The Innovative Household Solar Oven for Cooking

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ABSTRACT

The test results of a new innovative solar household oven for cooking are given, the design features of the oven are indicated, the advantages are ease of use, reliability, wind resistance, transportability, and an absorber is used instead of mirrors to further increase the temperature inside the oven chamber.

Keywords: Solar oven, hot box, thermal insulation transportability, convenient operation, wind resistance, glazing, side door, protective cover, temperature fluctuation, absorber

Introduction

It is known that using solar energy, the Swiss scientist Horace Benedict de Saussure first cooked soup in 1767. His solar kitchen consisted of a wooden box topped with glass, inside the chamber was thermally insulated and painted black. It was the simplest "hot box". The pioneers of solar cooking were Ehrenfried Walter von Chirihaus, John Fred Herschel, Auguste Mouchot, Charles Gili, Ebot and Maria Telkesch and many other authors. A solar kitchen was in operation at the Mount Wilson Observatory in the mid-1920s [1-7]. At present, the American standard ASAE C580 1-201 3 is known based on the rate of water heating under certain conditions. Can be used to compare the performance of solar kitchens. In the scientific press, mainly the Indian standard IS13429-3 (2000) is used, which is the best way to study the properties of boxboards. The simplest solar cookers are made of cardboard foil, aluminium foil reflecting sunlight and pans painted black [8-11]. These cheap cardboard solar cookers are used in refugee camps. (Iridium). In India, China, and the USA, industrial models of solar kitchens have been developed. Solar cookers are widely used in India, Greece, Mexico, Israel, and China. So in 2008, China ordered 19,000 solar kitchens for 31 villages in Finland [12-17]. This will allow 2008-2012 to reduce harmful emissions of CO gas into the atmosphere. Inventor Patrick Sherwin took a vacuum tube for heating water and adapted it to cooking like a thermos, these are GoSun stoves [18-22]. Which works in the absence of solar energy using organic wax enclosed in an aluminium box. To do this, you need to preheat it for 2 hours, this will allow you to cook dinner for 8 people. In the world there are 3 types of construction of solar ovens for food preparation: 1. Boxed 2. With a mirror concentrator, 3. Combined. The largest solar oven for cooking through the use of water vapour was created in India. In the town of Auroville, food is prepared 2 times a day for

1000 people. Inventor Wolgang Scheffler built a stove that has a 16m^2 paraboloid reflector concentrating 3kW of heat. The paraboloid reflector rotates around an axis parallel to the earth's axis. The mechanism rotates the mirror by 15 degrees per hour, allowing you to track the movement of the sun across the sky during the day. The focus is on a vessel for cooking [23-29]. An innovative domestic solar oven developed by us, fig. It opens easily downwards and is hinged. When opened, this is a small horizontal table, very convenient when laying dishes with food before cooking in the oven. The side door in a horizontal position is held by a metal strip of fixed length [30-37].

All types of lids for used dishes are painted with black matte paint. The height of the chamber allows you to cook several pots with different dishes at the same time. In the closed position, the door - is fixed with a latch - which tightly holds the door, protecting it from heat leaks. The oven kit includes a pot, a frying pan, and a metal sheet from a household oven for baking flatbread, samsa, Italian pizza, and pies, there are baking moulds for 3 loaves of bread. To operate the furnace, it is placed on a sunny platform, the outer cover of the furnace is opened, fixed with special steel support (steel bar with a diameter of 8 mm) creating an optimal angle of inclination, and the furnace body is turned to the south [38-41]. After 1 hour, the oven chamber heats up and you can load the ingredients for cooking food through the side door.

