ANALYSIS OF THE POTENTIALS FOR REDUCING ENERGY COSTS OF WOODWORKING ENTERPRISES

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Abstract

The work deals with the efficient use of wood as a renewable source of energy, and to reduce the share of energy costs in the cost structure of production.

Key words: wood, drying, energy saving.

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Introduction

Enterprises of the woodworking industries consume a significant amount of the purchased expensive thermal energy as a rule. The share of energy costs in the structure of production price is quite high (20-30%) today, indicating a high energy intensity of production [1, 2]. In modern conditions, when gradual tariff increase for utilities is inevitable, particularly relevant becomes a problem of energy saving in the production and business activity of the enterprises [3, 4].

Touching upon the issue of energy saving of the wood-processing enterprises, we cannot ignore the most energy-intensive process of this industry - drying of wood. Duration of drying takes from two weeks to two months at the majority of woodworking enterprises of the country depending on the assortment of the dried lumber, thus there is a significant consumption of heat and electricity. Therefore, drying of wood is quite energy-intensive and, consequently, expensive process. But even at high costs of the process it is unable to avoid the low-quality drying of lumber, because the enterprises often use the outdated design of drying chambers.

Often new, "modern" drying chambers do not satisfy the quality requirements of lumber, because they do not have the optimal hydrodynamic flows of heat carrier. In addition, it is not taken into account the specificity of the production when buying equipment: if the company focuses on production of small quantities of products made of valuable hardwood, such as oak, it is reasonable to purchase drying chambers using vacuum technology. If the company works for mass production of joinery products of inexpensive species, the convective drying chamber will be rational design.

There are great numbers of vacuum and traditional convective technologies and each of them has its place, so the choice of a way should be treated very carefully. A reasonable approach is to invite specialists-consultants able to recommend the necessary equipment or adjust the technology taking into account the production peculiarities. It is also important to attract to the production engineers-economists capable to calculate technical and economic indicators of a particular dryer, taking into account the quality of the end product, energy costs and other current expenses that form the cost of the product. For example, promising vacuum-dielectric drying cameras based on heating of drying material with dielectric properties, provide thickness heating of the material and high-quality drying of relatively thin lumber in electric field of high frequency. While drying thick lumber made from wood of firm breeds (thickness of more than 60 mm), water boils not in the whole volume of material, but only in the surface layers. Boiling does not occur in the Central areas of lumber, and the water moves to the border of the phase change due to temperature gradient. This mechanism of process of a continuous flow of high-frequency energy material leads to great extremes of humidity on the thickness of the material and drying voltage that cause cracking of the wood. In addition, high consumption of electricity is inevitable.

Results

A vacuum-oscillating drying chamber for drying round logs for the elite housing on the market offers, developed by employees of Department of processing of wood materials of Kazan National Research Technological University is offered. The drying process consists of sequence-hence alternating stages of wood heating and vacuum. Material is treated by superheated steam in the absence of inert gas in the working chamber of the machine at the stage of heating. In this period, the temperature of the wood increases, accompanied by the evaporation of moisture from the skin surface. Wood is heated to a certain temperature, followed by a stage of vacuum, which is characterized by intense evaporation of moisture from the surface of the material. At the next stage the camera is supplied by saturated vapour, which simultaneously carries out a role of the agent of heat and moisture treatment. The vapour removes the internal...
stresses and goes into the creation of the steam environment for its subsequent overheating. The technology of vacuum drying produces well results for the materials of the big sizes, but too complex for drying of other timber products.

It is distinguished the traditional technology with the use of water vapour to relieve internal stresses in the field of convective drying and “pulse” modes, developed by Moscow State Forest University, which have an increasing distribution in recent years. The main point of these modes is as follows. Drying of the material is organized in cycles, each of which consists of two stages. At the first stage of the cycle drying of wood is realized in the air of high temperature and low humidity. There is the intensive circulation of drying agent and air exchange with the environment in the chamber. This period is characterized by the accumulation of wood heat and high intensity of process of drying due to the large gradient of moisture. The tensile stresses appear in the wood surface areas. At the second stage circulation systems, heat supply and ventilation stop working. This period is characterized by the evaporation of wood moisture due to the heat, accumulated by material at the first stage, and by increasing the degree of saturation of the air.

As production experience shows, drying “pulse” mode while the corresponding ratio of the duration of the stage of the process takes place practically without the development of residual deformations, and consequently without residual stresses at low humidity drops on the thickness of the material.

