

## **Basics of thermal recycling of Myanmar' plants waste into carbon adsorbents**

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**Relevance of the research.** Constantly growing of productions and consumptions in all countries are accompanied by an increase in the scale of anthropogenic inflow of pollutants into the environment, despite the environmental measures implemented to varying degrees, causing a number of well-known negative consequences. Their totality, according to the opinion expressed by some scientists, already at the present time causes damage to humanity, comparable to the consequences of the use of means of mass destruction. Among the pollutants contained in this intake, the most dangerous are those of an organic nature, which is associated with the greater ease of their penetration into living organisms with the risk of not only the occurrence of typical temporary disorders of the latter, but also the development of many diseases and pathologies up to death.

In order to minimize this negative impact, harmful emissions and discharges are treated by various methods. Among them, the deepest extraction of toxic components is provided by carbon adsorption treatment, which is usually the final stage of purification. On world markets, active carbons, the main agents of this technology, are represented by relatively expensive materials. This is a very significant obstacle to the widespread use of these adsorbents, especially in developing countries such as Myanmar, which do not have their own production of such products, prompting interest in their possible organization on the basis of existing own resources.

Many modern sources of information point to an intensive search for solutions of this orientation, based on the identification of the possibility and efficiency of obtaining carbon adsorbents using large-tonnage little or inexpediently used (and

therefore very accessible and cheap) local raw materials in the form, in particular, of plant waste from agro-industrial, wood-processing and food production. The cost of such wastes, essentially determined by the cost of their domestic delivery, is very low.

Along with this, the published operational properties of carbon adsorbents obtained on the basis of a number of representatives of these wastes, and to varying degrees substantiated, are quite high. These circumstances, taking into account the well-known fact of the influence of the type and composition of raw materials on the quality of the adsorbents obtained, are serious arguments for the expediency of carrying out research focused on the urgent needs of the Myanmar economy related to the development of new technologies in attracting the largest tonnage plant waste of enterprises and industries of the country in the form of rice husks and coconut shells in the form of rice husks (RH) and coconut shells (CS), stems and rhizomes of dried cotton plants - guza-pai (GP), tamarind fruit peel (TFP), Burmese ironwood (BI), obsolete bouquets of roses (BR), mango seed shells (MSS) and plum seed shells (PSS), determining the prospects of the scientific orientation and the high relevance of this problem. The latter is also emphasized by the serious insufficiency of the country's own production of activated coals, due, in particular, to the practical lack of study of these wastes as a raw material basis for their production.

**The degree of development of the topic.** The analysis of available sources of scientific and technical information revealed only some data on the production of activated carbons from wastes similar in nature to the wastes used in this work. With a few exceptions, there is little similar information on these wastes from Myanmar's factories and industries. At the same time, the issues of processing a wide range of wastes from logging and wood processing industries into carbon adsorbents, the cultivation of a number of agricultural, technical, fodder and food crops along with



these, the processing and use of their crops are covered in sufficient detail and in detail, which also indicates the relevance of solving the existing problems of their rational use.

**The aim of the work** is for solving of the scientific problem of substantiating the expediency and efficiency of using the above-mentioned wastes of enterprises and industries in Myanmar for the production of activated carbons by systematic study (in accordance with the facts of research no.8 and no.9 in terms of the production of carbon reducing agents and sorbents, no.10 in terms of new types of raw carbon materials, no.11 and no.12 of the passport of scientific specialty 2.6.12 - Chemical technology of fuels and high-energy substances) indicators of their suitability representative samples and rational conditions for their thermal processing into active carbons with an assessment of the technical characteristics and applied properties of the target products..

**Research objectives:**

- Analysis of the current state of issues of thermal processing of plant waste with the production of carbon adsorbents and the use of activated carbons in solving the problems of environmental protection from anthropogenic pollution.
- Assessment of the fundamental suitability of the waste used for this purpose by means of thermographic, physicochemical, thermal and chemical studies.
- Identification of rational conditions for pyrolysis of raw materials and activation of their target products by vapour, as key thermal processes of the most affordable technology for implementation in Myanmar, with an assessment of the yield and structural and adsorption properties of the resulting target products, consolidation of material balances of both thermal stages, determination of the composition of their by-products and directions of their use.

