Preliminary communication

Fruit pre-drying using geothermal energy

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Abstract

Nowadays, the study of the theoretical and practical aspects concerning the design and the automatic control of the fruit pre-drying equipments, using as power agent the geothermal water with moderate enthalpy, represents a real necessity.

The presented paper analyzes the need of using geothermal energy as power agent, the completely automatized pre-drying equipment and also the advantages of using geothermal energy in fruit pre-drying installations.

Key words: fruit pre-drying, geothermal energy.

Introduction

At the end of the second millenium, two billions of people, that means a third of world’s population, did not have access to modern energy services yet. But, world’s population expect much more from the XXIst century. The key for an improved life level is represented by the accessibilty to clean energies and corresponding prices that people can afford. Energy affects all modern life aspects. There is a tight correlation between the energy used per capita, which ensures a high level of productivity per capita, and the life expectation.

The geothermal energy is a renewable source of energy, which can provide heat and power 24 hours a day, all year long, irrespective of external factors, such as weather and season. This permanent availability represents a very attractive attribute related to mixed energy source. Moreover, this energy source is almost inexhaustible and available all around the world.

At world level, the power plants that generate geothermal energy have an installed total capacity of over 8000 MW. The systems that convert geothermal energy can provide electricity with a factor of annual charge capacity bigger than 90%.

Geothermal energy consumption – Knowledge level in Romania

In Romania, hydro-geothermal sources (exploited through drilling-extraction) can be found in low enthalpy geothermy (with temperatures between 25°C and 60°C, in ground waters) and medium temperature geothermy (from 60°C up to 125°C in mezzo-thermal waters). Low enthalpy geothermal resources are used for heating and preparing domestic hot water in individual lodgings, social services (offices, education, social and commercial spaces etc.), industry or agro-zootechnic spaces (green-houses, solariums, animal husbandries etc.). At the same time, in Romania, the geothermal energy reserves, with current exploitation possibilities, are estimated at about 167 thousands toe (7.000x10⁶ GJ/year). The quantity of equivalent energy produced and delivered at the exploitation head of the well is about 30,171 thousands toe (1.326x10⁶ GJ/an), with an annual average degree use
of 22.3%. One has agreed that the economic drilling and extraction limit for the geothermal water is 3.300 m in depth and it has already been reached in some areas in Romania, such as the Geothermal Basin of Bucureşti Nord – Otopeni, some perimeters from Snagov and Baloteşti localities etc.

In 2003, in different geographical areas of Romania, 70 wells with local utilizations were in exploitation, ensuring the needs for heating and domestic hot water (with temperatures over 60°C) in housing developments, buildings with public or industrial destination, agro-zootechnic spaces etc. In present, 45 wells with attested energetic potential are in preservation or as reserve.

In Romania, the valorification degree of the geothermal energy sources is reduced due to the lack of an appropriate financial support, which could favour the development of this energetic branch with superior economic effects.

**Material and methods**

**The constructive-functional diagram of the pre-drying system**

The constructive-functional diagram of the fruit pre-drying system comprises:

The SC3 heat-exchanger, destined to prepare the agent for the pre-drying installation (Figure 1);

- Circulating pumps;
- Electric operated valves, for the geothermal water circuit;
- Temperature detectors;
- One hydrophore (endowed with compressors and adjunction pumps)

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**Graph 1. The SC3 heat-exchanger**

**The control block diagram for obtaining the agent for warm air preparation, necessary in the technological process of fruit pre-drying**

The block diagram with the automatization control loops is presented in Figure 2:
In order to use the geothermal water as fuel in the fruit pre-drying process, one has analyzed the possibilities and endowments existing at the University of Oradea. Therefore, one simulated the equipment functionality on the existing analogical simulator and consequently, the completely automatized installation was connected to the Allen Bradley Programmable Logic Controller that realized the control of the whole process (Fig.3).

The control loop for obtaining the agent for warm air preparation, necessary in the technological process of fruit pre-drying

Graph 2. The control block diagram for obtaining the agent for warm air preparation, necessary in the technological process of fruit pre-drying

Graph 3. The control block diagram (a) and the GM diagram (Graphic Modeller) for obtaining the agent for warm air preparation, necessary in the technological process of fruit pre-drying(b)
Graph 4. The graphic interface for the „Forest fruit pre-drying” subsystem

Results and discussion
The advantages of the system and conclusions
The utilization of geothermal water in the fruit pre-drying process, in a completely automatized system, presents the following advantages:
- continuous and constant availability of geothermal energy all year long, regardless of other energy sources that depend on meteorological conditions (e.g. sun energy, wind energy) or fuel supply (other pre-drying types);
- total elimination of fossil fuels;
- reduction of costs with cu 80%;
- total elimination of pollution, for the geothermal water is a totally non-pollutant agent;
- reduction of the pre-drying time with 50%, as compared to classical processes;
- utilization of a completely automatized system, with permanent control of the parameters that intervene in the pre-drying process;
- possibilities for determinating and adjustment of all the disturbance factors within the pre-drying process by using the computer simulation of the system functionality, eliminating thus the direct intervention in the system.

References
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