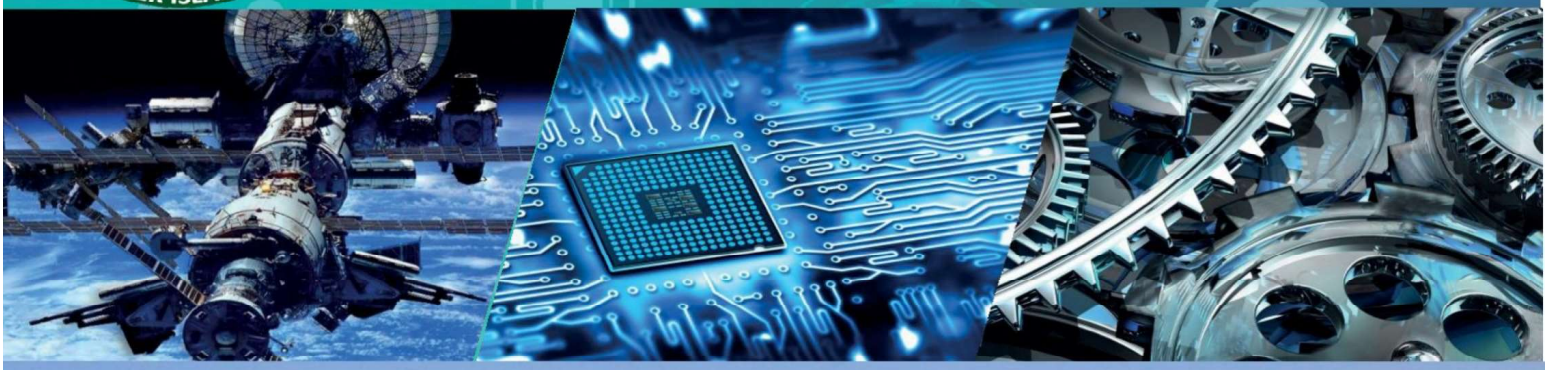
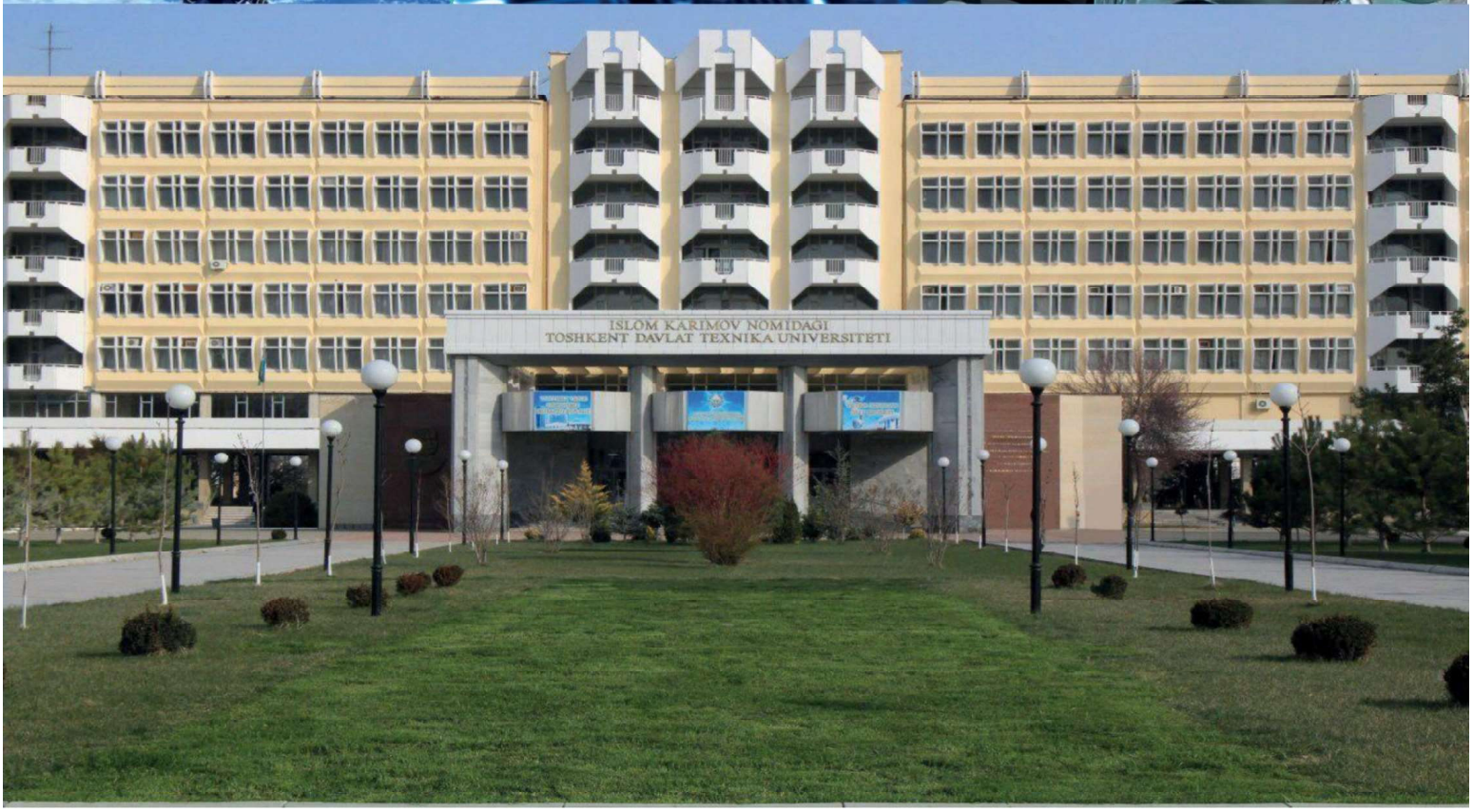
TASHKENT STATE TECHNICAL UNIVERSITY
NAMED AFTER ISLAM KARIMOV
ISSN: 2181-0400

