



Shallow Geothermal Resources Evaluation in the South and Southeast Brazilian

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Abstract

Energy security, self-sufficiency and the reduction of greenhouse gas emissions are crucial priorities in a country's current and future energy policies. Several nations are actively supporting the advancement of renewable energy technologies, including geothermal energy. Most attention in the field of renewable energy is focused on the production of electricity from alternative sources. In the case of using heat sources, such as geothermal energy, for electricity generation, it is necessary to access sources of deep origin that have high temperatures, generally above 150°C.

Geothermal resources of shallow origin (up to 400m) are easy to use in terms of geological configurations and temperature variation, but, however, do not allow use for the production of electricity. These resources are known as shallow or surface geothermal energy with low enthalpy, and have been widely used in many countries of the world, with an increasing number of installations in recent decades. Its are based on simple and established technological principles and are therefore large in numbers and popular all over the world. Specially for domestic air conditioning, the use of surface geothermal energy is considered an ecologically correct alternative to traditional heating techniques, such as oil or gas fired boilers. The main uses of this resource are associated with the Ground Source Heat Pump and Groundwater Heat Pump that result in local temperature anomalies (cold or hot plumes).

In Brazil, most of the use of this type of resource is based on tourism, fish farming and agroindustry, with no tradition regarding the use of heat pumps. Therefore, this study aims to contribute to an assessment of geothermal resources of shallow origin, mainly for the exploration of this system. This work refers to a preliminary compilation and interpretation of geological and geothermal data in the south and southeast regions of Brazil.

A shallow geothermal study of a region involves knowledge of temperature variation and local thermal conductivity values. For this, data from thermal profiling in wells up to 200m deep and a lithological analysis of the environment were involved. In general, the southern region of the country geostructurally encompasses part of the Paraná basin and the Mantiqueira province. For this region, 84 geothermal data were used. The average conductivity found was 2.7 W/m.K and an average geothermal gradient of 26°C/km. The values of the average annual temperature on the surface vary around 16 to 22°C. From the well data, we can establish that, for this region, the average temperature variation, in the depth of up to 200m, is $24 \pm 4^\circ\text{C}$.

The southeastern region of the country geostructurally encompasses the northwest part of the Parana basin, the southern Tocantins province, part of the Mantiqueira province and the south-central part of the São Francisco craton. For this region, the geothermal data collection had 92 CVL/CBT type data and 19 BHT type data. It has an average value of 2.8 W/m.K for thermal conductivity and an average geothermal gradient for the region of 23°C/km. The values of the average annual temperature on the surface range from 18 to 25°C. From the well data we can establish that, for this region, the average temperature variation, in the depth of up to 200m, is $24 \pm 2^\circ\text{C}$. Based on these studies, it is possible to assess the suitability of shallow geothermal as a source of renewable energy in the region in question. This information is essential for decision-making related to geothermal projects at the local or regional level, contributing to the development of sustainable energy solutions.