PARAMETERS OF THERMAL GROUNDWATER IN THE NORTHERN SECTOR OF HIGHER PANNONIAN WESTERN PLAINS

Cornel ANTAL[1], Aurel SETEL[2], Ovidiu GAVRILESCU[2], Gabriela Elena BADEA[1*]
[1]University of Oradea, 1 Universitatii Str., 410087, Faculty of Energy Engineering,
cantal@uoradea.ro, gbadea@uoradea.ro, *corresponding author
[2]University of Oradea, 1, National Geothermal Research Centre, Romania,
e-mail: asetel@uoradea.ro

Abstract
Available data processing has focused on two of the major structural units with geothermal potential in the Pannonia Depression.Hydro-geological parameters have been determined after efficacy, performance and background measurement tests carried out in wells that opened thermal aquifers in permeable structures of geological units making up the Pannonia Depression.Flow rate, static pressure (hydrostatic level respectively), dynamic pressure (dynamic levels respectively) and temperature measurements have been carried out.

Key words:exploitability; resource; aquifer; geothermal

Introduction

Using geothermal water in Romania, is based on the quality of drinking water or as needed, directly or indirectly (through heat exchangers) and mixed, water is used for heating, hot water as the greenhouses, swimming pools and technological purposes. Practically, geothermal water can be used whenever a relatively low temperature is needed (below 150°C). In industrial applications, geothermal energy provided by a geothermal fluid of up to 150°C is used in basic processes, such as: preheating, sterilisation, vaporisation, freezing, washing, drying, distillation, shucking, etc. Depending on the structure of the industrial process, geothermal energy may be used either independently or combined with caloric energy of different origins (fossil fuel, electricity, bioenergy, etc.).

Although geothermal energy is categorised in international energy tables amongst the "new renewables", it is not a new energy source at all. People in many parts of the world have used hot springs since the dawn of civilization. Geothermal energy is independent of weather conditions, contrary to solar, wind, or hydro applications. It has an inherent storage capability and can be used both for base-load and peak power plants.

2. Experimental

Available data processing has focused on two of the major structural units with geothermal potential in the Pannonia Depression.

Hydro-geological parameters have been determined after efficacy, performance and background measurement tests carried out in wells that opened thermal aquifers in permeable structures of geological units making up the Pannonia Depression.

Debit, pressure and static (hydrostatic level respectively), dynamic pressure (dynamic levels respectively) and temperature measurements have been carried out.

Physical and thermodynamic properties of the geothermal fluid determined due to their dependency on temperature, pressure and mineralisation, which have a definite influence on resource exploitation, have been brought to the foreground.

Hydrogeological parameters were determined from tests of effectiveness, performance tests and measurements of bottom, made in wells which have opened aquifer thermal units permeable geological formations within the Pannonian Basin constitution.

Measurements were made of flow, static pressure (hydrostatic levels respectively), dynamic pressure (dynamic levels respectively) and temperatures.

Measurements, interpretations and calculations for determining the parameters were made by specialists in the field of groundwater from SC TRANSGEX S.A.

The next parameters have been defined:

Piezometric level (hydrostatic) - **NH** - position of the water surface to ground level or above sea level, in static, may be positive when it is located above the ground or negative when it is located below ground level - is expressed in (meters) or units of water column pressure (atmospheres or bars).

Dynamic level –**Nd**- position of surface water to ground level, the pumping regime, may be positive when it is located above the ground or negative when it is located below ground level - is expressed in (meters) or units of water column pressure (atmospheres or bars)

Water-column height -H - height of water column measured from the aquifer to the level of hydrostatic complex - is expressed in (meters)

Bump-s - the length of descent from the hydrostatic water level during pumping with a flow rate - expressed in (meters)

Step flow - Q - maintained a constant flow pump in a certain period of time - is expressed in (l / sec) (cubic meters / sec) (Imperial gallons / min)

Specific flow-q - the ratio of pumping flow and gradient - is expressed in (l / sec / meter)

Specific Bump -s/Q - the ratio between bump and pump flow - is expressed in (meters / cubic meters / sec or feet / imperial gallon / min)

Transmissivity-T - the flow of water that can yield aquifer through a surface equal to 1 x thick carpet in a 24 hour period - is expressed in (cubic meters per meter per day). This parameter is an indicator of potential aquifer.

Filtration coefficient (hydraulic conductivity) - K - water flow rate through the collector under natural - is expressed in (meters / day). This parameter is an indicator of potential aquifer.

