BULETINUL Universităţii Petrol – Gaze din Ploieşti	Vol. LX No. 4A/2008	115 - 119	Seria Tehnică

Theoretical and Experimental Research Referring to the Possibilities of Heat Extraction from Soil

Sorin Neacşu, Mihai Albulescu, Renata Rădulescu

Petroleum – Gas University of Ploieşti, Bd. Bucureşti 39, Ploieşti
e-mail: sneacsu.ph@gmail.com

Abstract

The aim of this paper is to present the research made in the Thermodynamics laboratory of Petroleum and Gas University regarding the possibilities of heat extraction from soil. The experimental research tries to establish the maximum limits of thermal flux that can be obtained with each system.

Key words: *soil, heat, extraction, pump*

Introduction

An efficient possibility to make the geothermic energy of the soil available is the use of heat pumps to produce hot running water and the needed power for heating dwellings.

The heat pumps have remarkable performance; they have high performance coefficients (3,5-5) and can produce hot water. The useful temperature of hot water produced by the pump is 60^{o}C if the thermodynamic agent is a Freon (R134a). Recent research has led to the use of organics agents (propane, butane, pentane) for heat pumps, because the use of freon is limited in time.

The carbon dioxide pumps can attain hot water at 90 – 95^{o}C that can be used in the district heating process.

As previous research has shown, the heat pump extracts the larger part of the provided energy from a medium with relative low temperature. The soil represents an ideal heat source for the heat pumps because, starting with 8 meters the temperature remains practically constant (10 – 16^{o}C). The energy available in the soil is practically unlimited.

Soil Energy Extracting Systems

On this occasion several extracting systems of energy from the soil were realized in the Thermodynamics laboratory of Petroleum and Gas University from Ploieşti with the purpose of researching the maximum limits of extracting heat through each system, the dynamic of thermal flux and energy store problem.

The open system based on phreatic water

The neighboring geological conditions are favorable due to the existence of a phreatic water layer at 12 – 15 meters deep. A well was drilled and cased in order to capture phreatic water.

The measurements show that, because of the layer pressure, the hydrostatic level is 4,6 m. This allows the use of a hydrophore for water extraction from the well.

The water temperature from the well is 16°C in spring and 17°C in autumn. The phreatic water flow rate is sufficient to obtain the maximum performance of heat pump.

The system formed from a simple loop

A simple loop of polyethylene Φ32, 60 m long (figure 1) was realized for a detailed analysis of the heat exchange between the soil and an agent that goes through a polyethylene pipe

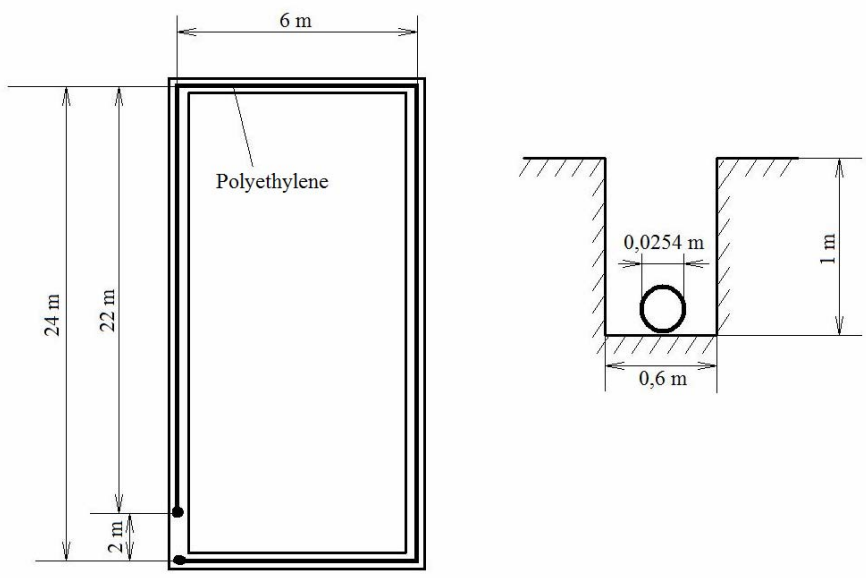

Fig. 1. Simple loop of polyethylene

The measurement of the thermal field around the pipe is made with a series of transducers buried around this simple loop (figure 2).

