ROLE OF ALTERNATIVE ENERGY SOURCES IN ENVIRONMENTAL PROTECTION AND INTENSIFICATION OF VEGETABLE GROWING

Summary

This monograph presents a review of the utilization potential of low-temperature waste heat of waters discharged from power industry and thermal energy of geothermal waters utilized for crops production alongside with the results of own studies conducted on existing experimental installations. The installations have been designed by the author and are subject of a pending patent application. The experimental installations served as a basis for multidisciplinary studies of the properties of the heated soil and cultivated crops.

While discussing the results of the studies attention was focused on the fact that an alternative use of thermal energy, either generated as waste heat in industrial processes or of geothermal origin, instead of fossil fuels contributes to the improvement of both: economic account and the quality of the environment.

At increasing prices of energy carriers and low profitability of vegetable crops production, implementation of new, more effective solutions seems an important issue. The aforementioned premises served as justification for undertaking a number of research initiatives within the framework of the National Keynote Project No. 10.2 “Principles of human environment protection and development with applications in industrialized regions” and the Goal-oriented Project No. 027-03 “Utilization of the geothermal waters’ heat for intensive vegetable production and fish-breeding”, as well as developing a design and constructing experimental installations utilizing low-temperature waste heat from the waters discharged from energy industry (a 1 ha site at the Rybnik Power Plant) and geothermal waters (GZD Bańska near Zakopane). In the case of soil heating, the distance from the energy source should be taken account of.

The many-year and multidisciplinary research studies contributed to the recognition of the dynamics of changes of the physical, chemical and biological properties of the heated soil as well as plant reactions (vegetable yield, growth acceleration, chemical composition) alongside with the determination of the economic viability of the proposed solutions.

Depending on the depth, soil temperature was by 5.4–16°C up to 21°C (geothermal water) higher in the heated than in the non-heated (control) facilities of the experimental station of geothermal energy utilization.

Increases of soil temperature with the highest effect on soil biological activity and plants growth were observed in the heated facilities in March, October and November. Except for the gaseous phase, the analysis of soil from the experimental facilities proved no significant effect of heating on its physical properties.

An increase of temperature resulted in a more intensive dynamics of the chemical changes taking place in soil i.e.: the chemical composition of the heated soil was slightly different from the non-heated control soil what was expressed by a higher content of mineral components in plants, mainly potassium, phosphorus, magnesium and some trace elements.

Beside the research aspect, the conducted studies allowed formulating application effects of the proposed solutions. The following effects obtained for the utilization of geothermal waters of temperature range 35–45°C (in Podhale Region conditions) and waste heat from the waters discharged from energy industry of temperature range 26.7 ± 8.5°C for vegetable crops production in foil tunnels have been considered of priority economic importance:

– successful utilization of the discussed energy sources, especially waste energy;
– multiplied number of yield obtained in one growing season;
– acceleration of yielding by 2–32 days alongside with a 3.2–176% increase of its efficiency;
– power raw-material saving in the amount of 36.0–38.0 Mg hard coal/100 m2/year;
– reduction of atmospheric pollution which would take place when using conventional heating.