large-tonnage waste is formed - cotton stalk. In addition, most of the territory of the republic is occupied by sowing fields, where mulberry, poplar, maple and other trees can be grown on the outskirts of these fields, which can serve as a good raw material for the production of activated carbon [13-17].

In this work, the goal was to obtain activated carbon samples from mulberry and maple wood and test them during filtration of spent MDEA at the Gazlinsky GPP.

Methods and materials. The process of carbonization of mulberry and maple wood was carried out in a laboratory tubular reactor with a capacity of 0.25 m3 with electric heating without air access (figure) [18–20]. Fractions 0.2–5.0 mm were processed and dried at 110°C for an hour. After loading the dried granules, the upper part of the reactor was hermetically sealed, and the lower part had a tubular outlet for the removal of resinous and gaseous products of thermal pyrolysis.

The carbonization process was carried out at 300–500°C. The process temperature was controlled using a thermocouple located in the middle part of the reactor. The rate of temperature rise was 7–10 °C per minute.

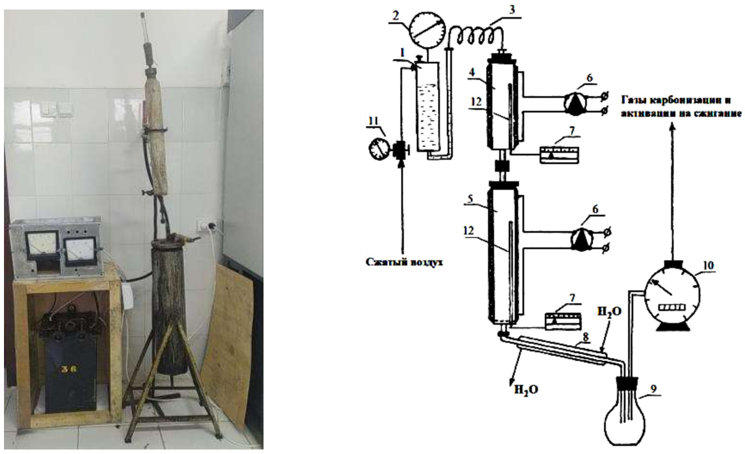

Figure 1. Laboratory plant for the production of activated carbons from organic raw materials

1 - water tank; 2 - pressure gauge (exemplary); 3 - copper capillary; 4 - steam generator; 5 - carbonization and activation furnace; 6 - lators; 7 - millivoltmeters; 8 - refrigerator; 9 - receiver; 10 - gas meter; 11 - pressure stabilizer; 12 - thermocouple pocket

Upon reaching the required temperature of the experiment, the sample was kept in the reactor for 1–2 h, and then cooled to room temperature. The released gaseous products of pyrolysis were removed from the reactor through a gas outlet tube and sent to a cooled condenser to condense water vapor and resins.

The process of carbonizate activation was carried out in the same reactor (figure). To carry out activation, carbonized granules were loaded into a tubular reactor, which was purged with a stream of nitrogen gas for 15 min to remove oxygen from the reaction zone. The upper flange of the reactor is equipped with a branch pipe for the inlet of superheated water vapor, and the lower one has a branch pipe for the removal of the vapor-gas mixture. The superheated steam required for activation was obtained in a steam generator. The flow rate of water vapor for activation was controlled by the amount of water entering the steam generator by changing the rate of its outflow in the capillary depending on the pressure above the water created in the dosing tank with the help of nitrogen. Температуру активации регулировали нагревом реактора и парогенератора. Нагрев образца проводили до конечной температуры активации, которая находилась в интервале 700÷800 °С. The activation temperature was controlled by heating the reactor and steam generator. The sample was heated to the final activation temperature, which was in the range of 700–800°C. When the set temperature was reached, water vapor was supplied to the reactor from the generator for 4–6 h. thermal conductivity detector.

After heat treatment of the obtained activated carbon, it was left to cool to room temperature without air access.

To test the obtained samples of activated carbons during the filtration of the spent MDEA solution, as well as to analyze the physicochemical and technical properties of the purified solution at the Gazlinsky GPP, analysis methods were applied in accordance with the State Standards and the technological regulations of the plant.

Results and discussion. When we obtained samples of activated carbon by carbonization of mulberry and maple wood with subsequent steam activation of coal, the following results were obtained (see Tables 1 and 2).

Table 1

Conditions and results of carbonization of mulberry and maple wood

Samples	Process of temperature, °C	Raw material weight, g	Carbonizate weight, г	Bulk density, g/dm^3	Ash content, %	Adsorption activity according to C_6H_6, g/100 g
	300	1000	613	524	4,8	0,24
AU-T	400	1000	521	507	5,2	0,46
	500	1000	405	482	6,1	0,52
	300	1000	576	516	4,2	0,87
AU-K	400	1000	453	463	4,5	1,18
	500	1000	345	368	5,3	1,35

The obtained carbonizates of wood raw materials are activated by water vapor. Conditions and results of activation are given in the following table. 2.

Table 2

Conditions and results of steam activation of mulberry and maple wood carbonizates

Samples	Temperature, °C	holding time, h.	Degree of burning, %	Bulk density, g/dm³	Iodine activity, %	Ash content, %	Adsorption activity according to C_6H_6, g/100 g
АУ-Т	700	6	35	377	30,2	8,45	1,45
	800	4	52	270	48,5	10,51	1,87
АУ-К	700	6	43	258	36,2	8,26	1,65
	800	4	58	187	50,6	9,67	2,11

The obtained experimental results are given in table. 1 allowed us to state that the satisfactory conditions for the carbonization of mulberry and maple wood are the duration of 1 hour at 500 °C.

Based on the data obtained (Table 2), it was stated that the rational conditions for the activation of mulberry and maple wood carbonizates are: temperature 800 °C, process duration 4 hours.