Radius of influence-R - distance from the drilling of production until it feels the effect of pumping, which distorts the distance that the piezometric surface - is expressed in (meters)

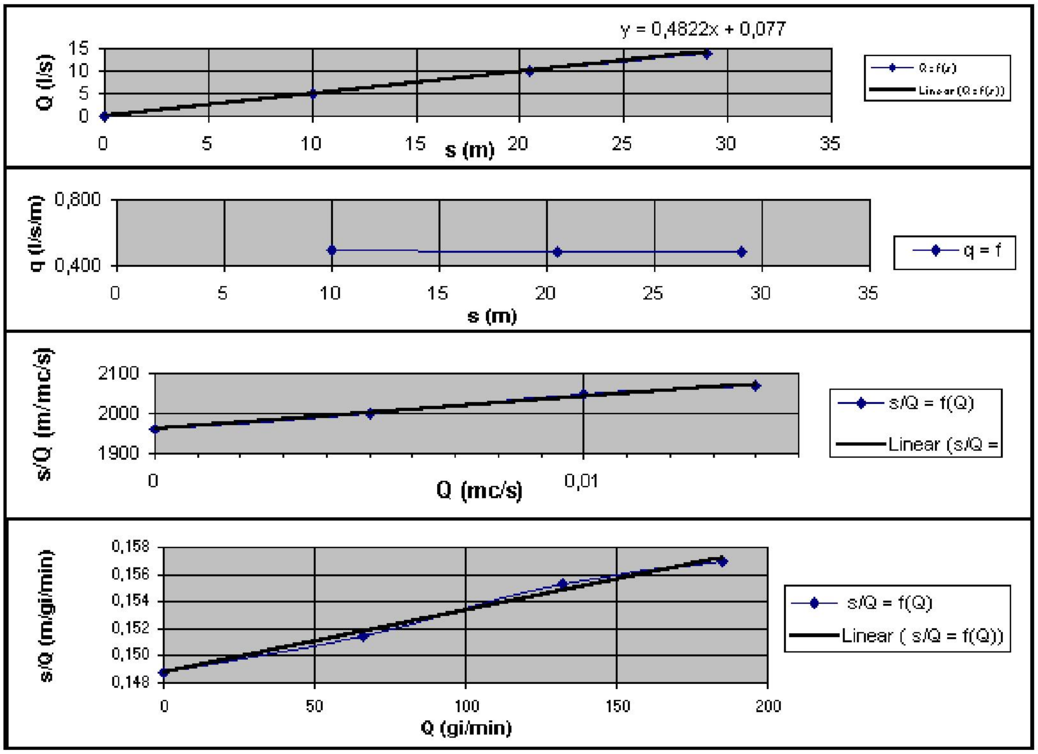
Effectiveness or efficiency of hydraulic drilling-E - show the influence of design parameter of the event aquifer drilling at these water inside the column filter, the filter pressure loss are producer - is expressed as (percentage), if the load losses are reduced effectiveness is high.

Characteristic function of the drilling-W (u) - is an integral exponential function used for standard curve (theoretical) in theis method - pumping test under non-permanent (transient)

The next parameters have been determined for *Acâş - Beltiug – Tăşnad Area* for several wells**:**:

Charts effectiveness , Well 1501 Acas

Q			**s**	**q**	**s/Q**	**s/Q**
l/s	mc/s	ig/min	(m)	(l/s/m)	(m/mc/s)	(m/gi/min)
5,00	0,005	66,00	10,00	0,50	2000	0,15
10,00	0,010	131,99	20,50	0,49	2050	0,16
6	0,014	184,79	29,00	0,48	2071	0,16



