Spectrum Journal of Innovation, Reforms and Development
Volume 09, Nov., 2022 ISSN (E): 2751-1731
Website: www.sjird.journalspark.org

STUDY OF PHYSICAL-MECHANICAL PROPERTIES OF POPLAR WOOD USING HOT STEAM

Tursunov Narimon Sultonboevich
Fergana Polytechnic Institute, Senior Lecturer
n.tursunov@ferpi.uz

Abstract
In article it is resulted materials after working out and a substantiation of technology of thermomodifying of wood of the local poplar, allowing to receive a material with the improved physicomechanical characteristics and various architecturally - the art decision.

Keywords; Wood, a poplar, heat treatment, physicomechanical the characteristic, technologies of thermomodifying, an autoclave.

Introduction

Recently, one can observe an increasing interest in improving the quality of lumber using heat treatment. The market of thermal wood (TMD) in our republic is in its infancy. Speaking of thermowood, it seems appropriate to position this product in two niches: the first of them is thermowood made from fast-growing species (birch, spruce, aspen, pine, poplar); the second is thermal wood, made from valuable wood species (beech, oak, ash, some tropical species). And if the first involves giving fast-growing breeds high consumer qualities, bringing them closer to valuable breeds, and often surpassing them, then the second is an expensive product, where the exclusivity of the material with new, unique characteristics (for example, the wood of a recently fresh oak acquires the parameters of a bog one); this category is designed for consumers with incomes significantly above average.

In this regard, depending on the material being modified and the required depth of processing, European standards distinguish three classes of thermowood:

- processing is carried out in the temperature range of 190 - 210 °C. There are no significant changes in the physical properties of the material. The main purpose of this mode is to give certain decorative properties to wood: its color darkens, acquires a brownish, reddish or yellowish tint. Wood treated in this way is recommended to be used in the same cases as wood not subjected to heat treatment.
- processing temperature 210 - 230 °C. As a result of processing, resistance to decay increases by 3-4 times, but at the same time flexibility and elasticity decrease. Such wood is used to produce high-quality lumber, landscape gardening structures, finishing panels and floors, home and garden furniture, windows, doors, etc.
- processing is carried out at a temperature above 230 °C. Thermowood with this class of processing is recommended in cases where a very high resistance to decay is needed. For example, for the manufacture of windows, exterior doors, exterior wall decoration, street

decking, fences, playground structures, etc.

Improving the efficiency of woodworking industries and the utilization rate of local and imported wood species is currently one of the urgent tasks for Uzbekistan. There is a need for a wood processing technology that allows reconsidering the use of wood, including low-grade wood, for the needs of construction and furniture production. Such a basic innovative technology today is the thermal modification of wood, which raises the depth of processing and wood products to a new competitive level.

Relevance

Currently, wood products are increasingly used in construction, and hardwoods are mainly used. There has been a shortage of hard rocks (they are renewed 7-10 times slower than low-value soft rocks) and, as a result, their cost is growing.

At the same time, in the woodworking industry, technological methods have been widely used in world practice that contribute to the modification of soft, low-value tree species to impart unique consumer and physical and mechanical properties. Of the available technologies at the moment, the most relevant are the technologies for processing wooden products in special chambers, which significantly improves the performance properties of wood: biological stability is increased, equilibrium moisture is reduced, the coefficient of swelling of wood when moistened is reduced, the possibility of water penetration into the material is significantly reduced, decorative properties, etc. Currently known foreign technologies in the process of heat treatment to protect the material from oxygen, as well as the supply of thermal energy, use superheated water vapor or a liquid medium. In addition, the technologies currently used still do not have a calculation base that allows obtaining the optimal operating parameters of the process, there are no clear recommendations on the choice of temperature regime and processing time depending on the required qualities of the finished product.

In our state, some scientific experience of thermal modification of wood is known. The most relevant for this period are studies aimed at thermal modification of the properties of wood of those species that grow in Uzbekistan. Since wood, as a unique natural material, has properties that depend not only on the species, but also on the conditions and place of growth. In accordance with this, the properties and technological modes of heat treatment for our wood species may differ from foreign analogues. Thus, the study of the processes of thermal modification of local poplar wood under conditions of superheated steam and the development of domestic energy-saving technologies and equipment should be considered an urgent task of great national economic importance.

When developing a method for experimental processing of poplar wood of local species in laboratory conditions using the "THERMOWOOD" technology, the characteristic features of the processes that manifest themselves under the conditions of processing with superheated steam were considered, which made it possible to trace the phenomena occurring in the process of heat treatment. In the course of experimental processing, bars made from poplar wood growing on the territory of our state were taken as model samples.

