GEOCHEMICAL STUDIES ABOUT WELL 4014 FROM CHIŞLAZ SITUATED IN BIHOR COUNTY

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Abstract

In this paper we will study the geothermal water from the Chislaz from 4014 well, county Bihor.In this purpose will be presented physico-chemical analyzes for geothermal fluid. We will predict mineral deposits that may arise in the instalations, at the use of geothermal water with a program simulation. The program will estimate the mineral deposits that form by cooling the geothermal fluid. Based on the silica content in geothermal water we will determine the temperature in the geothermal reservoir with silica-enthalpy model.

Key words: well 4014, ternary diagram, Watch simulation program, silica-enthalpy model

INTRODUCTION

Perimeter geothermal Chişlaz do part of the area Biharea-Sacuieni-Marghita, featuring in mostly features of the this geothermal area.With uniformly distributed in Western Plain, Pannonian upper thermal system represents a the regional hydro-structure (Tenu, A., 1981), developed in the all Pannonian Basin. Spatial development of the aquifer in this area is determined by the complex structure of the crystaline foundation.In order physico-chemical characterize more the complete of the geothermal aquifer Chişlaz we determined using model silica-enthalpy geothermal reservoir temperature, based on the content of silica (SiO_2) of geothermal water.With a simulation program we will estimate the mineral deposits that may occur at cooling the geothermal fluid, in water distribution system. For to make these determinations is necessary to analyzed physico-chemical the geothermal fluid from well 4014.

MATERIAL AND METHOD

Geothermal water was sampled, in order to get the chemical composition. The measured temperature was 58°C, at collection. The physico-chemical methods used for analysis (Buliga, E. et al 1996) are presented as follows: potassium and sodium were analysed flame photometrically, at λ=767 nm and 589 nm, respectively; - magnesium and calcium were analysed by complexonometric titration (Buliga, E. et al

1996); content of iron in geothermal water was analysed spectrophotometric at λ=510 nm, using o-phenantroline; boron was determinated at λ=420 nm, by spectrophotometric method; it is based on the reaction in a buffer solution with azomethine; silica content was analysed by spectrophotometric determination at λ= 410 nm; this method is based on the reaction, at pH=1,2-1,5 with molibdate, when is formed a yellow complex- silica-molibdate ; the chlorine was analysed by using the Mohr method (Pătroescu, C. et al 1980); - sulphate concentration was analysed by titration with barium perchlorate used as thorin indicator; - total carbonate was determined by titration, using metilorange as indicator with HCl solution, total dissolved solids was detemined by gravimetric analysis (Buliga, E. et al 1996).

2.1. Chemical characterization of geothermal waters

The chemical composition for well 4014 Chişlaz, of the analyzed geothermal water is show in table 1.

Table 1. Physico -chemical characterization of geothermal water from well 4014.

Flow l/s	*Depth drilling m*	*Temperature °C*
4	1000	58
Chemical analysis mg/l		*Well 4014*
pH		8,4
Na^+		274
K^+		7,09
Ca^{2+}		5,12
Mg^{2+}		2,02
Cl^-		11
SO_4^{2-}		17
HCO_3^-		755
SiO_2		41
Fe^{2+}		0,12
B^{3+}		0,88
CO_2		485
TDS		720

RESULTS AND DISSCUSIONS

These waters present a high mineralization and a slight basic pH. We used a triangular diagram for an initial classification, in terms of the major anions Cl, SO_4 and HCO_3 of geothermal water. Geothermal water form the well 4014 Chişlaz is situated on ternary diagram Cl-SO_4-HCO_3 (Figure 1.) near to the bicarbonate corner in the field of peripheral waters.

