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# Physical and Thermophysical Properties of Materials Based on Mineral and Vegetable Raw Materials

***Tillayev Abidjon***
*Professor of Samarkand State Architectural and Civil Engineering Institute*
***Berdiyev Haqberdi***
*Master student of Samarkand State Architectural and Civil Engineering Institute*

***Abstract:*** *Numerous studies have established that one of the ways to rationally use agricultural waste is to use it as a heat-insulating and heat-insulating structural building material; in most cases, this applies to low-rise and, especially, rural construction. In this case, mineral and organic binders can be used as binders. The problems of obtaining such materials were mainly solved. There are no studies of physicochemical, physic technical, incl. and pyrotechnic properties of agricultural waste, especially cotton stalks and materials based on them, and the operational and technical properties of structures using of these materials, which makes it difficult to predict the long-term preservation and, accordingly, ensure the thermal comfort of residential buildings in the sharply continental climatic conditions of the Republic of Uzbekistan.*

***Keywords:*** *Physical and thermo physical, organic binders, mineral, heat-insulating structural.*

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## Introduction

The mineral resource potential is the most important factor in the location of modern production, which largely determines the territorial organization of productive forces, the scale of concentration of production and the nature of its specialization. Therefore, the issues of the effectiveness of building materials are of undeniable relevance. However, it should be noted that the use of this potential leads to the depletion of natural resources, which negatively affects the ecological state of the environment. The development of the building materials industry is closely connected with the involvement of the most effective natural resources in the national economic turnover and with the economic development of natural resources, which requires, first of all, accounting and correct assessment of natural resources, in particular mineral ones. The problem of the rational use of mineral resources is one of the complex problems of an economic and social nature. Therefore, the development of the correct methodology for quantitative accounting and the rational use of mineral resources will make it possible to determine the actual magnitude of the effect that can be obtained from optimizing their use. When determining the need for building materials, the volumes of capital investments given in the tables for construction and installation work in all sectors of the national economy were taken as a basis. When calculating the need for building materials, a change in their structure in favor of more advanced materials was also taken into account. In the end, based on a comparison of the need for building materials calculated by us and their possible production based on the use of proven resources, the degree of supply of building materials industry enterprises with

mineral raw materials and the efficiency of its use for each construction zone in the future were determined. Uzbekistan has large reserves of various types of raw materials for the production of building materials [1].

## 2. Materials and methods.

The cotton stalk is characterized mainly by a more uniform folded structure, which confirms the similarity of the cotton stalk and wood in terms of structure and chemical composition. This makes it possible to use the main characteristics of wood for the stem of a cotton-loose structure [1]. Nevertheless, cotton, like any plant tissue, is a complex of constituent parts that differ sharply in properties, which largely determine its structure-forming characteristics [2]. Cotton stolk consists of cellulose (approximately 44% of the total mass of cotton stalk), pectin, lignin, hemicellulose and a small number of extractives - tannins (tannins and dyes) and fats (see Table 1). Cellulose and lignin, which make up the bulk of fiber, are fairly stable substances and do not have a harmful effect on the hardening process of clinker cements. Pectens and the hemicellulose part of the cotton stem are a complex of oligo- and polysaccharides capable of being hydrolyzed in an alkaline environment and converted into water-soluble sugars. The simplest water-soluble sugars (sucrose, glucose, and fructose) are contained in cotton stalk in a small amount (0.1 ... 0.5% of its mass). Due to the small size of the molecules, water-soluble sugars are easily washed out of it with a “mineralizer” solution and enter the cement paste. Water-soluble sugars are the strongest "cement poisons". Extractive substances - tannins have large molecular sizes. They are washed out of the wood only with hot water or a hot solution of a "mineralizer" and are well deposited. As a result, tannins do not have a significant effect on the cement hardening process. The resinous substances contained in the cotton stalk also do not affect the cement hardening process. Resin acids released from the stalk of cotton, when interacting with alkalis that are in the cement paste, form soap solutions. With a significant content of resinous substances in the cotton stalk, the strength of the RCC may slightly decrease due to a decrease in the wettability of the cotton stalk particles and deterioration of adhesion to the cement paste (stone). Studies have shown that the cotton stalk contains easily hydrolysable and extractive substances - "cement poisons" that are harmful to cement, which slow down the strength development of the tested samples. Therefore, our efforts were aimed at neutralizing such harmful influence. Studies have shown that easily soluble simple sugars have the most harmful effect: sucrose, glucose, fructose and part of hemicellulose, which can hydrolyze to sugars under certain conditions, and pectin polysaccharides, tannins and resins are less dangerous.

Fig. 1. Preparing cotton stalk as a filler.

