Performance of a geothermal heat pipe using propane

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House heating amounts to 33% of the German overall energy consumption [1]. The use of energy efficient technologies from renewable energy sources is strongly increasing since several years. Heat pumps in combination with various kinds of geothermal heat exchangers are a promising alternative to gas or oil fired condensing boilers. The use of shallow geothermal energy technology enables reduction of the primary energy consumption for heating by about 35 to 45% compared to oil and gas condensing boilers [2]. For house heating roughly 30000 geothermal heat pumps were installed in Germany in 2008 and most of them are based on standard heat exchangers like U-tubes or coaxial tubes [3]. Ground coupled heat pipes, however, enable a more effective way of extracting energy and no electricity is needed for circulation of the heat carrier fluid.

An energy park has been installed at Technical University Bergakademie Freiberg where several renewable energy sources are presented including a heat pump system based on seven geothermal heat pipes which are used for heating a lab building. Each of them is approximately 95m deep with an inner diameter of 53mm being combined with an additional coaxial or U-tube geothermal heat exchanger for cooling.

The present work contribution is focused on the operating performance of this heating and cooling system. The experimental plant is equipped with various measuring systems including a fibre-optical sensor fixed outside of the tubes. The paper reports the effect of various operating parameters on these temperature profiles along the tubes together with pressure and temperatures at selected locations of the heat pump system, and finally its power consumption. The amounts of extracted and introduced energy per day will be shown leading to conclusions for an effective operating regime.

The operation of geothermal heat pipes proved to be effective, there are however, some needs for further optimization. The evaluation of measured data shows, e.g. that film spreading can not be expected along the whole tube. The plant operating regime has also an important influence. The present paper will also discuss several problems and tasks which are crucial for the successful operation of geothermal heat pipes.

References:

