POSSIBLE USES OF GEOTHERMAL ENERGY IN THE SACUIENI AREA

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Abstract - The paper presents information about the measurements conducted on Săcuieni geothermal reservoir and about estimated calculations on the possibility of using geothermal energy in the area

Key words: Geothermal Energy, Săcuieni

1. INTRODUCTION

Săcuieni geothermal reservoir
It is located on an area of about 25 km^2 and there is an outdated heating system that has technological loss of 40%.

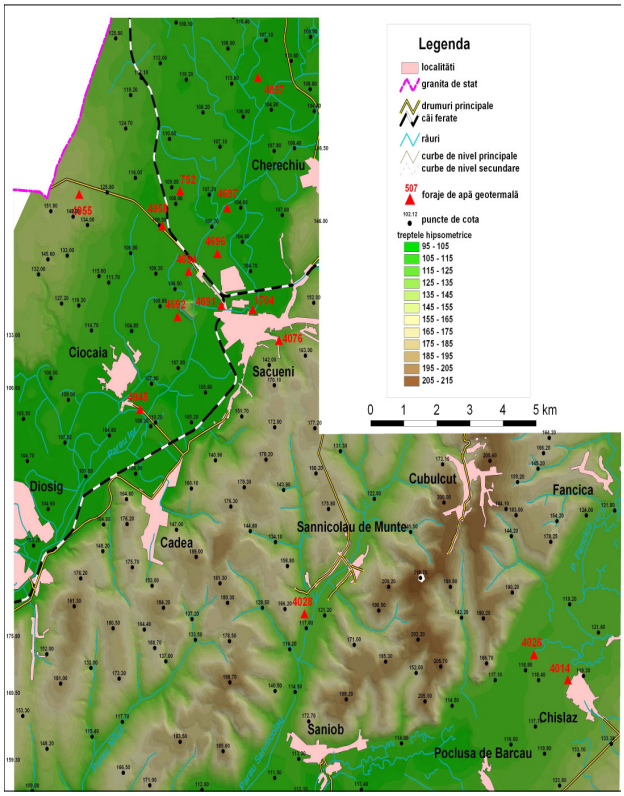

Fig. 1. Location of the Săcuieni geothermal reservoir

The geothermal aquifer is located in the poorly cemented sands and sandstones from the Upper Pannonian base. Impermeable formations from the roof and shelter, which serve as screen, are made of clay and marl.

In Table 1 are presented the main characteristics of the aquifer.

Table 1. The main characteristics of Săcuieni thermal aquifer

PARAMETER	SĂCUIENI AREA
ROCK	
density	**2690** Kg/m^3
porosity	**25**%
permeability	**700-2000** mD
compressibility	**4,97 x 10^{-10}** m^2/N
specific heat	**837** J/KgK
thermal conductibility	**2,5** W/m^{0}K
caloric capacity	**2251,5** KJ/ m^{3}K
WATERS	
density	**977** Kg/m^3
viscosity	**0,32 x 10^{-3}** s N/m^2
volume factors	**1,025**
specific heat	**4208** J/KgK
thermal conductibility	**0,673** W/mK
total compressibility aquifer (rock + water)	**9,33 x 10-10 m2/N**
total caloric capacity aquifer (rock + water)	**2809 KJ/m3K**

The geothermal gradient values determined in deep boreholes executed in the Sacuieni city area are presented in Table 2.

Table 2. Geothermal gradient values

INDICATIVE OF THE WELL	GEOTHERMAL GRADIENT (^{0}C/Km)
F4055 Sacuieni	64
F4043 Ciocaia	64
F4043 Ciocaia	63
F4057 Sacuieni	57
F4056 Sacuieni	57
F4031 Sacuieni	57
F4058 Sacuieni	53

2. EXPERIMENTAL DATA

Chemical characteristics of the geothermal water produced through the Sacuieni wells (ion concentrations in mg / l). These characteristics are shown in Table 3.