s_{max}= 29,05,
R = 1240 m,
H =1174,5 m,

Efficacy =100-(BQ^2/s max)
Efficacy =94,6%

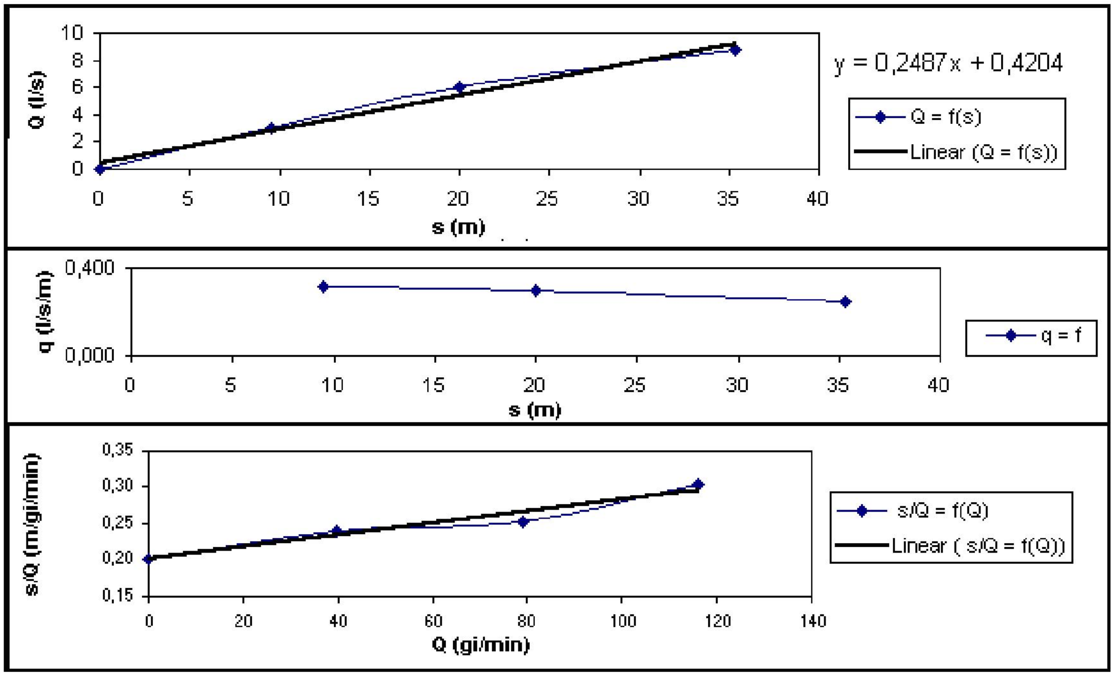
Charts effectiveness, Well 1502 Acas

Q			s	q	s/Q	s/Q
l/s	**mc/s**	**gi/min**	**(m)**	**(l/s/m)**	**(m/mc/s)**	**(m/gi/min)**
3	0,003	39,60	9,5	0,316	3167	0,240
6	0,006	79,20	20	0,300	3333	0,253
8,8	0,0088	116,15	35,3	0,249	4011	0,304

S(m)	Q l/s	s (m)	q (l/s/m)	Qmc/s	s/Q (m/mc/s)	Qig/min	s/Q (m/ig/min)
0	0	9,5	0,316	0	2646	0	0,20
9,5	3	20	0,300	0,003	3167	39,60	0,24
20	6	35,3	0,249	0,006	3333	79,20	0,25
35,3	8,8			0,0088	4011	116,15	0,30

NH = + 36,3m = 3,63 at,
T=62^0C
A=2646 m/mc/s
A=0,030625294 m/mc/day
H =1539 m
A = s/Q
W(u) =19,45
T =50,54 mc/m/day
R = 2s(kh)1/2

R =1831 m
T = 50,54 mc/m/day
M =115,7 m
K =0,44 m/day
8,30E-04 B
s=AQ+BQ^2
s_{max} =34,48
BQ^2/s max 32,5%
Efficacy 100-(BQ^2/s_{max})= 67,5%