Due to the fact that the production of thermomodified wood in our state is not established and there is no equipment. Therefore, to obtain thermally modified samples of local poplar wood,

experimental processing was carried out in laboratory conditions and an autoclave was taken as an aggregate.

Following the stages of the "THERMOWOOD" technology for heat treatment of wood, a preliminary preparation of the processed material is carried out: in the case of experimental studies on wood processing under conditions of superheated steam, the processed material must have a high natural moisture content. Next, the test material is weighed and placed in an autoclave. After that, drying, heat treatment and hardening by means of heat and steam take place in accordance with the established heat treatment mode.

The heat treatment process starts:

- during the experiment, the samples are placed in the autoclave, the cover 2 of the autoclave is closed, the safety valve 15 is opened and steam is supplied. The safety valve 15 is open until the steam has completely displaced the oxygen from the autoclave. After the displacement of oxygen, valve 15 closes, the desired temperature is set in the autoclave, and wood processing begins.
- in the case of experiments on wood processing with the supply of superheated steam, the process consists of successive stages: drying, heat treatment and hardening.
- the experiment begins with the fact that the temperature in the autoclave rapidly rises to 1000 C for 2 hours, then the temperature is brought to 1300 C for 4 hours. During this time, the samples are dried.
- after 6 hours, the heat treatment stage begins. The temperature in the autoclave rises to 2200 C for 1.5 hours. Further, for another 1.5 hours, the temperature in the autoclave remains unchanged at 2200 C. The total heat treatment time is 3 hours. During the period of heat treatment, a structural change occurs in the processed wood of local poplar species.
- the last stage of heat treatment is the hardening of wood. The autoclave is turned off and the samples remain inside until they cool completely. After cooling, the autoclave is opened, samples are taken out and examined.

The initial examination of the samples showed that the weight and dimensions of the treated wood had decreased. The texture became denser to the touch, the color became brownish.

As a result of close contact of the material with the heating surfaces 5 and 6, the sample is intensively heated. The heating temperature is controlled using a thermocouple 10 installed in the stove, a control electronic device 11 and a control panel 12.

In the case of conducting experiments on vacuum-conductive drying of wood with a periodic supply of thermal energy, the process consists of successively alternating stages of heating and vacuuming, therefore, after reaching a certain temperature in the center of the material, which is also recorded using thermocouples installed in the wood, the heating plates are switched off , and the stage of evacuation is carried out. To do this, the vacuum pump 2 is switched on and the refrigerant is supplied to the condenser 3. The absence of free volume ensures the instant removal of the vapor-gas mixture through the perforated plates into the vacuum system. The absolute pressure in the chamber at the stage of evacuation is determined using a pressure gauge 13. Exposure under vacuum is carried out until the temperature in the center of the lumber 4 drops to a predetermined value. After the end of the evacuation stage, the vacuum pump 2 is switched off and by opening the inlet valve, atmospheric air is injected into the

chamber 1 and the stage of lumber heating begins.

The creation of an air environment in chamber 1 in the process of heating the wood is carried out in order to reduce the evaporation of moisture from the surface of the material and, as a result, the possibility of increasing the temperature of the wood to higher values. Thus, the alternation of the stages of heating the dried wood and vacuuming is carried out in the process of vacuum-conductive drying of wood with a periodic supply of thermal energy. The number of "heating-vacuuming" cycles is determined by the given final moisture content of the wood. When conducting experiments on thermal modification of wood, a pre-dried sample is subjected to double-sided heating to a predetermined temperature during a time interval specified by the experiment plan with a simultaneously operating vacuum line. Next, having depressurized chamber 1 with an inlet valve, cover 9 is opened and the sample is examined.

Conclusions

- Obtaining thermomodified wood for laboratory research was carried out in a specially designed chamber, similar in its action to an autoclave.
- In the laboratory studied: changes in the structure; water resistance; biostability and dimensional stability.
- Heat treatment contributed to a decrease in the size and weight of the samples, the appearance of brittleness, and a change in color.
- Heat treatment has affected the decrease in the swelling of wood, the acceleration of the process of dumping excess moisture.
- Heat-treated wood has sufficient relaxation properties in comparison with non-heat-treated wood;
- A positive aspect of thermomodified local poplar wood is a decrease in water saturation during prolonged exposure to moisture (more than 3 weeks). Wood increases its size by 3-4 times less and at the same time does not rot and does not lose its appearance.
- Heat-treated wood, thus obtained with an organized structure, density, water resistance, which makes it possible to exclude its additional processing with hydrophobic compounds.
- With all the qualities described above, heat-treated wood acquires the texture and color necessary for finishing materials.