Table 3. Ions concentrations in mg / l

Nr crt.	Chemical Characteristics	Wells 4058	Wells 1704	Wells 4691
1.	pH	7,88	8,6	7,7
2.	Na^+	1456,75	1178,055	1406,452
3.	K^+	193,94	157,322	187,152
4.	Ca^{2+}	25,7	54	20
5.	Mg^{2+}	3,9	0,617	1,236
6.	Cl^-	828,87	474,27	776,130
7.	SO_4^{2-}	27,6	14,814	22,632
8.	HCO_3^-	2596,77	2506,1	2361,888
9.	SiO_2	53	40	66,5
10.	Fe^{2+}	0,22	0,13	0,34
11.	NH_3	-	0,44	-
12.	CO_2	1998	2010	1890
15.	Mineralizație	12208	10560	8900
16.	H_2S	-	-	-
17.	Fenoli	2,04	-	1,06

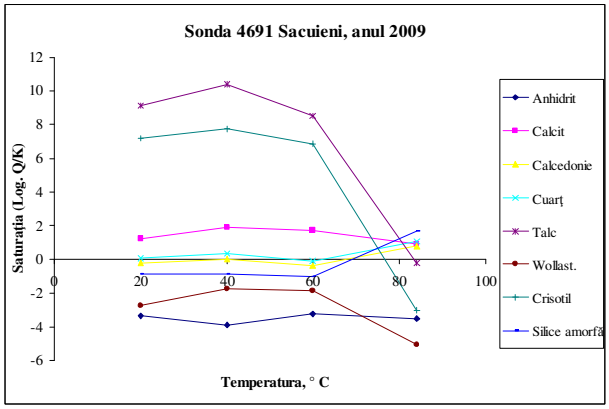

Fig. 2. The temperature dependence of the saturation index (log Q / K)

The values of the saturation indices for the minerals that may separate by cooling geothermal waters from 4076 Sacuieni well, at different temperatures in 2010 - January.

Table 4. Values of saturation indices

Temp. °C	Log.Q/K (Anhidrit)	Log.Q/K (Calcit)	Log.Q/K (Calced.)	Log.Q/K (Cuart)	L Log.Q/K (Talc)	Log.Q/K (Wollast.)	Log.Q/K (Crisotil)	Log.Q/K (Sil.amorf.)
79	-2,495	0,238	0,009	0,382	-1,390	-5,151	-3,091	-0,712
75	-2,476	0,352	-0,017	0,293	-0,506	-4,976	-2,810	-0,801
60	-2,561	0,497	0,077	0,360	-1,718	-5,227	-4,302	-0,791
45	-2,624	0,046	0,224	0,548	-2,846	-5,980	-5,824	-0,592
20	-2,745	-0,003	0,373	0,729	-3,895	-6,555	-7,456	-0,456

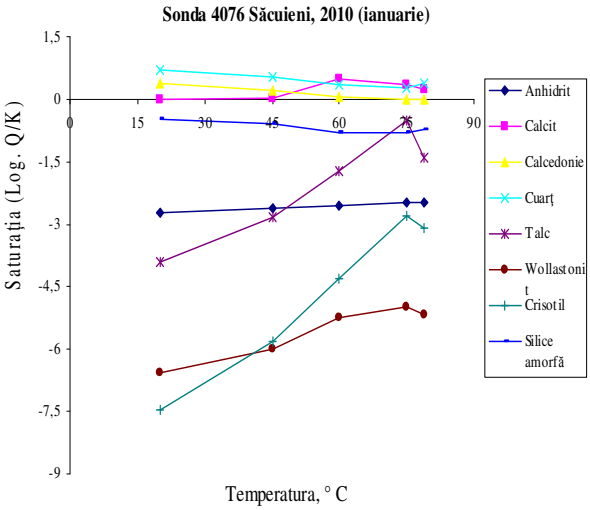

Fig. 3. The temperature dependence of the saturation index (log Q / K).