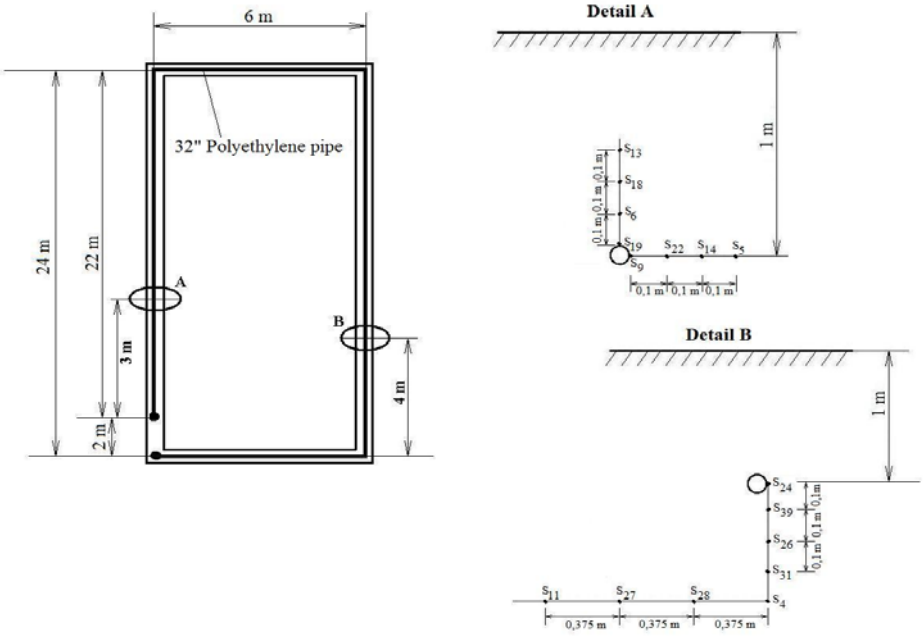

Fig. 2. Transducers arrangement

The system formed as a result of a polyethylene spiral loop

The thermal flux extracted from the soil can be increasing the lengthening the polyethylene pipe. The spiral loop system with a 200 meters length buried at 2 meters deep, made from polyethylene, is presented in figure 3.

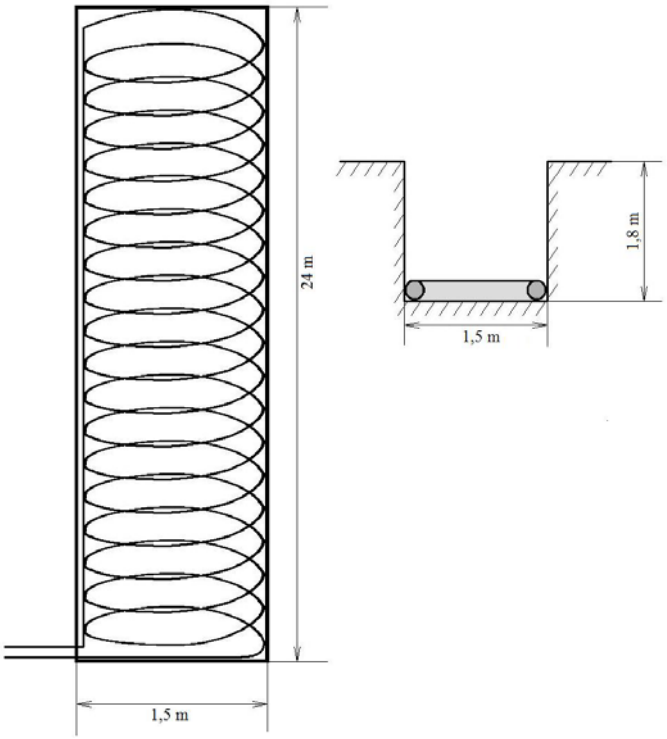

Fig. 3. Spiral loop buried at 2 meters

The system formed from an U-shape loop introduced in the well

Another system realized consists in an U-shape loop introduced in a well drilled at 40 meters deep (figures 4 and 5).

Fig. 4. Introducing the loop

The well was uncased. The polyethylene loop was introduced and the well was covered with sand and bentonite.

Temperature transducers were arranged on the entire length of the well. At 2 meters deep temperature transducers are radially placed to the well from 10 to 10 cm.