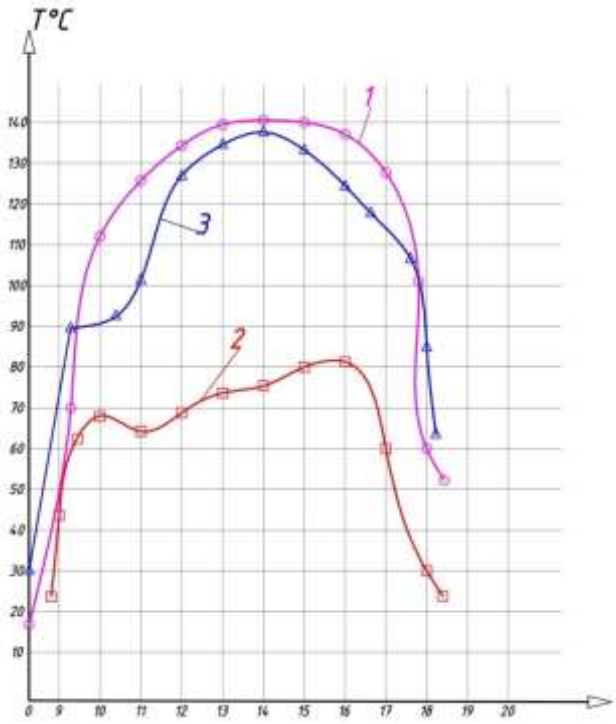

Fig. 1. The results of the operation of a solar household stove.

The figure-2 shows the results of the operation of a solar household oven without loading products for cooking. This is curve-1, as can be seen from the graph (vertical line), the maximum temperature reaches the day at 13-15 hours (horizontal line). Curve 3 shows how the course of the temperature curve changes when the oven is loaded with cooking ingredients. The laying took place at 9 a.m., it can be seen that the temperature of the oven chamber decreased, since the ingredients had the temperature of the surrounding air [42-49]. Gradually, the products warmed up and the cooking process began, starting from a temperature of 80 °C. Curve 2 shows the course of the absorber temperature curve. The maximum temperature in the chamber - an innovative domestic solar oven in summer

exceeded 140 ℃ at 13:15. Thus, within 6-8 hours during the day, it is possible to cook any high-quality dishes [50-54]. This is especially helpful for diabetics. Food does not burn, no need to stir it. As field tests showed in December 2017, on a sunny day at an air temperature of 6-7 ℃, it reached 100-105 ℃ inside the chamber. Even in December, at this temperature, you can cook food. Omelette and scrambled eggs can be cooked in 12-15 minutes. An innovative domestic solar oven is especially useful for a large Uzbek family living in remote areas far from power lines.

Table 1. Field tests of innovative domestic solar cooking oven 2020-2022

No.	*Time spent preparing diet meals*		
	NAME OF DISHES	TIME, MINUTES	
	SCRAMBLED EGGS	15	minutes
	porridge: buckwheat	26	minutes
	BARLEY	20	minutes
	RICE	20	minutes
	VEGETABLE SOUPS: MEAT	60-90	minutes
	STEW MEAT DISHES	70-90	minutes
	FISH FRIED	30	minutes
	MEAT PIES	80-120	minutes
	BUNS, COOKIES	50-70	minutes
	BOILING COW LEGS	300(5 hours)	minutes
	DUMPLINGS	43	minutes
	BEEF CUTLETS	45-50	minutes

The design of the innovative domestic solar oven of Figure 1 Sturdy, compact, transportable, self-contained, wind-resistant, space-saving, and multi-functional in remote areas and mountainous areas, can also be used for pasteurization and sterilization of canning jars. Innovative domestic hot box solar oven is safe, non-explosive, and electrically safe, unlike paraboloid, parabolic trough, facet, quasi-paraboloid, combined and other focusing ovens, where you can damage your eyesight and burn your hands, they also need an expensive complex system for tracking the sun. In our furnace, none of this is needed, except for the constant orientation to the south. The oven heats up within 1-2 hours and will be ready for operation.

Very convenient for working family members. Leaving for work in the morning, put all the food for cooking in a saucepan, bring it through the side door into the oven chamber and calmly go to work. In the evening after work, dinner is ready and even hot. People have not yet understood how convenient 300-320 sunny days a year are for free without gas, kerosene, electricity, and without firewood to cook food, saving 10-15 kg of firewood per day of conventional fuel, all this due to free solar energy. In 300 days, 4.5 tons of standard fuel will run up. It costs several million soums. The firewood saved in the summer will be used for heating in the winter. The innovative household solar oven is installed on a special table - the size of the body of the innovative household stove and the table is the same 97 * 75 cm, and there are 4 swivel wheels - for ease of movement and rotation. A metal sheet is reinforced on the south side of the table. Metal sheet - half bent at an angle of 120 degrees is under the furnace body, the other half is turned to the south, painted with black matte paint - it serves as an absorber -. When heated under the influence of sunlight, the absorber heats up and transfers heat to the chamber of the innovative furnace from the bottom side, thereby providing additional heat to the working

