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Efficiency improvement of the soil and waste water energy usage based on the heat pump
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<p>The technical opportunity of creation of alternative heat supply system for energy saving technologies on the basis of renewable energy source (soil) and waste energy source (waste water) for heat pump which provides essential economy of traditional energy resources and reduction of environmental contamination is proved. It is determined that the proposed systems are perspective for Ukraine which has the deficit of own energy resources, as enables to increase the replacement factor of organic fuel and reduce the amount of thermal effluent to the environment.</p> <p>The mathematical model of thermal processes in the elements of heat pump systems based on renewable energy (soil energy) and waste energy (waste water) with the account of environmental requirements: preventing of ground undercooling during exploitation of ground heat pipes and damage of vegetation with the account of seasonal climatic changes of renewable energy sources and different technological conditions is developed.</p> <p>The numerical modeling of thermal processes in the heat exchangers of the heat pump supply system, which uses renewable energy source (soil) and waste energy source (waste water), is completed. The ecological and energy efficiency of the mentioned system with the account of various climatic and technological factors is defined.</p> <p>For thermal processes in the heat pump elements at base of soil energy and waste water the algorithms and calculation programs for a PC are developed. Recommendations for implementation of the heat pump system at general principles of energy-saving technologies are given.</p> <p>Results of calculation both analysis and summary of the heat pump supply system using the alternative energy which based on the proposed mathematical model with the account of environmental requirements (soil thermal relaxation prevention) are presented. Fothermore, it allows to determine changes the temperature gradient of the soil near the heat exchanger and to assess more accurately the heat flow in each section of the heat pipe.</p> <p>The exergy efficiency of the heat pump system, which uses renewable energy source (soil) and waste energy source (waste water), and the expediency of its usage for heating various objects (industrial, agro-industrial and individual consumers) are analyzed. Energy efficiency of the proposed cycles is 17.7% and 25.4% respectively for soil energy and waste water energy. Such range of exergic efficiency is occurred due to the low-temperature potential between the low potential source of energy and the carrier of heat pump evaporator where the largest exergy losses are observed. For big industrial and agricultural complexes the heat pump at waste water</p>

can be recommend because its efficiency is higher in comparison with the heat pump at soil energy. For individual consumers the heat pumps with soil pipes can be recommended because these consumers are usually located far away from waste water drainage systems. In this case the reserve source of traditional is necessary.

Key words: energy saving, heat pump, thermal relaxation of the ground, damage of vegetation, ground heat exchanger, renewable energy, waste energy, waste water.