TECHNICAL SCIENCE AND INNOVATION

№ 3/2022





THE MINISTRY OF HIGHER AND SECONDARY-SPECIALIZED EDUCATION OF THE REPUBLIC OF UZBEKISTAN

TASHKENT STATE TECHNICAL UNIVERSITY NAMED AFTER ISLAM KARIMOV

TECHNICAL SCIENCE AND INNOVATION

The Journal was established in 1993, Renamed in 2019

Published 4 times a year

2022, №3(13)

Tashkent 2022

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CIVIL AND ENVIRONMENTAL ENGINEERING

METHOD OF LONGLONG-TERM HIGH-QUALITY STORAGE OF LEMON CROP WHICH ARE GROWN IN THE AUTONOMOUS GREENHOUSE

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Abstract: *The features of the operation of the autonomous dual-slope trench-type solar greenhouse which is operating on alternative energy sources are briefly described in this article. The positive aspects of using the autonomous solar greenhouse with a small area of more than 1 acre are shown. A method for long-term high-quality storage of lemon crop grown in a solar greenhouse has been developed, as well as step-by-step steps for storing lemons in the mountainous conditions of Kashkadarya are given. It was determined that using the developed method, it is possible to store lemon crops for at least 8 months, and according to the results of many months of experiments, it was revealed that the weight loss of lemon from each box was up to 7% of the total mass. After analyzing the marketing of citrus fruits on the domestic market of Uzbekistan, we can say that when selling lemons in the summer season, the net profit will be about 35 million soums.*

Keywords: *citrus fruits, lemon, autonomous solar greenhouse, long-term storage, crop, weight loss, sawdust, relative humidity, approximation reliability value.*

INTRODUCTION. Citruses are considered the important component in the human diet throughout the year. They contain the necessary vitamins C, B2, B, A, E, PP, as well as pectins, acids, mineral salts, volatile oils, and others. Fruits on the basis of citrus increase immunity of people, enhance metabolic processes, remove toxins and slags from the body, have antimicrobial effects, positively effect on the cardiovascular systems and muscles, and also improve nervous activity [1,2]. Among them, lemon perfectly tones the body, is able to fight heartburn and nausea. When consuming lemon, cholesterol in the blood decreases, and it leads to rapid fusion of bones in fractures [3].