Some characteristics of the obtained samples of activated carbon AU-T and AU-K are compared with the known industrial activated carbon of grade AG-3 (Table 3).

Table 3

Some comparative characteristics of activated carbons

The name of indicators	Activated carbons		
	AG-3 (control)	AU-T	AU-K
Bulk density, g/dm³	450	270	187
Adsorption activity according to C_6H_6, g/100 g	1,23	1,87	2,11
Iodine activity, %	43,0	48,5	50,6
crush strength, kg/ granules	0,8	1,0	0,9
Ash content, %	14÷16	8÷10	8÷9

Based on the data presented in Table 3, it is proved that activated carbon samples obtained from local raw materials - AU-T mulberry wood and AU-K maple wood, are superior in adsorption properties to activated carbon AG-3 imported from the Russian Federation, which is currently time is used in the existing gas processing plants of our republic. The conducted studies allow us to recommend these samples for filtration of amino alcohols (MEA, DEA, MDEA) used during natural gas purification.

The obtained new samples of activated carbon AU-T and AU-K were tested during filtration of the spent (saturated) and regenerated MDEA solution at the Gazlinsky GPP. After filtration, the physicochemical and technical characteristics of the purified solution were determined. The results of the analysis are shown in the following tables 4 and 5.

Table 4

Results of analysis of saturated MDEA solution

№	Samples	Concentration, %	Quantity H_2S, mole/mole	Quantity CO_2, mole/mole	pH	Quantity of minerals mg/l	Density
1	Насыщенный раствор	33,9	0,06	0,36	9,30	6483	1,055
			Results after filtering				
2	АГ-3	31,2	0,03	0,25	9,32	6465	1,057
3	АУ-Т	32,6	0,04	0,26	9,35	6373	1,058
4	АУ-К	34,0	0,04	0,27	9,40	6427	1,058

Table 5

Results of the analysis of the regenerated MDEA solution

№	Samples	Concentration, %	Quantity H_2S, mole/mole	Quantity CO_2, mole/mole	pH	Quantity of minerals mg/l	Density
1	Regenerated solution	26,4	0,006	0,35	9,36	7846	1,034
			Results after filtering				
2	AG-3	26,7	0,003	0,01	10,26	7735	1,032
3	AU-T	26,8	0,004	0,02	10,36	7243	1,029
4	AU-K	26,7	0,002	0,01	10,41	7942	1,034

As can be seen from the test results presented in tables 4 and 5, after filtering the saturated and regenerated MDEA solution using activated carbons AU-T and AU-K, the content of foaming and corrosive components in the solution decreased in the following order: H2S - from 0.006 to 0.002 mol/mol; CO2 - from 0.35 to 0.01 mol/mol; minerals - from 7846 to 7243 mg / l. The above results show that the pH of the solution after filtration increased from 9.36 to 10.41, indicating a decrease in the concentration of foaming components.

Conclusion. Comparison of our own experimental data with the literature data showed that the samples of activated carbon obtained by us from local raw materials AU-T and AU-K in terms of adsorption activity and other physical and chemical parameters are at the level of the well-known activated carbon AG-3, which is one of the highest quality coals. world industrial production. According to the test results, it was proved that the filterability of these activated carbons exceeds the filterability of activated carbon of the AG-3 type imported from the Russian Federation, which is used to filter the MDEA solution at the Gazlinsky GPP.

Thus, the performed studies show the feasibility of processing mulberry and maple wood into carbon adsorbents for various purposes.

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BASED ON ENERGY EFFICIENT PARAMETERS OF FRUIT DRYING CHAMBER DEVICES FOR SMALL ENTERPRISES

KURBANOV NE'MATILLA

PhD of Namangan Institute of Engineering and Technology
E-mail: nematilla68@mail.ru, phone: (+99894) 275-69-39

ROZIKOVA DILSHODA

PhD of the Namangan Institute of Engineering and Technology
E-mail: dilshoda@mail.ru, phone: (+99893) 677-41-35

Abstract:

Objective. Identifying the biological characteristics of the date fruit set as tasks in the organization of the technology of artificial drying of date fruit and skin; Analysis of widely used varieties in Uzbekistan; determining the main technological processes; biological properties and determination of the composition of the finished powder and the secondary filler. Expanding the assortment of agricultural products and providing the population with environmentally friendly food products is becoming one of the urgent issues. Development of an energy-efficient improved device that dries agricultural products in sufficient quantity with low consumption costs, as well as justification of its main parameters, efficient use of energy is directed to the main tasks. The drying chamber consists of two modules (drums) moving against the flow of hot air, and in the process of drying raw materials, it makes efficient use of time and leads to the drying of quality products in an energy-efficient way.

Methods. Thus, factors that increase the speed of the drying process include:

- process temperature raise _
- on the material being dried in the void the pressure reduction ;
- keep the heat conductor moist reduce _
- heat conductor on the material speed increase _
- process during the material mixing _

Results. The dry fruit version of dates is higher in calories than the fresh fruit. The high calorie content of dates gives a person great energy throughout the day. Dates are also packed with many vitamins and other nutrients that can be very beneficial for your health. Dates are rich in fiber and carbohydrates.

Conclusion. Diabetes is treated using synthetic drugs in combination with several drugs and supplements such as insulin. The substances contained in the date and its skin cells have the property of increasing the production of insulin, as well as reducing the absorption of glucose from the intestine. It is advisable to eat dates fresh, dried, or after drying the fruit skin and turning it into a powder, as an additive to food.

Keywords: Pharmacological properties, date skin, compounds, flavonoids, calories, pharmacological properties.

Introduction. Today, expanding the assortment of agricultural products and providing the population with environmentally friendly food products is becoming one of the urgent issues. Development of an energy-efficient

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