References List

1. Tursunov, N. S., & Razzakov, S. J. (2020). METAL WOODEN SPATIAL ROD CONSTRUCTION FROM COMPOSITION WOODEN ELEMENTS. Journal of Tashkent Institute of Railway Engineers, 16(4), 78-82
2. Umarov, S. A. (2021). Development of deformations in the reinforcement of beams with composite reinforcement. Asian Journal of Multidimensional Research, 10(9), 511-517.
3. Умаров, Ш. А. (2021). Исследование Деформационного Состояния Композиционных Арматурных Балок. TA'LIM VA RIVOJLANISH TAHLILI ONLAYN ILMIY JURNALI, 1(6), 60-64.

4. Abdugofurovich, U. S. (2022). BONDING OF POLYMER COMPOSITE REINFORCEMENT WITH CEMENT CONCRETE. Gospodarka i Innowacje., 24, 457-464.
5. Абдуллаев, И. Н., Умирзаков, З. А., & Умаров, Ш. А. (2021). Анализ Тканей В Фильтрах Систем Пылегазоочистки Цементного Производства. TA'LIM VA RIVOJLANISH TAHLILI ONLAYN ILMIY JURNALI, 1(6), 16-22.
6. Davlyatov, S. M., & Kimsanov, B. I. U. (2021). Prospects For Application Of Non-Metal Composite Valves As Working Without Stress In Compressed Elements. The American Journal of Interdisciplinary Innovations Research, 3(09), 16-23.
7. Умаров, Ш. А., Мирзабабаева, С. М., & Абобакирова, З. А. (2021). Бетон Тўсинларда Шиша Толали Арматураларни Қўллаш Орқали Мустаҳкамлик Ва Бузилиш Ҳолатлари Аниқлаш. TA'LIM VA RIVOJLANISH TAHLILI ONLAYN ILMIY JURNALI, 1(6), 56-59.
8. Тошпулатов, С. У., & Умаров, Ш. А. (2021). ИНСТРУМЕНТАЛЬНО-УЧЕБНО-ДИНАМИЧЕСКИЕ ХАРАКТЕРИСТИКИ СРЕДНЕЙ ШКОЛЫ И КОНСТРУКТИВНЫЕ РЕШЕНИЯ СРЕДНЕЙ ШКОЛЫ№ 2 Г. ФЕРГАНЫ. TA'LIM VA RIVOJLANISH TAHLILI ONLAYN ILMIY JURNALI, 1(6), 10-15.
9. Hasanboy o‘g‘li, A. A. (2022). Stress Deformation of Flexible Beams with Composite Reinforcement under Load. American Journal of Social and Humanitarian Research, 3(6), 247-254.
10. Hasanboy o‘g‘li, A. A. (2022). Stress Deformation of Flexible Beams with Composite Reinforcement under Load. American Journal of Social and Humanitarian Research, 3(6), 247-254.
11. угли Ахмадалиев, А. Х., & угли Халимов, А. О. (2022, May). КОМПОЗИТНОЕ УСИЛЕНИЕ ИЗГИБАЮЩИЙ БАЛК ПОД НАГРУЗКОЙ. In INTERNATIONAL CONFERENCES ON LEARNING AND TEACHING (Vol. 1, No. 7, pp. 409-415).
12. Сон, Д. О., & Халимов, А. О. (2021). УПРАВЛЕНИЕ МЕТРОЛОГИЧЕСКИМИ РИСКАМИ КАК ОСНОВА ДЛЯ УВЕЛИЧЕНИЯ КАЧЕСТВА ПРОДУКЦИИ. Экономика и социум, (2-2), 202-210.
13. Бахромов, М. М., & Раҳманов, У. Ж. (2020). Проблемы строительства на просадочных лессовых и слабых грунтах и их решение. Интернаука, (37-1), 5-7.
14. Мирзаева, З. А. К., & Рахмонов, У. Ж. (2018). Пути развития инженерного образования в Узбекистане. Достижения науки и образования, 2(8 (30)), 18-19.
15. Mirzaakbarovna, M. S., & Sultanbayevich, T. N. (2021). Wood Processing For Construction. The American Journal of Applied sciences, 3(05), 186-189.
16. Tursunov, N. S., & Razzakov, S. J. (2020). METAL WOODEN SPATIAL ROD CONSTRUCTION FROM COMPOSITION WOODEN ELEMENTS. Journal of Tashkent Institute of Railway Engineers, 16(4), 78-82.
17. Мирзаева З. А. К., Рахмонов У. Ж. Пути развития инженерного образования в Узбекистане //Достижения науки и образования. – 2018. – Т. 2. – №. 8 (30). – С. 18-19.

