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Review on the International Legal Status for the Thermal Use of Groundwater

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ABSTRACT

Worldwide the number of shallow geothermal installations (< 400 m depth) is continuously rising. One consequence is widespread man-made temperature anomalies in natural aquifers. These have to be controlled to guarantee long-term usability of the geothermal reservoirs and to avoid adverse effects on groundwater ecosystems. However, nationally as well as internationally, regulations to achieve these controls are very heterogeneous, sometimes contradictory and scientifically questionable. For example, what is the optimal distance between adjacent, potentially competing ground source heat pump or groundwater heat pump systems? Answers to derive a good code of practice have to balance technical, economic and ecological criteria. As an overview of the current situation, we started an international survey that compares various regulations regarding minimum distances and temperature limits for the use of shallow geothermal installations (open and closed systems). We discuss the typical criteria applied and present some preliminary findings.

1. INTRODUCTION

Groundwater fulfills various functions. For humans, it has highest relevance as a freshwater resource. Another increasingly important issue is the use of aquifers as renewable energy source. Shallow geothermal installations (< 400 m depth) employ the energy from the subsurface mainly for heating and cooling of buildings, in open or closed systems (Omer, 2008). In both cases this use results in temperature anomalies (cold or heat plumes) in an aquifer. Especially in housing and industrial areas the number of shallow geothermal installations is continuously rising (Sanner et al., 2003, Lund et al., 2005). Hence, the pressing questions are what temperature changes would be acceptable, and how extraction rights can ideally be balanced and made sustainable (Hähnlein et al., 2008, Ferguson, 2009).

Politically there is a demand for a responsible behavior when using groundwater (EU-WFD, 2000). To find some answers on the important questions of how much usage of groundwater and how much energy extraction is acceptable, different steps are necessary. The extension of such heat plumes has to be known in order to interpret their influence on adjacent geothermal installations and on groundwater ecosystems. Their length and the absolute short- and long-term temperature changes can be simulated with numerical and analytical models (e.g. Hecht-Méndez et al., 2009, Hähnlein et al., 2009a).

To avoid potential energy overload and adverse impacts, consistent legal regulations and prospective management strategies are crucial, where exploitation and protection of aquifers is balanced. Hence, the objective of the present study is to provide an overview of the current international legal and regulative framework for the thermal use of groundwater and subsurface. To do so, we examine the current international legislation on shallow geothermal energy use with focus on minimum distances and existing temperature limits for heating and cooling groundwater. In the following, first results are compiled.

2. METHODOLOGY

We developed a questionnaire, in which we asked representatives from industry, academics and public authorities about the current situation regarding mandatory temperature thresholds and minimum distances between adjacent shallow geothermal installations. If such values exist, we wanted to know about their legal status and the development basis. The survey was sent to more than 30 countries worldwide and we received answers from 24 of them. The collected information was completed with a review of publicly available literature dealing with shallow geothermal energy legislation (e.g. Sanner and Mands, 2009).

3. RESULTS

In most cases there are no regulations on temperature limits for using the groundwater with shallow geothermal installations. There are also only few regulations and recommendations for minimum distances of these installations. Some countries have no regulations, instead recommendations that are not legally binding.

For heating and cooling of groundwater, there are generally three kinds of action values for the groundwater temperature: (i) an absolute allowed minimum temperature, (ii) an absolute maximum temperature and (iii) an accepted temperature difference between the disturbed and undisturbed background temperature of the groundwater. Overall replies to the survey revealed a very heterogeneous picture. Besides the different legal status, the action values also show a wide range (Figure 1). In Figure 1 it is shown in which countries temperature thresholds exist. The colors of the countries show the legal statues of the values. The arrows show the wide range of values for the three kinds of thresholds. The accepted temperature difference values show the highest variability (3°C to 11°C) (e.g. BEK 1206, GSchV 1998, ÖWAV-RB 207, VDI 4640-1). There are absolute values (temperature minimum, maximum) in only a few countries. This shows us that there is uncertainty about the correctness of the values. To our knowledge no sound scientific basis currently exists for the determination of these values. Often such thresholds appear to be empirically based and follow rules of thumb (e.g. Fry, 2008).

For minimum distances there are different definitions. One can distinguish between minimum distances to (Hähnlein et al., 2009b):

- the property line
- the next installation
- the drinking water well

- the neighboring building
- the power line.

The corresponding distances show, similar to the temperature action values, a great variability (5 m to 20 m) (Hähnlein et al., 2009c). Again, it can be observed that there exist no standard regulations and that in most cases scientific arguments are missing.

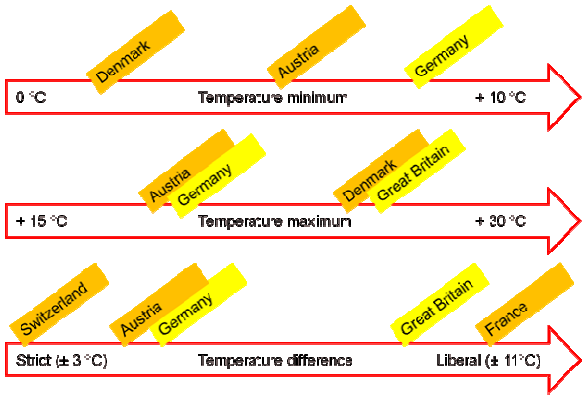

Figure 1: Recommended (yellow) and legally binding (orange) action values for groundwater temperature by thermal use in selected European countries: a) absolute temperature minimum, b) absolute temperature maximum c) relative temperature difference.

4. CONCLUSIONS

We can conclude that there are no consistent international regulations for shallow geothermal energy. In most countries there is a lack of temperature thresholds and minimum distances. Regarding action values for temperature, there is no scientific basis and the thresholds are often only recommended, not legally binding. Also, the existing minimum distances are not consistent and embedded in completely different legal frameworks. There is no doubt that an internationally consistent legislation reflecting scientifically based ecological, economical and technical aspects would be desirable. To promote geothermal energy as a simultaneously economically attractive, sustainable and environmentally friendly renewable energy source, such constraints have to be integrated into a regulatory frame-work.

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