Abstract

The use of the geothermal technology for cooling and heating of buildings is growing in importance due to rising energy costs and mounting political will to replace conventional heating and cooling systems with practical alternatives that are both ecologically and economically sound.

Through the use of surface radiant heating systems in new construction and renovated existing buildings, properties can be heated, and cooled if necessary, using low-temperature heating systems. The relatively low flow temperatures of about 35 °C of such heating systems allow for the use of more cost effective "ambient heating", in conjunction with electrical or thermal heat pumps. This paper addresses the development of geothermal energy by means of closed vertical ground heat exchangers.

The use of the ground is particularly interesting as the brine retains a constant temperature of 10 °C year round. For heating, the difference between the heat source (ambient heat) and the heat sink (inlet temperature of heating system) significantly affects the efficiency of the heat pump. The temperature of the brine in winter compared to other heat sources, such as ambient air, is considerably higher and allows for higher energy efficiency ratios (EER) of the heat pump to be achieved. At the same time, the year round outlet temperature of the probes is low enough in the summer to support the free cooling of an office building or the effective re-cooling of refrigeration compression units (common to the food industry).

Because there are numerous potential applications of geothermal energy in the building sector, it is appropriate to develop a simulation tool that covers a wide range of uses, which should include energetic parameters for system designers and also temperature distributions of soil or groundwater for soil ecologists.

A project group consisting of the University of Tübingen (ZAG), University of Stuttgart (VEGAS) and the University of Applied Sciences Stuttgart (zafh.net) was formed around the core competencies of the project partners to the further develop existing simulation models (zafh.net) and calibrate commercial simulation tools (ZAG) based on compiled high temporal and spatial resolution data (VEGAS). In addition, specialized topics were modified and further investigated by each of the project participants. For zafh.net, these focused areas of research included the development of a pilot cooling system (Diffusion-Absorption-Chiller - DACM) in Stuttgart Vaihingen, the energy flow measurements of a food market in Northern Germany and the creation of design and dimension guidelines for geothermal heat exchangers based on simulation and measurement data.