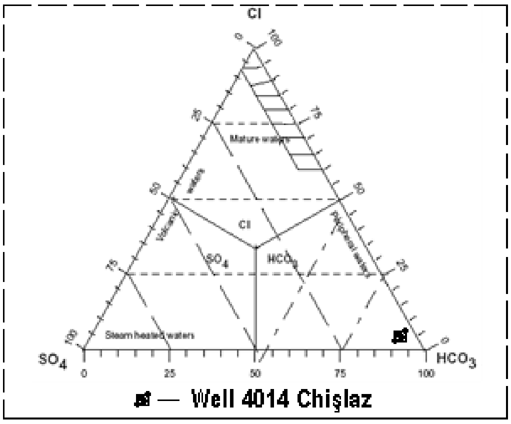

Fig. 1: Cl-SO_4-HCO_3 ternary diagram.

Geothermal water from well 4014 Chişlaz are close to curve of equilibrium of Arnorsson, partially balanced. When the points on the ternary diagram Na-K-Mg is found in the region corresponding to the metastable equilibrium, is a good indication that the chemical composition of these waters may be successfully used for the calculations with geotermometre (Giggenbach, W.F., 1991).

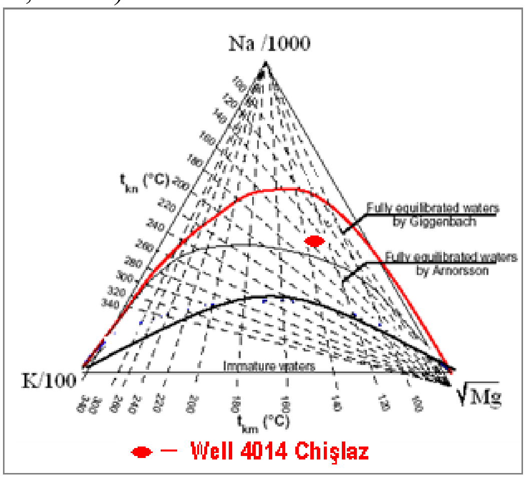

Fig. 2: Na-K-Mg equilibrium diagram.

Estimation the solid mineral deposition (Bjarnason J.O., 1994)

The results of the laboratory analyses have been calculated in the Watch simulation program at production temperature and by cooling in steps of 15º C.In this way it is possible to predict the scaling potential. By the use of the program it was calculated the ionic activity Q corresponding to different minerals in the brine and it was compared with the theoretical solubility, K, of the respective minerals. When $Q < K$ the saturation index is negative and the solution is undersaturated with respect to the mineral considered.

When $Q > K$ the solution is supersaturated and when $Q = K$ the solution is exactly saturated or in equilibrium with the mineral in respect.Changes in water by cooling within the system during utilization can by modelled and subsequent changes in chemistry evaluated. This is an important tool for the assessment of scaling problems (Sebesan Radu et al, 2009).The results obtained by the Watch program are presented in table 2 . Representation the saturation indices, calculated for minerals, depending on temperature is shown in the figures 1.

Table 2 . Values for logarithm of solubility products of minerals in deep water at different temperatures for geothermal water from 4014 well.

T °C	Log.Q/K Anh.	Log. Q/K Calcit	Log. Q/K Calc.	Log. Q/K Quart	Log.Q /K Woll.	Log.Q /K Am.s.
55	-0,733	-0,716	0.114	0.477	0,003	0,021
40	-0,951	-0,640	0.342	0.672	0,044	-0,697
25	-0,892	-0,521	0.032	0.388	-0,001	-1,273

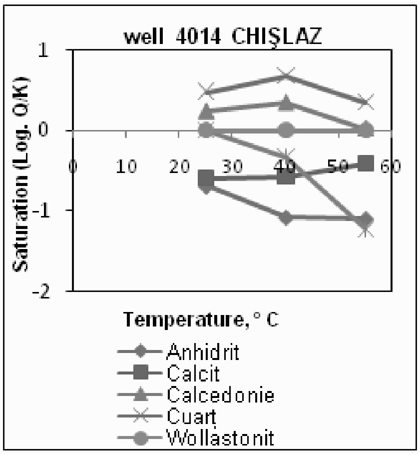

Fig. 3. Log.Q/K vs temperature for geothermal water, well 4014.

