# DEVELOPMENT AND HEATING SYSTEMS MATHEMATICAL MODEL OF HEAT AND MASS TRANSFER IN THE GREENHOUSE WITH ALTERNATIVE ENERGY SOURCES

**V. Gorobec,**

**O. Yatsenko**

*The proposed project equipment heating greenhouses solar collectors and heat pumps. Simulations of processes of heat and mass transfer in the greenhouse. Simulations performed using software environment ANSYS Fluent 14.0. The result obtained velocity field and temperature in the greenhouse.*

***Greenhouses, solar collector, heat pump modeling processes of heat and mass transfer.***

The problem greenhouses are usually unreasonably high cost of traditional energy resources. To provide the necessary cold season microclimate in buildings protected ground need heat. Big Greenhouse Vegetable plants, a single area reaches 60 hectares and heat load of 350 MW, is the most concentrated and energy-intensive consumers of heat in agricultural production. The annual heat consumption in these buildings is 290 million GJ on the expense of 12 million. Tons of fuel. Note that the production of 1 kg of greenhouse agricultural products consumed 5 kg of fuel. Therefore, the problem of energy savings in heating buildings protected ground by improving their heating systems, the use of alternative energy sources - is very crucial. So for heating greenhouses proposes that a hybrid system consisting of solar panels and heat pumps.

The purpose of research - modeling processes aerodynamics and temperature field in the greenhouse and implementation of alternative energy sources in the heating system.

Materials and methods research. Cultivation facilities have a number of distinctive features to consider when solving problems of their heating:

• large heat loss due to small thermal resistance barriers of glass or plastic film, together with a significant infiltration of outside air (10 to 40% of the main heat);

• rizkozminnyy character load during the day, season of the year;

• low thermal stability of structures due to low thermal inertia fences;

• increased demands on microclimate caused by cultivation techniques;

• the need for technological measures that require additional costs of heat (thermal treatment of soil layer, soil heating, irrigation, etc.).

Thus, the correct choice of source and means of heating is important because this is determined by the economic efficiency of cultivation facilities, the degree of profitability of vegetable protected ground.

Cultivation facilities are heated by solar radiation, biofuels or various technical means.

Power of heating define conditions for stationary night mode for the design temperature difference between air (domestic and foreign, the latter is taken as the average temperature of the coldest day long) and the average wind speed.

In buildings protected ground using water, steam, air, gas and contact-combined heating methods.

In this case, the system is considered water-heating method of the hybrid system, which consists of solar collectors and heat pumps.

Results. The system of heating greenhouses using the combined system heating (heat pump plus heliocollector) that will provide not only environmental, but also significant energy savings.

After the computer simulations obtained velocity field and temperature field inside.

The speed of the air in the greenhouse is uneven. The maximum speed is reached in mid-air in the greenhouse hatches and tidal reaches 1.65 m / s. The walls and floor heating pipes are created stagnant zone air velocity at which is 0.2 m / s. The average velocity of the air inside the greenhouse is in the range of 0.5 - 0.7 m / s.

The average temperature in the greenhouse is 13 ° C, corresponding to the normalized values of temperature 12 - 15 ° C. In most open ventilation hatches underneath the minimum temperature of 5 - 6 ° C.

## Conclusions

The proposed environmentally safe and energy efficient heating greenhouses using combined installation of alternative energy sources.

A computer model in ANSYS Fluent 14.0 environment for modeling of heat and mass transfer in the greenhouse. As a result of modeling the dynamics of the distribution will be obtained velocity field and temperature field greenhouse. This will make it possible to determine the value of maximum and minimum air velocity and temperature.