**Brief information about the project**

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| Name of the project | AP19679878 «Conversion of plant biomass waste into microporous activated carbons to successfully capture and separate $CO_2$, $N_2$ and $CH_4$» |
| Relevance | The idea of the project is to synthesize microporous activated coals from plant biomass waste by physical and chemical activation methods and to test synthesized activated coals in capture and separation of $CO_2$, $N_2$ and $CH_4$ from gas-air media. Kazakhstan occupies a leading position in the development of agriculture and during the harvesting and processing of agricultural products a huge amount of waste products is formed, which find little further use or burned. In this regard, the processing of plant biomass waste into activated carbon is an urgent task. The obtained activated carbons will find practical application in chemical enterprises for purification of gas-air emissions. |
| Purpose | Obtaining activated carbons from waste plant biomass with a developed microporous surface structure by physical and chemical activation methods for capture and separation $CO_2$, $N_2$ and $CH_4$ from gas-air media. |
| Objectives | 1. Obtaining activated carbons from plant biomass waste by physical activation (thermal carbonization followed by activation by superheated water vapor) and studying their main physico-chemical properties.<br>2. Preparation of activated carbons from plant biomass using the chemical activation method and selection of optimal conditions, as well as a chemical reagent for chemical activation to obtain carbons with a developed microporous surface structure. Determination of the main textural and physico-chemical properties of activated carbons prepared by chemical activation.<br>3. Study of the effect of textural and physico-chemical properties of prepared activated carbons on the capture and separation of $CO_2$, $N_2$ and $CH_4$. |
| Expected and achieved results | **Expected results.**<br>1. Activated carbons from plant biomass waste by the method of physical activation will be obtained (thermal carbonization followed by activation with superheated water vapor) and their basic physicochemical properties will be studied.<br>2. Activated carbons will be prepared from plant biomass using the chemical activation method and optimal conditions will be selected, as well as a chemical reagent for chemical activation to obtain carbons with a developed microporous surface structure. The main textural and physicochemical properties of activated carbons prepared by chemical activation will be determined.<br>3. The influence of textural and physicochemical properties of prepared activated carbons on the capture and separation of $CO_2$, $N_2$ and $CH_4$ will be studied.<br><br>**Achieved results.**<br>To obtain activated carbons, the following plant biomass wastes were selected: corn cobs and grape seeds. Work was carried out to grind plant biomass waste to a fraction of 2-3 mm, then the resulting working fractions were subjected to carbonization (pyrolysis) in an inert atmosphere at three different temperatures (600 °C, 700 °C and 800 °C) with exposure at these temperatures for 1 hour. After the carbonization process (pyrolysis), activation was carried out with superheated water vapor at a temperature of 800 ° C for 1 hour. Then the textural and physicochemical characteristics of |

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| | the resulting activated carbons were determined by such methods as: BET, SEM, XRD, Raman spectrometry, X-ray fluorescence analysis, IR-Fourier spectroscopy, determination of sorption capacity for iodine, determination of ash content, etc. |
| Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles | **Research Team Members.**<br><br>**1. Project manager:** Kishibayev Kanagat Kazhmukhanovich, PhD, leading researcher.<br>*Scopus Author ID*: 56604294100 (https://www.scopus.com/authid/detail.uri?authorId=56604294100)<br>*Researcher ID*: C-7678-2015 (https://publons.com/researcher/2429119/kishibayev-kanagat-kkk/)<br>*ORCID*: https://orcid.org/0000-0003-1590-5243<br>*Google Scholar*: https://scholar.google.com/citations?user=XG23bY8AAAAJ&hl=ru<br>*ResearchGate*: https://www.researchgate.net/profile/K-Kishibayev<br><br>**Executors:**<br><br>**2. Tokpayev Rustam Rishatovich**, PhD, leading researcher:<br>*Scopus Author ID*: 56998810900 (https://www.scopus.com/authid/detail.uri?authorId=56998810900)<br>*Researcher ID*: D-3859-2015 (https://publons.com/researcher/2424520/rustam-r-tokpayev/)<br>*ORCID*: https://orcid.org/0000-0002-0117-4454<br>*ResearcherGate*: https://www.researchgate.net/profile/Rustam-Tokpayev<br>*Google Scholar*: https://scholar.google.com/citations?user=bmnxQHEAAAAJ&hl=ru<br>**3. Khavaza Tamina Narimanovna**, master, researcher:<br>*Scopus Author ID*: 57345081100 (https://www.scopus.com/authid/detail.uri?authorId=57345081100)<br>*ORCID*: https://orcid.org/0000-0002-1614-3060<br>*ResearcherGate*: https://www.researchgate.net/profile/Tamina-Khavaza<br>**4. Ibraimov Zair Tairovich**, 3rd year doctoral student, researcher:<br>*Scopus Author ID*: 57345388600 (https://www.scopus.com/authid/detail.uri?authorId=57345388600)<br>*ORCID*: https://orcid.org/0000-0002-1476-3231<br>*ResearcherGate*: https://www.researchgate.net/profile/Zt-Ibraimov/research<br>**5. Ospanova Karlygash Atakanovna**, leading engineer.<br>**6. Yergeshov Maksat Ildaruly**, 3rd year student, laboratory assistant.<br>**7. Abdullanova Amina Moldabekovna**, 3rd year student, laboratory assistant**.**<br>**8. Serafin Jaroslaw**, University of Barcelona, PhD, leading researcher:<br>*Scopus Author ID*: 57193009079 (https://www.scopus.com/authid/detail.uri?authorId=57193009079)<br>*Researcher ID*: ABG-3073-2020 (https://www.webofscience.com/wos/author/record/2141042)<br>*ORCID*: https://orcid.org/0000-0003-3719-8762<br>*Google Scholar*: https://scholar.google.com/citations?user=foV9wm4AAAAJ&hl=ru&oi=sra<br>*ResearchGate*: https://www.researchgate.net/profile/Jaroslaw-Serafin |

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| List of publications with links to them | - |
| Patents | - |

Figure 1 – Installation for the Carbonization of Vegetable Raw Materials in an Inert Atmosphere

Figure 2 - Installation for superheated steam activation

Figure 3 – with ready-made activated carbon samples