Thermodynamic Properties of the Geothermal Resources of 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. More than 50 million m^3 of geothermal energy resources are available in Azerbaijan, which can be divided into the following regions: Nakhichivan, Greater Caucasus - Pre-Caspian, Lesser Caucasus, Talish mountains, Samur-Devechi piedmont, Absheron peninsula and Kura-Araz depression. Azerbaijan's part of the Greater Caucasus region and Pre-Caspian (800-3385 m) region are rich in geothermal energy resources. The temperature of the waters fluctuates around 90°C, the salinity of the waters is not high, and the estimated discharge is about 4.0 million litre/day.1 The main chemical components are: Cu, Br, J, F, Mn, Ti, H_2S, Sr etc. H_2S waters are found on the south and southeast slope of the Greater Caucasus and are confined to sedimentary deposits. Fresh bicarbonate calcium-sodium hot waters were found with temperatures of up to 90°C. Some geothermal resources have a depth of 1400 m. The waters are imbibed. The main conditions treated are: diseases of the stomach, the liver and biliary ducts, the kidneys and the urethra canal, urology and metabolic disorders. The geothermal resources have high salinity up 60 g/l.[2]

The main objective of this presentation is to provide accurate experimental density data of the geothermal resources of the second geothermal region (Greater Caucasus - Pre-Caspian) of Azerbaijan. For this purpose, the (p,ρ,T) properties of the Palchig-Oba and Muxtadir geothermal resources of Khachmaz region of Azerbaijan at T=(278.15 to 373.15) K and at pressures up to p=40 MPa were examined for the first time. The samples were filtered and degassed slowly using the vacuum system. For the stopping of vaporisation of pure water, the vacuum procedure was very slow (the groove of flask valve, which held the sample, was very slightly opened). We tried to use the samples as close as possible to the original state, but at the same time to remove all dissolved gases and other non mineral compounds. The amounts of dissolved gases or air play a very negative role in the density measurements. The (p,ρ,T) measurements were carried out using a new modernized high pressure – high temperature vibrating tube densimeter DMA HPM (Anton-Paar, Austria). Using an equation of state the thermal properties of geothermal resources of Azerbaijan were calculated. The chemical compounds of samples were analysed in the IRIS Intrepid II Optical Emission Spectrometer.

[1] Ibrahimova, I.Sh., Tagiyev, I.I., Babayev, A.A., 2001, Resources of mineral & thermal waters of Azerbaijan, Chashiogly, Azerbaijan, 166 pp.
[2] Ismailova, M.M., 2006, Environmental problems associated with utilization of mineral waters in urbanized areas of Azerbaijan, NATO Science Series, 74, 279-288.