- Establishment of comparative efficiency of the use of the obtained carbon adsorbents in solving environmental and related problems.
- Determination of the expediency of processing certain types of used raw materials into activated carbons by other methods.
- Substantiation of the basic technological schemes for the production of carbon adsorbents according to the developed technologies and their instrumentation.
- Approximate technical and economic assessment of the production of activated carbons on the raw material base of used plant waste.

**Scientific novelty:**

According to the field of research of the passport of scientific specialty 2.6.12 - Chemical technology of fuels and high-energy substances in the work for the first time:

- Systematic studies of raw materials and products of their destruction have scientifically substantiated the fundamental possibility of thermal processing of most of the large-tonnage plant waste of Myanmar used in the work into active coals, competitive in solving the problems of environmental protection and human health, which potentially provides a significant contribution to the economy of the state and the range of these adsorbents in the world market.
- Through thermographic, physicochemical and chemical studies, a set of indicators of the delivered waste has been established, indicating the expediency of their study as a raw material for the production of carbon adsorbents, thereby contributing to the field of scientific knowledge about these resources of Myanmar.
- The regularities of the influence of raw material factors and pyrolysis processes of the named raw materials and the activation of pyrolysis products by water vapor parameters (heating intensity, limiting temperature, duration of isothermal treatment during it, specific steam consumption) on the yield and structural and adsorption properties of the obtained carbon adsorbents were revealed.



- The conditions for obtaining high-purity commercial products (liquid glass and silicon dioxide) and high-quality activated carbons from rice husks by activating the carbon part of the carbonized pyrolysis product of these wastes with  $\text{ZnCl}_2$ , as well as the possibility of changing the ion-exchange properties of activated carbon based on ironwood by impregnating it with thiourea and pyrolysis of the resulting impregnate.
- Kinetic regularities of intensive contact of small fractions of the obtained target products with samples of multicomponent effluents from the territory of the coke oven and by-product production of JSC Moskoks and their interaction with floating films of diesel fuel have been established, indicating the high efficiency of using most of them to remove organic impurities and their fundamental suitability for fixing oil spills.
- Kinetic and equilibrium regularities of extraction of vapors of volatile organic solvents (using the example of n-butanol) from the streams of their mixtures with air (PVA) by the grains of the obtained active carbons were evaluated, indicating the expediency of using a number of them for the preliminary treatment of PVS of increased concentrations.

**Theoretical and practical significance:**

1. Based on theoretical and experimental studies, a method has been developed for calculating baromembrane units using hollow-fiber membranes for ultrafiltration (UF) and spiral-wound membrane elements for reverse osmosis (RO).
2. Methods for obtaining drinking water with constructive simplicity and low energy costs have been developed, allowing for a high degree of purification comparable to that of water undergoing deep multi-stage purification.
3. A techno-economic analysis has been conducted to minimize the cost of treating brackish groundwater using a combined UF and RO system to produce clean water.

4. The proposed technology, utilizing combined UF and RO-based systems, enables the production of high-quality clean water while enhancing energy efficiency and resource conservation at water treatment facilities.

**The main provision of this work is to be defended:**

- results of physicochemical, thermographic and chemical studies of raw materials, focused on substantiating the expediency and conditions of its use in order to obtain carbon adsorbents, methods, sequence and conditions of thermal impact on processed materials during pyrolysis of raw materials and activation of its carburized products by water vapor.
- experimentally substantiated conditions and patterns of implementation of the processes of pyrolysis of raw materials, and activation of its carbonized residues by water vapor, providing a rational combination of yield and structural-adsorption properties of target products.
- technical, structural and adsorbent properties of the obtained target products, characterizing, in honesty, some of them as unique adsorbents.
- comparative assessments of the efficiency of the use of the obtained adsorbents in the processes of purification of industrial effluents and process solutions from organic impurities, fixation of film spills on the water surface of diesel fuel, detoxification of soils contaminated with herbicides and products of their degradation, and extraction of vapors of volatile organic solvents from their mixtures with air.
- The results of the approximate assessment of the cost of production of the resulting activated carbons in the conditions of Myanmar.