Application “pulse” modes for convective drying chambers allows not only refuse the use of water vapour, but also to save electricity by turning off the circulating fans at the second stage and significantly simplify the system of automatic regulation of process of drying. The technology for drying on the basis of «pulse» regimes proved to be sufficiently universal and effective. It can be recommended for steam forest drying cameras that in addition to reducing the cost of electricity will give 30% saving water of vapour owing to the fact that there will be no necessity to conduct a final and intermediate heat and moisture treatment and air-conditioning.

However, the consumption of thermal energy by enterprises can not be completely excluded, even in view of climatic conditions. Therefore, the wood processing enterprises is forced to buy expensive thermal energy cogeneration plant. This leads to a high annual costs and increases the cost of production. The calculation of Prime cost of 1 Gcal of heat energy from various sources taking into account operating costs in developing showed that viable option for heat energy is the use of waste of woodworking enterprises.

Wood wastes, which can reach 50-60 % in some cases, are technological inevitability of woodworking industries. If wastes are used as technological raw materials for other industries at the large enterprises of wood, they are disposed of in landfills and dumps at the small enterprises, that increase costs for transportation and waste disposal, as well as the pollution of the environment. In this regard, the creation of Autonomous sources of thermal energy, using the unclaimed wood waste is of particular urgency.

However, the use of wood waste as fuel in existing furnace devices leads to certain difficulties. This is due to the fact that a slight modification of the characteristics of wood fuel, typical for the majority of woodworking enterprises, reduces the efficiency of the combustion process, and hence the profitability of thermal waste treatment. The change of humidity and composition of the fuel also leads to a change in volume and toxicity of wastes of generated flue gases.

In this regard many researchers have conducted investigations in the field of increase of efficiency of burning of wood waste in recent years. So, the preliminary drying of wastes by exhaust flue gases in the bunker-dosing was proposed by the employees of the Kazan National Research Technological University. The proposed structure of the furnace allows the device to use almost all the types of waste wood with humidity up to 60% (sawdust, shavings and lump waste).

The principle of gasification used in this construction is the way to high temperature oxidation of wood with restricted air in the producer gas, which consists of combustibles (CO, H₂, CH₄) and inert gases (CO₂, N₂) which are then combusted in the combustion chamber. It should be noted that the gas emissions from waste incineration according to this scheme on the quantitative and qualitative composition are close to the emissions from boilers on natural gas. The efficiency of this installation is as high as 85-90%. Thus, the use of the proposed technical solution will allow not only to get cheap heat, but also to solve the environmental problem of disposal of wood waste.

However, not always all waste are burned because the company may not need such amount of thermal energy, for example in forestry, practicing in cutting and export of raw wood.

In connection with this, we consider another way of effective use of timber as a continuing source of energy wood by the example of pyrolysis - high-temperature distillation of wood without access of air. In this case, the end products are the production of charcoal, liquid product of pyrolysis and combustible gases. As is well known charcoal is in a strong demand both in Russia and abroad and finds application in a life, chemical, metallurgical, medical and other industries. Simplicity of hardware design, variety of products and ease of adjustment
system settings make this method not less perspective. However, liquid product of pyrolysis and combustible gases are not caught in existing devices. Whereas the further processing of product of condensation of steam mix allows to receive veterinary and smoke drugs, creosote oil used for antiseptic treatment of leather on leather factories etc. And, finally, permanent flammable gases can be used for generating cheap power. In addition, the productivity and efficiency of the installation may be significantly increased with the proper organization of the process with prior predrying of raw materials and following intense cooling of the obtained coal.

Conclusion

Introduction of the energy saving technologies require the cost of its implementation. In this case, the questions of where to get the tools, what are the payback periods for energy efficiency projects, what’s the benefit for enterprises carrying out work in the field of energy efficiency are in the first place. According to specialists, to realise the energy saving programs for Russian companies it is necessary to allocate 25-35% of their annual energy costs that actually reduce energy consumption by 30%. Moreover, the energy-saving programs will be quickly enough recompensed, in about a year. Taking into account, that he average payback period of large investments is 6-7 years, the energy-saving technologies are of great interest for investment-investors. Many enterprises of chemical and petrochemical industry, and also enterprises working in the field of energy, have already assessed the benefits of investing in energy-efficient technologies. Positive experience of energy savings of such enterprises should serve as an example for woodworking enterprises. Increase of efficiency of activity of individual woodworking enterprises will provide positive shifts in the economic growth of the entire timber industry complex, which is especially important in the period of establishment of market relations.

References