PILOT PROJECT ON UTILIZATION OF HIGH TEMPERATURE GEOTHERMAL FLUIDS

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ABSTRACT

In territory of Hungary, located in central part of Carpathian basin big amount (more than 3000) of abandoned CH-wells were drilled in course of oil and natural gas exploration estimated part are suitable after recompletion for production of geothermal fluids of high surface temperature more than 100°C and high production rate (up to 4000 cu.m./day).
These wells are useful for power generation by ORC or single flash method and coupled generation of heat and electricity by gas engine, absorption method of cooling based in production of geothermal fluids content high amount of dissolved gas with gas/water ratio up to 10.
Information is provided on the status of the geothermal energy utilization – geothermal based power generation and direct use – in Hungary with emphasis on developments between 1998–2001.
The parameters of direct use were decreased in this period and the proportion of geothermal energy utilization in the energy balance of Hungary, despite the significance proven dynamic reserves (with reinjection) of 380 Mm^3/a with heat content of 63,5 PJ/a at ΔT = 40 °C is remained very low (0,25%).
Hungary has the reliance on imported natural gas in 70% and practically only in 1-2 places are exist in the country an integrated multi-purpose approach where drinking water supply, direct use with reinjection, bathing and other uses are implemented in integrated cascading system (e.g. City Hódmezővásárhely).
Three important factors for this low utilization: is a lack of support from the state in first, *no consistent* legal background and overtaxing.

1. INTRODUCTION

The heat flow density [1] and geothermal gradient of the Carpathian Basin are characterized expressive by the favourable endowment of geothermal energy-sources of Hungary (Fig. 1), because of this values are between 80 and 100 mW/m^2 and two times higher, than te World average. For example the calculated and measured maximum is: 113 mW/m^2 existing in the closed district of Szeged City (The European average is 62 mW/m^2).

In course of hydrocarbons exploration in last century among the more than 10.000 exploration wells, in number of cases and places result of slag test and DST was only an “influx of thermal water” like secondary product Over 3000 wells had been therefore qualified as “abandoned oil wells” contrary to production oil and natural gas wells.
In territory of Bács-Kiskun County more than 400 abandoned wells were identified, Kiskunság area is located inside borders of the County (Fig. 2.).

2. GEOLOGICAL BACKGROUND

In territory of the "Mélykút-Északkelet" exploration area in period between 1970–1990 were drilled some wells among them the well Mélykút-Ék-3, (Settlement Balotaszállás) started its activity as an oil production well (Fig. 3.).
During the oil production from a small closed oil reservoir in Middle Triassic dolomites was observed that the formation pressure has not reduced despite big amount of produced water (3500 cu.m/day).
In base of interpretation of pulsation test data carried out in 1984 and the oil production was determined that he system in Middle Triassic dolomites is a very big geothermal reservoir. Strategraphy and results of pulsation and production test were carried out between 1984–1990 are given in Table 1.

3. PILOT PROJECTS

According to our preliminary assessment for production and utilization of geothermal fluids, about 8 doublets or triplets could be implemented using abandoned CH wells showing presence of medium enthalpy geothermal fluids from Middle Triassic dolomites in "Kiskunság" area (Fig. 4.). Based on this geothermal fluid production potential, a multiple integrated application of the resource could be implemented within the framework of pilot projects [1–4].
The effective viability of these systems can further be improved, provided adequate support is given. This is due to the fact that the high well yield (1500–4000 m^3/day) also contains a large amount of dissolved gas (mostly methane) (15–28.000 m^3/day), which through traditional separation (from the primary fluid will yield additional income for the project.
The methane gas separated from the geothermal fluid may be used in a gas engine and/or an absorption cooling system (Fig. 5.) (Appendixes 1,2).
The calculations relating to the doublet (M1, M2) for electricity production showed water yield of 30 liters per second. The temperature of the output water is projected to be 135^{o}C.
Based on the preliminary technical calculations and estimations [3], the installed electric capacity of the Mélykút-Balotaszállás geothermal based power plant is 1.0–1.3 MW and its geothermal potential for direct use is 21,5–30,0 MW_t. The electric energy would be utilized on one hand by supplying it to the existing medium-sized voltage network (20 kV), whereas the thermal energy would be supplied to local greenhouses and small entrepreneur heat consumer-group in form of district heating system (heating + SHW). The significant amount of gas dissolved in the water (main data in Figure 5.), could for instance be used after separation in parallel with the ORC system for the production of electric energy produced by a special gas generator. According to preminінary calculations the output would generate an additional 0,8 to a maximum of 1,35 MW_e. For details see process diagram of the project depicted in Fig. 5. [2]
The economic calculations of the prefeasibility study (1997), to which we referred are out of date. These need to be recalculated taking account of the priority given to domestic combined energy developments and renewable energy resources. The small and medium-sized power plants are expected to become competitive generally speaking. In our specific case, taking into consideration the positive aspects of the M2-M1 power plant (with extended functions). This would apply even with the added investment and other costs of the new installations accompanying the extended functions, especially if the reimbursement period could be reduced to an acceptable levels.
Operating aspects favouring local small power plants are for instance the proximity of electric transmission mains and medium-size distribution networks for energy transport. Medium-size voltage distribution networks (20 kV) suffice for the purpose of receiving small scale electric

power, while for larger power levels access to the national main distribution network (120 kV) is needed.
The 20 kV networks, originating from the Kiskunhalas in part, and the Szeged 120/20 kV transformer stations are sufficient for receiving the smaller power levels calculated from power plants located in the Balotaszállás area.

4. CONDITIONS FOR REALIZATION OF PILOT PROJECTS

The fossile energy prices that applied at the time, the economic calculations and financial assessments of the prefeasibility studies [5] were carried out have to be updated.

4.1 Process of realization of pilot project

1) After attaining the necessary **approvals and licenses** from the authorities the next step is to **update** the **pre-feasibility study** previously completed (economical data, financial assessment etc.).
2) Execution of the feasibility stage of project ("long term production test")
   a) Controll of situation in production well (well repair)
   b) Production flow test in production well
   c) Controll of situation in reinjection well (well repair)
   d) Carrying out of a pulsation interference test between production and reinjection wells to determine the existence or absence of hydrodynamic connection between 2 wells.

   In case the existence of hydrodynamic connection between the wells is proven:
3) Laying down a permanent insulated pipeline between the 2 wells and construction of surface water storage facility with sufficient capacity to accommodate 10 days of waterproduction.
   a) To carry out a long-term testing between 2 wells (60 days).
      i) Production test (free flow, reduced flow) for determination of geothermal fluid properties
      ii) Reinjection test with pumping
4) Interpretation of results of all measurements carried out in feasibility stage of the project, assessment of power and heat consumers in the area.
5) Compilation of the feasibility study of the project.

   In case of absence of the hydrodynamic connection:
   a) Opening new intervals in reinjection well by perforations and/or recompletion of other abandoned oil wells in the area.
   b) Carrying out operations according to 2–5.

5. RECOMMENDATIONS

The realization of the small scale power plant presented, which is designed for a region possessing special location specifics might be an excellent reference and also provide motivation to developers in other regions, particularly since no geothermal power plant have been built in Hungary so far. Based on the country's well-known potential endowments, another 10 plants with similar outputs could potentially be established by 2010 under Phase I. (in total resulting in 10–30 MW_e + 1350 MW_t). This solution would improve the level of renewable energy-resource utilization and simultaneously improve the renewable energy ratio within the national energy resource structure, thus reducing the percentage of fossile imports needed.

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