The Republic of Uzbekistan exported 1.2 thousand tons of lemons at the beginning of 2022 to six countries of the world. The total sum of export contains 1.3 million US dollars. According to the State Committee of Uzbekistan on Statistics, the export of lemons increased by 309 tons compared to the same period in 2021. Most lemons - 715 tons were exported to Russia. The second place is occupied by Kazakhstan - 325 tons were imported there, and 194 tons were exported to Kyrgyzstan in the first two months of this year [4]. The production of citrus fruits such as lemon, orange, tangerine, lime and others in the conditions of the republic is carried out by growing them in greenhouses of various designs.

MATERIAL AND METHODS. The research of the long-term high-quality storage of lemon crop which is grown in a duo-slope trench-type solar greenhouse [5-10] where is built in the conditions of the mountainous Yakkabag district of Kashkadarya region, is carried out in this work (Fig. 1). The development of this type of structure with a small area and dimensions creates many positive conditions for the owners of the greenhouse: firstly, nowadays, most residents in the republic have no more than ~6 acres of land plots, so the greenhouse of small-scale farm is considered rational for the appropriate use of their land; secondly, when

managing a small area of a greenhouse structure, it almost does not require the use of traditional fuels (coal, natural gas, oil fuels, and others.) in the conditions of the winter period; thirdly, only in severe winter weather, cotton waste, solid manure, firewood, straw, and others were used to heat the air space inside the greenhouse; fourthly, the structures of this type of greenhouse were made entirely from local raw materials and available resources.

The version of the greenhouse construction which is developed by us, provides for a direct fall of solar radiation on the southern sides, and there are walls made of stone mixed with soil mixture, a transparent film of polyamide material is covered on top and behind the wall on the northern, eastern and western sides.

Fig.1. Autonomous duo-slope trench-type solar greenhouse which is operating on alternative energy sources

The wall which is formed from stone and soil mixture allows to accumulate thermal energy which is received from solar radiation and emit it at night. The autonomous trench-type solar greenhouse with an area of ~105 m^2 (~1.1 acres) was tested and the following results were obtained: the productivity of the energy-saving solar greenhouse consists of ~600÷700 kg of lemons per year, and other citrus fruits (orange, mandarin) of the young seedling are planted there. The quantity of lemon seedling consists of 12 pieces and the age is 8 years old. The purpose of the research is considered long-term high-quality storage of lemon crop which is grown in the autonomous trench-type solar greenhouse, so we will not dwell deeply on energy, heat engineering characteristics and modes.

Due to the seasonality of greenhouse production, there is a demand for storing products (vegetables, fruits, and others) for their use for various needs during a year or more. The development of the science of storage of agricultural products and the widespread introduction of mechanization made it possible to put into practice improved new technological methods which reduce product losses and reduce storage costs [11-13]. Each employee in the field of agriculture should be well versed in the problems of the quality of crop products and ways to improve it, know the nature of the loss of these products and the

organization of their storage, as well as rational ways of cultivating and processing agricultural raw materials.

Basically, lemon fruits begin to turn yellow at the end of the month of September and at the beginning of October. This process will be accelerated by covering the transparent film of the greenhouse and starting from November, the lemon can be harvested. The lemon harvest, harvested from November to December, is stored with high quality, the reason for this is considered full ripening in this period of time. The fruits must be fresh, clean, not ugly, without mechanical damage, without damage by pests and diseases, with a peduncle evenly cut at the base of the fruit.