s_{max}34,48
$BQ^2/s_{max=}$32,5%
Efficacy 100-(BQ2/s max) = 67,5%

R = 1831 m
H = 1539 m

Charts effectiveness, Well FH 1 Beltiug

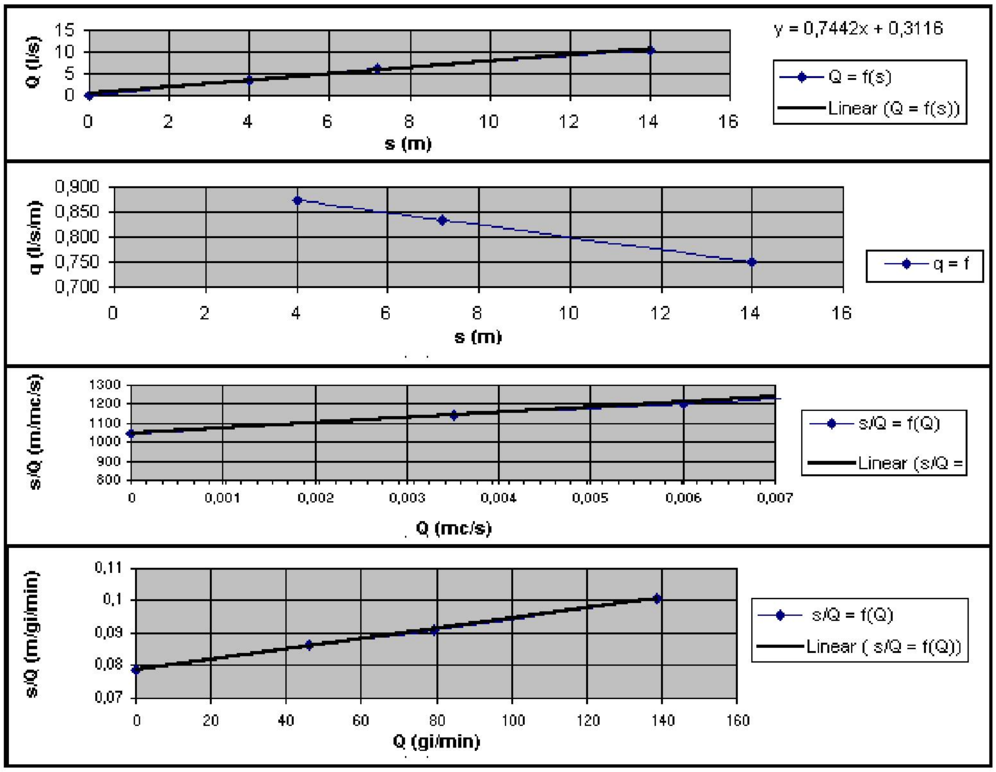
Q			s	q	s/Q	s/Q
l/s	**mc/s**	**gi/min**	**(m)**	**(l/s/m)**	**(m/mc/s)**	**(m/gi/min)**
3,5	0,0035	46,19758	4	0,875	1143	0,087
6	0,006	79,19585	7,2	0,833	1200	0,091
10,5	0,0105	138,5927	14	0,750	1333	0,101

Pd = 0,1 at, NH=+15m = 1,5at, T= 65^{0}C

S (m)	Q l/s	S m)	q (l/s/m)	Q mc/s	s/Q (m/mc/s)	Qig/min	s/Q (m/ig/min)
0	0	4	0,875	0	1042	0	0,078948744
4	3,5	7,2	0,833	0,0035	1143	46,19757648	0,086584629
7,2	6	14	0,750	0,006	1200	79,19584539	0,09091386
14	10,5			0,0105	1333	138,5927294	0,1010154

A=1042 m/mc/s
A=0,012060981m/mc/day
H =1229m
W(u) =19,45
T =128,33mc/m/day
R = 2s(kh)1/2
R =1149 m
T 128,33mc/m/day

M= 93,7m
K =1,37m/day
$s=AQ+BQ^2$
s_{max} =13,97 m
BQ^2/s_{max} =21,7%
Efficacy
100-(BQ^2/s_{max}) 78,3%



CONCLUSIONS

One of the major concerns of mankind today is the ever-increasing emissions of greenhouse gases into the atmosphere and the threat of global warming. There is an international acceptance that a continuation of the present way of producing most of the energy needed - by burning fossil fuels - will bring about significant climate change, global warming, rises in sea level, floods, droughts, deforestation, and extreme weather conditions. The sad fact is that the poorest people in the world, who have done nothing to bring on the changes, will suffer the most. One of the key solutions to avoid these difficulties is to reduce the use of fossil fuels and increase the sustainable use of renewable energy sources. In many parts of the world, geothermal energy can play an important role in this respect.

REFERENCES

1. **Airinei Şt., Pricăjan A.** (1977) Cadru conceptual pentru investigarea complexă a termalității apelor subterane din Cîmpia de Vest a României, Comunicări, geologie, 101-121
2. **Airinei Şt., Pricăjan A., Bandrabur T.** (1976) Conceptual pattern concerning the study of geothermalism and the thermalization process of underground waters in Romania, 20 - 2, Revue Roumaine de Geologie, Geologie, 283-298
3. **Crețu I., Nechiti Gr., Vamvu V., Veliciu Ş.** (1984) Geothermal resources of Romania, LXIV, Anuarul Institutului de Geologie şi Geofizică , 281-389
4. **Nakicenovic, N., A. Gübler, and A. McDonald**, (editors) 1998. *Global Energy Perspectives*, Cambridge Univ. Press, 299 p.
5. **Stefansson, V.** (1998). *Estimate of the world geothermal potential*.
6. Setel A.**, Antal C.**, Gavrilescu O., Rosca M., *Energia Geotermala in Romania***,** Editura Universitatii din Oradea 2010,
7. **Antal C. –** coordonator – *Utilizarea durabila a resurselor regenerabile de energie. Energia geotermala* – Editura Risoprint Cluj Napoca, **2010**