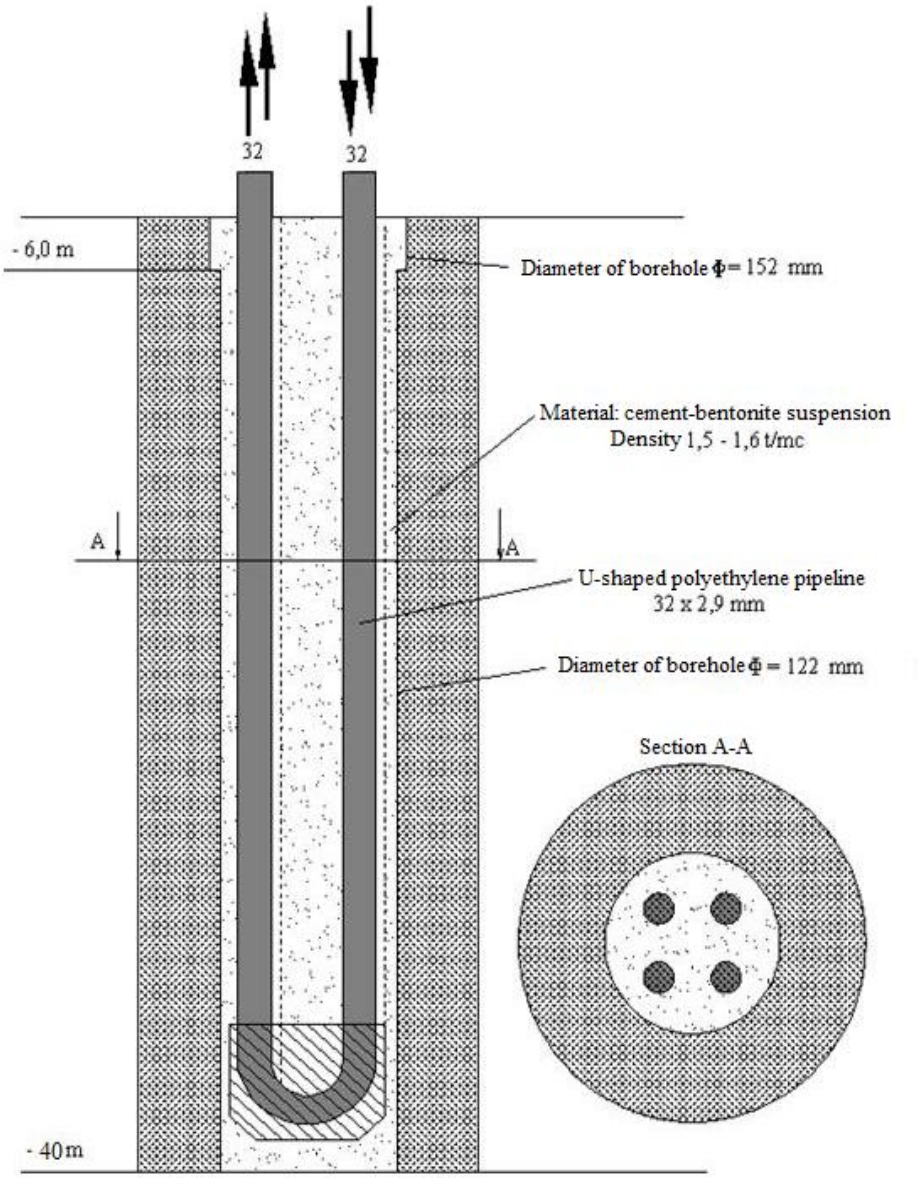

Fig. 5. U-shape loop introduced in the well

Conclusions

The capture systems of thermal energy from the soil are connected with the reversible heat pump from the Thermodynamic laboratory.

The experimental research tries to establish the maximum limits of thermal flux that can be obtained with each system in parallel with the modification of thermal field around the respective system.

An important parameter for the closed loop systems is the restore time of the thermal field around the loop. This can be experimentally determined with the measurement system of the thermal field.

The results obtained through the analysis of the various capture systems of energy available in the soil allow the improvement of projecting the heating systems based on soil-water heat pumps.

References

1. Allan, M.L., Kavanaugh, S.P. –*Thermal conductivity of cementitious grouts and impact on heat exchanger length design for ground source heat pumps*, International Journal of HVAC&R Research, Vol. 5, (2), 1999;
2. Allan, M.L., Philippacopoulus, A.J. – *Thermally Conductive Cementitious Grouts for Geothermal Heat Pumps*, FY 1998 Progress Report, BNL 66103, 1998
3. Kakas, S., Bergles, A.E., Mayinger, F. - *Heat Exchangers: Thermal-Hydraulic Fundamentals and Design*, McGraw-Hill, 1981
4. Neacşu, S., Trifan, C., Albulescu, M., Eparu, C., IONESCU, E.M. - *Analysis on energy available in soil to be used for heating dwelling places,* CNEI, Bacău, 2005
5. Neacşu, S., Trifan, C., Albulescu, M. - *Răspunsul termic al solului în cazul utilizării pompelor de căldură* Conferința națională de termotehnică cu participare internațională, Ediția XVI-a, Vol 2, Ploieşti, 2007,
6. Rybach, L., Sanner, B. - *Ground-Source heat pump systems the European experience*, Institute of Applied Geosciences, Giessen, Germany
7. Sanner, B. –*Prospects for Ground-Source Heat Pumps in Europe*, Newsletter IEA Heat Pump Centre, 17/1, 1999

Cercetări teoretice şi experimentale referitoare la posibilitățile de extragere a căldurii din sol

Rezumat

În această lucrare sunt prezentate cercetările făcute în cadrul laboratorului de Termodinamică a Universității Petrol - Gaze din Ploieşti privind posibilitățile de extragere a căldurii din sol. Cercetările experimentale urmăresc stabilirea limitelor maxime ale fluxului termic ce poate fi obținut prin fiecare sistem.