Table 1. Main characteristics and chemical composition of cotton stalk

| | Name of minerals | Uzbekistan (Central Asia) | Tajikistan (Central Asia) | Turkmenistan (Central Asia) | USA |
|---|---|---|---|---|---|
| 1 | proteins | 11.1 | 5.1 | 1.1 | 0.1 |
| 2 | pectins | 10.2 | 10.2 | 10.2 | 10.2 |
| 3 | cellulose | 35.4 | 30.4 | 35.4 | 25.4 |
| 4 | fatty oil | 34.2 | 39.2 | 44.2 | 34.2 |
| 5 | phytin | 0.4 | 0.4 | 0.4 | 0.4 |
| 6 | phosphatides | 0.8 | 0.8 | 0.8 | 0.8 |
| 7 | sterols | 0.5 | 0.5 | 0.5 | 0.5 |
| 8 | starch | 1.0 | 1.0 | 1.0 | 12.0 |
| 9 | coloring pigments | 1.05 | 6.05 | 1.05 | 1.05 |
| 10 | gossypol | 1.35 | 1.35 | 1.35 | 1.35 |
| 11 | vitamins B6, B2 | 1.6 | 0.6 | 0.6 | 10.4 |
| 12 | thiamine | 0 | 1 | 0 | 0 |
| 13 | folic acid | 0 | 1 | 0 | 0 |
| 14 | provitamins A, E | 1.1 | 1.1 | 1.1 | 1.1 |
| 15 | tannins | 0.3 | 0.3 | 1.3 | 0.6 |
| 16 | organic acids | 0.3 | 0.3 | 0.7 | 0 |
| 17 | flavonoids | 0.7 | 0.7 | 0.3 | 0.9 |
| 18 | polyhydric alcohol | 0 | 0 | 0 | 0 |
| | total | 100% | 100% | 100% | 100% |

## 3. Results and discussion

To date, there is practically no industrial processing of cotton stalks for building materials. At the same time, cotton waste can become a valuable raw material as additives for cement-containing compositions. In [3], from cotton leaves and cotton meal, formed during the mold-press extraction method for the production of cottonseed oil, additives were obtained to increase the strength of concrete. In order to determine the feasibility of using cotton stalk to obtain additives, analyzes of the compositions of different morphological parts of cotton stalks were carried out. The cotton stem morphologically consists of bark, bast, wood and pith. The woody part of the stem is 63 ... 65%, bark and bast - 28.6 ... 29.7%, boxes - 3 ... 5% and the core - about 3% of the total mass. The chemical composition of various morphological parts of the stem is given by the content of the components. Comparison of the chemical composition of cotton stalks with the composition of wood raw materials, in particular, sawmill waste, shows that the cellulose content in cotton stalks is slightly lower than in ordinary wood, but the total carbohydrate content is approximately the same. This is due to the high content of hemicellulose, in particular, pentosans, and the low content of lignin in cotton stalks. The content of substances extractable with an alkali solution is higher in cotton stalks than in wood. With this extraction, starch, pectins, inorganic salts, some polysaccharides, cyclic alcohols, dyes, tannins, as well as part of hemicellulose, uranic acids, and low molecular weight fractions of cellulose pass into solution. The difference between the extractive components of cotton stalks and wood is primarily quantitative. So, in the stems of cotton, there are significantly more extractable substances than in hardwoods and somewhat more than in coniferous woods. The qualitative difference is that the hemicelluloses of cotton stems consist mainly of pentosans (xylan, araban), while the hemicelluloses of coniferous wood are very complex mixtures of polysaccharides containing, in addition to xylans, glucomannans and galactomannans.

Fig. 2. Cotton stalk after grinding (milling).

**4. Conclusion.**

Taking into account the fact that the release moisture content of a cotton stalk according to Standard 19222-84 [4] is up to 25% and the moisture content of samples when determining brand strength is not regulated, and extreme strength values are obtained at a moisture content of 15 ... 17%, to increase the objectivity of the assessment strength characteristics and comparability of results when selecting mixture compositions (for sample moisture from 5 to 25%), one should determine the maximum strength MPa - ultimate compressive strength at humidity W,%; a - the correction factor for humidity, obtained empirically, is taken with a sign (+) at W 16 and (-) at W 16); W is the humidity of the test sample, %; 16 - average humidity corresponding to the maximum strength of wood concrete. Thus, the possibility of reducing the strength of the cotton stalk due to the nature of the cellulose-containing plant aggregate itself is an irreversible process and manifests itself as a consequence of the susceptibility of the plant aggregate to significant volumetric moisture deformations and the development of swelling pressure. Influence of an aqueous solution of hydrazine on the strength of the burr stem during its heat treatment. There are various methods for hardening the cotton stalk mixture. One of these methods is the use of various vapor-air mixtures during their heat treatment. Hydrazine in aqueous solutions is easily oxidized. A strong reducing agent, for example, separates precious metals from solutions of their salts. Technical hydrazine contains water, carbon dioxide, hexane, toluene, hydrazine-carbonic acid, 1,2-dimethylhydrazine and aniline as contaminants. Aqueous solutions of hydrazine have strong basic properties. Anhydrous hydrazine - dehydration of hydrazine monohydrate with alkalis or treatment of liquid hydrazine sulfate. Thermal decomposition of hydrazine occurs at a temperature of 250-310C. In this case, only a small amount of ammonia is formed.

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