As long-term observations have shown, if lemons are stored in a tree stem, their glucose content will increase, and the acidity property will decrease. The lemon tree loses its strength at this time, and also in the second half of November, a cold snap begins, due to the negative effect of low temperature on lemon fruits, their long-term storage becomes difficult. There are many methods for storing lemon at home. One method among them is considered to store the lemon in the refrigerator, in a special compartment or box for a period of 2-4 months. It is possible to place the fruits in a lower temperature part of the refrigerator, thereby extending their shelf life up to 6 months, but because of this, the taste may deteriorate [14-16].

RESULTS AND DISCUSSION. Our suggested storage method for lemons is as follows: Be especially careful when picking lemon fruit from the stem, as the tree of the lemon seedling is thorny. Lemon with a spike is not stored for a long time;

The ripe lemons should be decomposed for no more than 2-3 days at a temperature of 14-15^{0}C in a cool dark place. Because within 2-3 days from the casing of the lemon fruit, moisture is released into the space. If you leave lemons unfolded for more than 3 days, this will lead to a change in its casing and it will be impossible to store them for a long time;

It is need to prepare a wooden box with dimensions of 50x150x50 cm^3 (Fig. 2) for placing lemons;

It is need to sift dry sawdust through a sieve with holes of different sections (Fig. 3). The sawdust will absorb the moisture released from the lemon and prevent moisture from building up in the skin of the fruit;

Fig.2. Wooden box for placing lemons

Fig.3. Sieve for passing small particles of sawdust

At the bottom of a wooden box, first of all, it is need to lay paper, and then sawdust dried under direct sunlight under natural conditions, and then, respectively, lemons were placed and covered with sawdust at a distance of 3-4 mm from each other in sections in blocks (6x18 pcs). The number of layers in a wooden box for laying lemons is no more than six rows, after that it is also covered with sawdust with a thickness of 4-5 cm, and then it was covered with a wooden board lid on top. Each box contained lemons of approximately 60÷70 kg. The total number of boxes for placing the lemon harvest was 10 pcs.

Lemons were stored at home at the air temperature of 2 to 14° C and at a relative humidity of 65-70% from 15.11. 2021 to 15.07.2022, in the mountainous regions of Kashkadarya.

On the results of experimental work for 8 months, it was determined that the loss of lemon mass from each box was ~ 5÷7% of the total mass (Fig. 4). This is mainly due to the release of moisture from most of the lemon crop and its absorption to the sawdust, as well as the formation of a dying process in some fruits located along the box.

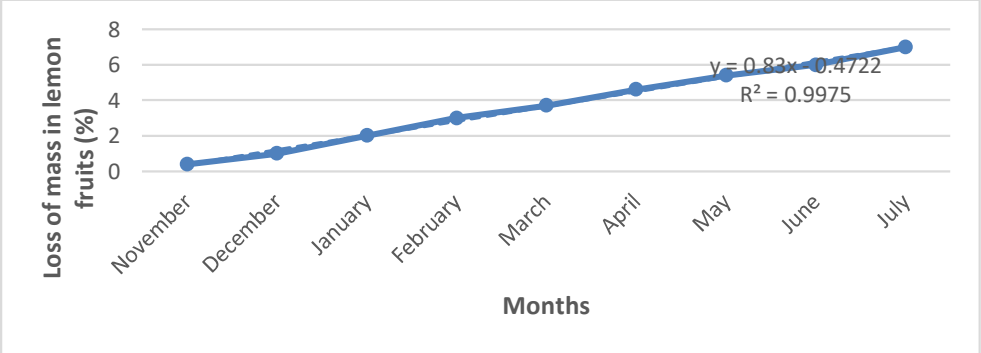

Fig.4. Dependences of the weight loss of the lemon crop on the months of the year

From Fig. 4 it can be seen that the weight loss in lemon fruits increases with the increase in the storage period of months. A linear approximation function was compiled that characterizes the dependence of weight loss in lemon fruits on the period of its storage. The following designations were used in the approximation: τ -storage period (months); ΔM - weight loss in lemon fruits (%); R^2 - is the value of approximation reliability. Analyzing the value of R^2~0,99 for the graph, we can conclude that the most suitable approximating function is linear. In this case, the linear approximation describes the given dependence (Fig. 4) with high accuracy.

