Sad neglect of geothermal energy

Discussions on the merits and demerits of energy resources and their availability are centred on the renewable/non-renewable or conventional/non-conventional energy resources. The prime candidate between non-conventional and renewable energy sources is solar energy, which is projected as a big supplier of our future energy requirements[1,2], but production of energy is not large so far even today. Once boiling, liquid ball earth cooled to the present condition by gradual loss of heat over billions of years. The hot interior funds the incessant loss of heat from every part of the earth, which flows out unevenly through the surface apparently in small amounts (84 mWm^{-2}), depending upon the geological set-up of the area. The net annual heat loss by this conduction mechanism from the earth is 4×10^{13} W; this is more than the energy released by all earthquakes in a year[3]. On the contrary, nature has geologically controlled but sporadically distributed high-temperature anomalous thermal manifestations with economic potential such as the presence of magma pockets, volcanic eruptions, geysers, fumaroles, solfatara, hot grounds, hot dry rocks, geopressurized water and the highly useful hot-water springs. Springs emitting water more than 5°C than the average annual temperature of the area fall under the hot-water category. The water temperature and quantity are controlled by the geological characteristics of the region. Inside the earth water is heated up by magma pockets, cooling crystalline igneous rocks, tectonic activity located within the range of a few hundred metres to a few kilometres depth and by the downward increasing geothermal gradient. This is 30°C/km under normal conditions; however, it ranges from as low as 10°C/km to exceptionally high values near the mouth of a volcano. The quantity of emitted water is controlled by depth of the heat source, porosity and permeability of the rocks, quantity of percolating meteoric water or source of water, fractures and structural set-up of the area. The geothermal water cycle comprises downward percolation of meteoric water inside the earth through pores and fractures to lateral migration over the heat source and finally emergence of water on the surface. The entire process from percolation to re-emergence of water may be completed in hundreds to ten thousands of years. Once the cycle is established, it may survive up to a million years[4].

The emerging hot water on the surface can be put to various economic/commercial uses, such as power generation to poultry farming to tourism. Globally more than 11 GW electrical power is generated in 26 countries by various technologies[5] and water from the hot springs is used in 72 countries for different purposes.

One hundred and thirteen Indian geothermal systems comprise 350 hot water springs. The top 100 geothermal energy sources have heat potential of 40×10^{18} cal, which is equivalent to 27.6 billion barrels of petroleum or 5,730 million tonnes of coal energy capacity of 10,600 MW, but direct production capacity of 2000 MW power generation. If this energy is recovered with 0.25% efficiency, then Rs 60 billion can be saved over a period 30 years[6]. The non-conventional geothermal energy from the hot springs has not been able to capture the attention of policy makers, probably due to the small potential in individual cases and locational reasons.

The temperature of hot water on the surface varies from mild warm to boiling depending upon the surface and subsurface conditions. Mixing of cool percolating water with the ascending hot water would decrease the temperature; however, for power generation temperature in the subsurface reservoir needs to be considered. Hot springs are discharging water in variable quantities: <1 litre/min to tens of litres/min. The discharged hot water on the surface can be enhanced by forceful injection of surface water to artificially fractured hot reservoir through drill holes and the same may be brought back on the surface through another set of holes.

Attempts were made in India to utilize the heat for power production at Puga, Leh and Tattapani, Chhattisgarh where inferred reservoir temperature was high. The achievements were not laudable possibly because of inadequate geotechnical appraisal of the selected sites or inexperience in the field. High reservoir temperature in hydrothermal fields such as Yamunotri, Beda in Mandakini, Tapoban in Dhauli River and Dar in Dhauliganga, Uttarakhand[7] or where the ground emits jets of steam besides boiling water could be among other promising sites.

An ambitious programme for power generation can be launched through geotechnical studies such as reservoir depth, size, lithology, age, structure and tectonics of the area, temperature, horizontal and vertical thermal profile, heat source, geomorphology and water source for injections, if required. Quality, quantity, temperature of the hot water and groundwater conditions in the reservoir and the adjoining areas should be known along with the technology to be used for power generation.

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