Geothermal water is supersaturated with chalcedony and quartz, there not is a supersaturation with calcite. Curves for calcite and anhydrite are below the balance.

Determination the temperature in the geothermal reservoir from Chişlaz with model silica-enthalpy (Sebesan M. et al, 2010)

Using the silica-enthalpy model we estimated the temperature in the geothermal reservoir.On the basis of silica content in geothermal water and the surface temperature we measured the enthalpy for geothermal fluids, the results are presented in table 3.

Table 3. Temperatures, enthalpy of surface and concentration SiO_2, for well 4014 from Chişlaz .

Well	SiO_2 (mg/l)	Temperature to surface,°C	Enthalpy [kj/kg]
4014 Chişlaz	41	58	243,6
Cold water	20	10	42

The simplest method of determining the temperature of the water in depth in the geothermal reservoir is the graphical representation of the concentration of silica based on the enthalpy for the geothermal liquid .

Although temperature is a quantity that can be measured and the enthalpy is a property derived obtained from thermodynamic tables (Amorsson, S., 1985) depending of the temperature, however in the Silica - Enthalpy model is preferred using the enthalpy. In Figure 4 we presented the silica-enthalpy model for wells in city Oradea studied.

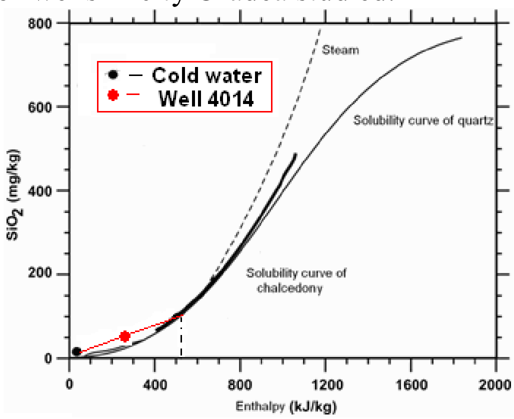

Fig. 4. Diagram of dissolve ilica-enthalpy for well 4014.

Temperatures in the geothermal reservoirs interior respectively enthalpies for hot parts determined with silica-enthalpy model, for well studied are shown in Table 4.

Table 4.Temperatures resulted by silica-enthalpy model calculations.

Well	SiO_2 (mg/l)	Enthalpy in reservoir, [kj/kg]	Hot water temperature in reservoir, °C
4014 Chişlaz	41	501,4	119,4
Cold water	20	42	10

Analyzing the value obtained with the model silica - enthalpy, for temperature of geothermal fluid in the interior of reservoir, it is found as this value obtained is significantly higher value than that measured at the surface. Therefore, it is assumed that mixing occurs geothermal hot water with cold water in the upper , causing the cooling of the geothermal water to surface.For well 4014 Chişlaz, by using silica - enthalpy model found a temperature of 119,4°C (Figure 1.), Which could lead us to the conclusion, that higher temperature geothermal water is caused to mixing with cold water.

CONCLUSIONS

With means of chemical analysis we characterized the geothermal water from well 4014 Chişlaz. using ternary diagram Na - K - Mg was determined that: water from chişlaz is located on curve of equilibrium of Arnorsson, it is considered partially balanced. Using ternary diagram Cl-SO_4-HCO_3, water from well 4014 Chişlaz is located in field of peripheral water, geothermal water has a strong content in bicarbonate.Temperature of geothermal reservoir from Chişlaz was set with silica-enthalpy model, which is based on the graphical representation of the concentration of silica based on the enthalpy of the liquid. For the well studied it was found that the temperature of the geothermal water in the tank is higher than at the wellhead. This is explained by mixing with cold water in upper layers and by the contact with rocks.

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