In order to establish as accurate as possible the possibilities of using the geothermal energy several simulation tests have been conducted on the geothermal wells in the area. The results of the tests are shown in the following Tables and Figures

Table 5. Simulation Test Well 4691 Săcuieni

Q	s	s/Q
l/s	(m)	(m/gi/min)
8	16	0,152
16	33	0,156
23	48,5	0,160

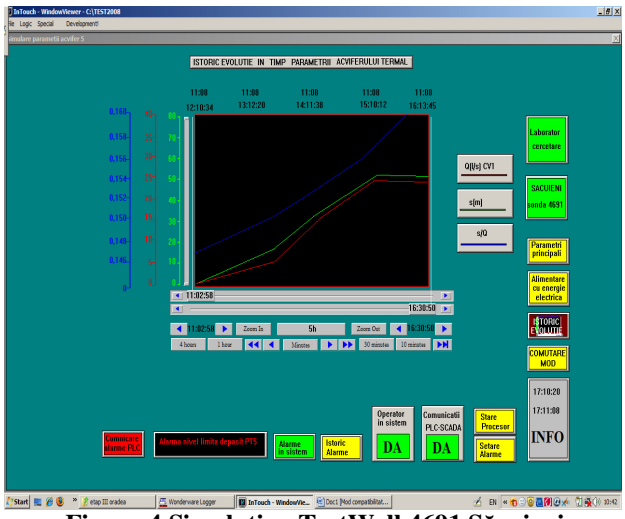

Figure 4.Simulation TestWell 4691 Săcuieni

Table 6. Simulation Test Well 4076 Săcuieni

Q	s	s/Q
l/s	(m)	(m/gi/min)
5	5,8	0,088
10	12	0,091
15	18,5	0,093

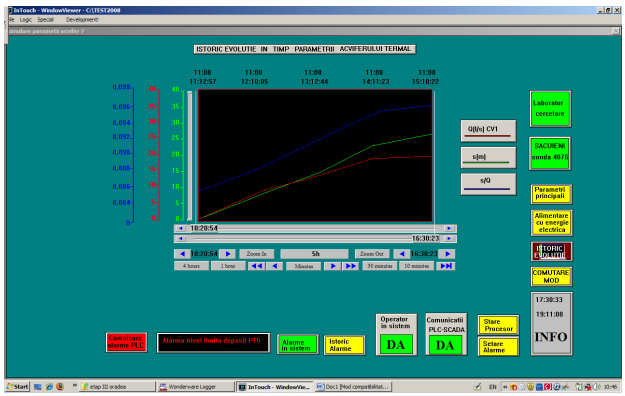

Figure 5.Simulation Test Well 4076 Săcuieni

3. DETERMINATION OF THE BUILDINGS FOR GEOTHERMAL HEATING

The volumes calculated for the buildings in Săcuieni city are shown in Table 7

Table 7. Volume calculation for the buildings

City Hall	High school	Sport's hall	ANL blocks	Houses (3200 houses in Sacuieni)
2000 m^3	11437 m^3	3750 m^3	648 m^3	250 m^3 / house

Currently for heating and tap hot water the wells are used: 4076, 1704, and 4691 with a flowrate of 6 l /s, with a temperature of 86^0C for each well (18 l/s total flowrate).

The necessary of tap hot water is 26829 m3/month (10 l/s) for Săcuieni city residents.

Thermal calculation

Heat demand: 108 979 W City Hall
1689 m^3/ month (0.65 l/s) geothermal water
Heat demand: 398 862 W College
6183 m^3/ month (2.39 l/s) geothermal water
Heat demand: 160 281 W Hall Sports
2485 m^3/ month (0.96 l/s) geothermal water
Heat demand: 51675 W ANL
801 m^3/ month (0.31 l/s) geothermal water
Heat demand: 16737 W / House
53558400 W / 3200 houses
0.1 l/s/house geothermal water

The results of the calculations and interpretation of results

Available flowrate for heating 8 l/s (18 l/s – 10 l/s)
Necessary flowrate for heating City Hall, High school, Sport's hall, ANL 4.3 l/s
Available flowrate for houses heating 3.7 l/s (37 houses)
By using deep well pumps in each well, the total flowrate can be increased at 118 l/s. In this case, the available flowrate for houses heating is 103.7 l/s (1036 houses).

4. CONCLUSION

Given the simulations carried out at the wells, simulations showing that the exploitation can be made up to a total flowrate of 118 l/s, it is recommended the usage of deep well pumps in order to obtain the required flows and to provide the heating and tap hot water necessary to the Sacuieni city.

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