18. Zarnigor M., Ulug‘bek T. HUDUDNI VERTIKAL REJALASHTIRISH LOYIHASINI ISHLASHDA TABIIY SHART-SHAROITLARNI INOBATGA OLISH MASALALARI //INTERNATIONAL CONFERENCES ON LEARNING AND TEACHING. – 2022. – Т. 1. – №. 1.
19. Mirzaeva Z. A. Improvement of technology technology manufacturing wood, wood with sulfur solution //Asian Journal of Multidimensional Research. – 2021. – Т. 10. – №. 9. – С. 549-555.
20. Nazirov A. S., Mirzayeva Z. A. ORDER OF INSTALLATION OF ELEMENTS OF ASSEMBLY-MONOLITHIC FLOORS AND COVERINGS //INTERNATIONAL CONFERENCES ON LEARNING AND TEACHING. – 2022. – Т. 1. – №. 8. – С. 292-296.
21. Mirzajonovich Q. G., Qizi M. Z. A. Determination Of Condensation On The Inner Surface Of The Walls Of Canoe Buildings Under The Influence Of Aerosols //The American Journal of Engineering and Technology. – 2021. – Т. 3. – №. 12. – С. 14-19.
22. Мирзажонович ҚҒ, М. С. (2022). Биноларни ўровчи конструкцияларини тузлар таъсиридаги сорбцион хусусиятини яхшилаш. *RESEARCH AND EDUCATION*, 86.
23. Набиев, М. Н., Насриддинов, Х. Ш., & Кодиров, Г. М. (2021). Влияние Водорастворимых Солей На Эксплуатационные Свойства Наружные Стен. *TA'LIM VA RIVOJLANISH TAHLILI ONLAYN ILMIY JURNALI*, *1*(6), 44-47.
24. Tolkin, A. (2020). Reconstruction of 5-storey large panel buildings, use of atmospheric precipitation water for technical purposes in the building. *The American Journal of Applied sciences*, *2*(12), 86-89.
25. Tolqin, A. (2021). Ancient greek and ancient rome architecture and urban planning. *The American Journal of Engineering and Technology*, *3*(06), 82-87.
26. Axmedov, T. (2021). Gotika uslubining arxitekturadagi ahamiyati. *Scientific progress*, *2*(6), 1305-1310.
27. Obidovich, A. T. (2022). Architecture And Urban Planning In Uzbekistan. *Texas Journal of Engineering and Technology*, *9*, 62-64.
28. Yuvmitov, A. S., Toshpo‘latov, S. U., & O‘ktamov, B. B. (2021). Instrumental Study of Dynamic Characteristics of Secondary Schools with Different Syllabus and Construction Solutions in Fergana. *CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES*, *2*(11), 200-208.
29. Бахромов, М. М. (2020). Исследование сил негативного трения оттаивающих грунтов в полевых условиях. *Молодой ученый*, (38), 24-34.
30. Abdullayev, I., & Umirzakov, Z. (2020). Optimization of bag filter designs (on the example of cement plants in the fergana region of the republic of Uzbekistan). *Збірник наукових праць ΛΟΓΟΣ*, 31-34.
31. Abdullayev, I. N., & Umirzakov, Z. A. (2021). Efficiency of Fabric in The Systems of Dust and Gas Cleaning of Cement Production.
32. Xaydarov, A. M., & Tursunov, N. S. (2022). IMPLEMENTATION OF ENGINEERING AND PREPARATORY WORKS AND IMPROVEMENT IN THE CITIES.

INTERNATIONAL JOURNAL OF SOCIAL SCIENCE & INTERDISCIPLINARY RESEARCH ISSN: 2277-3630 Impact factor: 7.429, 11(07), 80-83.

33. Xaydarov, A. M., & Tursunov, N. S. (2022). URBAN PLANNING AND RECONSTRUCTION REGIONAL ENGINEERING TRAINING. INTERNATIONAL JOURNAL OF SOCIAL SCIENCE & INTERDISCIPLINARY RESEARCH ISSN: 2277-3630 Impact factor: 7.429, 11(07), 77-79.
34. Sultanboevich, T. N. (2020). Development Of Spatial Metal Wooden Bar Constructions of Coatings, From Composition Wooden Elements. The American Journal of Applied sciences, 2(12), 113-121.