GEOTHERMAL RESOURCE UTILIZATION

Paul J. Lienau
Geo-Heat Utilization Center, Oregon Institute of Technology
Klamath Falls, OR

Presented to AAAS Annual Meeting
January 3-8, 1980

ABSTRACT

Man has utilized the natural heat of the earth for centuries. Worldwide direct use of geothermal currently amounts to about 7,000 MW_t, as compared to 1,500 MW_e, now being used for the generation of electricity. Since the early 1970s, dwindling domestic reservoirs of oil and gas, continued price escalation of oil on the world market and environmental concerns associated with coal and nuclear energy have created a growing interest in the use of geothermal energy in the United States. The Department of Energy goals for hydrothermal resources utilization in the United States, expressed in barrels of oil equivalent, is 50 to 90 million bbl/yr by 1985 and 350 to 900 million bbl/yr by the year 2000. This relatively clean and highly versatile resource is now being used in a multitude of diverse applications (e.g., space heating and cooling, vegetable dehydration, agriculture, aquaculture, light manufacturing), and other applications requiring a reliable and economic source of heat.

SUMMARY OF UTILIZATION

The direct use of geothermal resources has been practiced internationally for centuries. Recorded history shows uses by Romans, Chinese, Japanese, Turks, Icelanders, Central Europeans, and the Maori of New Zealand for bathing, cooking and space heating. Today, worldwide, more than 7,000 MW_t (thermal) of geothermal energy are used for residential and commercial space heating and cooling, agriculture and aquaculture, and industrial processing.

Space heating generally utilizes temperatures in the range of 150 to 212ºF, with 100ºF being used in some marginal cases and heat pumps extending this range down to 55ºF. The leading user of geothermal energy for space heating is Iceland, where over 50 percent of the country is provided with geothermal heat. The only known cooling is in Rotorua, New Zealand, at the International Hotel; however, many other applications are presently being considered.

Typically, the agriculture-related uses utilize the lowest temperatures, with values for 80 to 180ºF being typical. Use of wastewater has wide applications here. The amount and types of chemicals and dissolved gases, such as boron, arsenic and hydrogen sulphide, are a major problem for this use. Heat exchangers and proper venting of gases may be necessary in some cases to solve this problem. Almost all of the agricultural-related energy utilization is in the Soviet Union where over 5,000 MW_t is reported being used.

Industrial processing typically requires the highest temperature, using both steam and superheated water. Temperatures up to 300ºF are normally desired; however, lower temperatures can be used in some cases, especially for drying of various agricultural products. Though there are relatively few examples of industrial processing use of geothermal energy, they represent a wide range of applications, from drying of wool, fish, earth and timber, to pulp and paper processing, and to chemical extraction. The two largest industrial uses are the diatomaceous earth drying plant in Iceland, and the paper and wood processing plant in New Zealand.

Examples of Current Utilization

Traditionally, direct use of geothermal energy has been on a small scale by individuals. Surface hot springs were utilized and shallow wells could be justified with on-the-spot use or short transmission distances in uninsulated pipes or channels. However,