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Thermophysical Properties of Geothermal Energy Resources of Germany and Azerbaijan

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Geothermal energy harnesses the heat energy present underneath the Earth and is generated in many places, where heat from the earth's core rises to the surface, for example where volcanoes and hot springs are present. Geothermal water resources of Germany are rich, which already use for the various purpose: in medicine, alternative energy etc. These resources have a low concentration of the major ions Na, Ca, Mg, and Cl, SO4, HCO3, which are thermal waters that have been in contact with rocks containing little or no soluble components. Azerbaijan possesses rich geothermal energy and mineral water resources. More than 50 million m3 of geothermal energy resources are available in Azerbaijan with maximum temperatures of up to ∼140 °C.

The geothermal resources of Germany and Azerbaijan have been extensively studied. But, most of these research investigations were of geological, geographical and chemical properties. The main thermophysical properties, such as density, viscosity, vapour pressure etc. have only had limited studies. To use the geothermal energy resources as an alternative energy source requires the investigation of the thermophysical properties of a wide range of parameters. In many cases, the temperature of the geothermal water remains high, but pressure quickly becomes equal to ambient pressure. If we will use the geothermal resources for power generation directly at the source, they can be generating the energy. Using experience in Iceland and other deve¬loped countries, we can maximise the use of geothermal energy as an alternative energy resource.

In this presentation, we will inform the thermophysical properties analysis of geothermal energy resources of Germany and Azerbaijan (more than 120 geothermal water resources) over the parameter range of interest: (p,rho,T) behaviour at T=(278.15 to 413.15) K and p=(0.101 to 100) MPa using the DMA HPM vibrating tube densimeter; density measurements at T=(278.15 to 363.15) K and p=0.101 MPa using the DMA 5000 vibrating tube densimeter; vapour pressure measurements at T=(278.15 to 323.15) K using the static method; viscosity measurements at T=(278.15 to 343.15) K using the SVM 3000 Stabinger Viscometer and the chemical compounds analysis using the IRIS Intrepid II Optical Emission Spectrometer. These investigations have been examined for the first time.

Using the (p,rho,T) data, the comprehensive and accurate thermodynamic equation of state over a well specified range of parameters which are of interest in renewable energy research was constructed. An empirical correlation for the vapour pressure and viscosity results has been developed. These equations are used to calculate the various thermodynamic properties of these resources.