chamber, this helps to reduce heat loss from the bottom side of the furnace [56-61]. There are no reflective mirrors in this solar oven, they are replaced by a special absorber that is lighter and cheaper. The purpose of the table is to provide comfortable conditions for the operation of the oven without bending over since the oven on the table has a height of 60 cm. Therefore, the maximum temperature of the developed solar oven is higher than in conventional ovens of this type, which leads to faster cooking. the other half is turned to the south, painted with black matte paint - it serves as an absorber -. When heated under the influence of sunlight, the absorber heats up and transfers heat to the chamber of the innovative furnace from the bottom side, thereby providing additional heat to the working chamber, this helps to reduce heat loss from the bottom side of the furnace. There are no reflective mirrors in this solar oven, they are replaced by a special absorber that is lighter and cheaper. The purpose of the table is to provide comfortable conditions for the operation of the oven without bending over since the oven on the table has a height of 60 cm. Therefore, the maximum temperature of the developed solar oven is higher than in conventional ovens of this type, which leads to faster cooking. the other half is turned to the south, painted with black matte paint - it serves as an absorber -. When heated under the influence of sunlight, the absorber heats up and transfers heat to the chamber of the innovative furnace from the bottom side, thereby providing additional heat to the working chamber, this helps to reduce heat loss from the bottom side of the furnace. There are no reflective mirrors in this solar oven, they are replaced by a special absorber that is lighter and cheaper [61-64]. The purpose of the table is to provide comfortable conditions for the operation of the oven without bending over since the oven on the table has a height of 60 cm. Therefore, the maximum temperature of the developed solar oven is higher than in conventional ovens of this type, which leads to faster cooking. When heated under the influence of sunlight, the absorber heats up and transfers heat to the chamber of the innovative furnace from the bottom side, thereby providing additional heat to the working chamber, this helps to reduce heat loss from the bottom side of the furnace. There are no reflective mirrors in this solar oven, they are replaced by a special absorber that is lighter and cheaper. The purpose of the table is to provide comfortable conditions for the operation of the oven without bending over since the oven on the table has a height of 60 cm. Therefore, the maximum temperature of the developed solar oven is higher than in conventional ovens of this type, which leads to faster cooking. When heated under the influence of sunlight, the absorber heats up and transfers heat to the chamber of the innovative furnace from the bottom side, thereby providing additional heat to the working chamber, this helps to reduce heat loss from the bottom side of the furnace. There are no reflective mirrors in this solar oven, they are replaced by a special absorber that is lighter and cheaper. The purpose of the table is to provide comfortable conditions for the operation of the oven without bending over since the oven on the table has a height of 60 cm. Therefore, the maximum temperature of the developed solar oven is higher than in conventional ovens of this type, which leads to faster cooking. There are no reflective mirrors in this solar oven, they are replaced by a special absorber that is lighter and cheaper. The purpose of the table is to provide comfortable conditions for the operation of the oven without bending over since the oven on the table has a height of 60 cm. Therefore, the maximum temperature of the developed solar oven is higher than in conventional ovens of this type, which leads to faster cooking.

The heat of solar energy comes: from 2 sides.

1. Direct and scattered enters the bevelled surface of the glazing, furnace.
2. The heat that comes from the side of the bottom of the housing from the absorber, is due to the thermal conductivity of the metal sheet of the absorber. As experiments have shown, the use of an absorber makes it unnecessary to use reflective mirrors of solar energy, since mirrors require continuous tracking of the movement of the solar disk across the sky. Our kiln is facing south and can be operated in a stationary position, which makes it convenient to operate.

A solar oven designed for a large Uzbek family, consisting of elderly and young family members. Environmentally meets all environmental protection standards.

Fig. 2. General view of the solar innovative household cooking oven.

The innovative solar oven for cooking can work even in cloudy weather. For this, an electric heating element with a power of 0.4 kW is installed in the chamber. Thus, the solar oven became all-weather, opening up wide possibilities for operation.

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