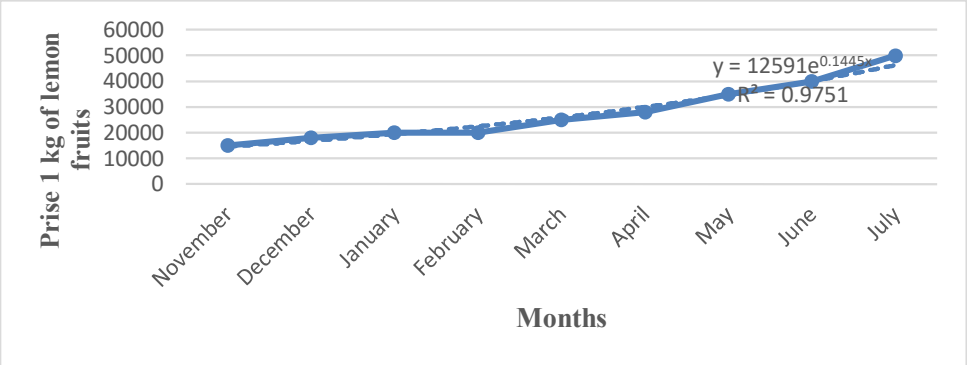

Fig.5. Dynamics of changes in the price of lemon fruits during storage

The dynamics of price changes for 1 kg of lemon during its storage period is shown in Fig.5. The following equation $\mathbf{P = c \cdot e^{b\tau}}$ was used in the graph to calculate the points using the least squares method. The fit confidence level is 0,97, which means that the curve fits the data very well. On the basis of Figure 5, we can conclude that if we sell the weight of the lemon crop in July, then the net profit will be about 35 million soums.

CONCLUSION. Most consumers know that picked lemons become dry and unusable for using after a week. Several methods exist to keep them fresh and juicy. In spite of this, most of these methods require huge amounts of energy and regular maintenance of personnel. The simplest method of high-quality storage of citrus fruits is considered to store them in the sealed condition and in large-capacity refrigerators. The disadvantage of this method of storing lemons is considered the high consumption of electricity to ensure a stable temperature and humidity climate and the need for their quick consumption after removal from the refrigerator.

As the results showed, it is possible to ensure high-quality storage of lemons without unnecessary energy costs using the method proposed by us. But only partially maintenance of personnel is required before sending them to the consumer. Analyzing Fig. 5, we can conclude that 3-4 years after planting the seedlings of lemon, the seedlings will be ready for a full harvest. In addition, in the period until the full harvest of the lemon, greens (dill, radish, bell pepper, eggplant) and potatoes, radish, turnips can be grown around lemon seedlings. It has been established that the autonomous trench-type solar greenhouse for small-scale farms with an area of 105 m^2 (~ 1.1 acres) pays for itself in the fifth year of operation, taking into account the growth of lemon seedlings.

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IMPLEMENTATION OF THE HUMAN FACTOR IN PRACTICE AND ITS MANAGEMENT

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Abstract: *Safe and high-quality organization of production processes is one of the main requirements today. The safe passage of the work process largely depends on the knowledge and skills of workers. Since the labor force is the main driving factor in the production process, a person has the opportunity to create and provide favorable conditions for the effective formation of an innovative economy, taking into account his creative potential. Human resources, as the sum of human capital, labor force, human potential, entrepreneurial abilities, act as a factor of human production, which, along with material factors, includes land resources, financial and production capital. Changes in production relations taking place in modern conditions lead to the need to change the composition of the human resources used*.

Keywords: *Human resources, social capital, labor market, labor ergonomics, post-industrial stage, human resources, human potential, intellectual activity, labor force.*

CONTENTS

CHEMISTRY AND CHEMICAL TECHNOLOGY

CIVIL AND ENVIRONMENTAL ENGINEERING

GEOLOGICAL ENGINEERING