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Potential Use of Geothermal Mine Waters in Europe

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ABSTRACT

The paper presents potential use of geothermal energy from abandoned and flooded mines in Europe. Some of these mines present high potential for geothermal utilisation of low-temperature water from remaining underground spaces. Energy is the identity of old coal-mine regions that are look black and ugly. Transformation of this into new renewable and green energy from mine waters is not only good are a measurement against climate change but also good for the feelings of people who live in that areas and worked in the mines.

In Czeladz town of the Upper Silesian Coal Basin (Poland) there is planned utilization of mine waters from coal mine abandoned in 1992 and flooded out to level of 200 m below ground level. The energy from mine waters will be used for heating of historical complex of old houses of mine workers.

Heerlen is situated in the south of the Netherlands. The last mines closed 30 years ago and still the city is struggling with the consequences of the closure. Heerlen has approximately 100.000 inhabitants. In the center and north of the city there are two development areas above two old mines, the Oranje Nassau 1 and 3. The ON3 is 835 meter deep and the ON 1 is 500 meters deep. In first the area temperatures of water in the mine reach 35°C, while in second area about 20°C.

Shawfair of Midlothian Council, Scotland, is a new town of some 5000 homes planned for construction to the south-east of Scotland's capital Edinburgh. The mine is continuously dewatered to prevent groundwater rebound and approximately 100 kg/s of minewater at 13°C is dicharged to a local water course. The minewater will not be used directly in the district heating network but as a heat source for large heat pumps which will be capable of producing hot water at 60°C; this will be heated up to a temperature of 80°C for distribution in the district heating network using gas engine CHP units.

1. INTRODUCTION

Abandoned and flooded mines present high potential for geothermal utilization of low-temperature water from remaining underground spaces. Some examples of use of mine waters in heat pumps installations are known from Germany (Rottluff 1998), Scotland (Burke 2002) and Canada (Jessop 1995). Further development of this technology is ongoing in face of restructuring of coal mining industry in Europe causing closure of mines in many regions (Malolepszy 2003). Use of heat from mine waters is one of important aspects of rational and sustainable utilization of post-mining infrastructure and may bring positive socio-economic results for communities living in European areas of former mining activity.

Energy is the identity of old coal-mine regions that are look black and ugly. Transformation of this into new renewable and green energy from mine waters is not only good are a measurement against climate change but also good for the feelings of people who live in that areas and worked in the mines. Energy is an obligation for a normal, functioning society. Without energy there is nothing. But climate change is a case of us all. Whit using the bridge from the past to the future and feel that energy is your identity it is easier to create awareness about a subject as 'energy'.

2. POTENTIAL USE

In many areas of coal mining in Europe there is potential of use of geothermal mine waters. Below three examples are presented:

2.1 Czeladz (Poland)

The municipality of Czeladz (35.000 inhabitants) is one of the areas of the biggest Central European coal field of the Upper Silesia in Poland where high potential for utilization of geothermal energy from mine waters was evaluated (Malolepszy, Ostaficzuk 1999). Since 1995 detailed studies are carried on to present importance of fact that former coal mines can provide with a new type of energy, which is renewable and environmentally friendly what is especially important in polluted and industrial post-mining areas. In the area of Czeladz there is closed coal-mine “SATURN”, out of use since 1992 and flooded out to level of 200 m below ground level. In coal mine drifts there are huge resources of warm mine water, out of use so far. The mine water has average temperature of 14°C and might be used for heating and cooling purposes after introducing it into heating pipeline system. Dewatering of mine is still maintained for safety of adjacent miming areas. Water is pumped out with average outflow of 400 kg/s. Estimated thermal output power of heat pump installation using mine waters as heat source is 2.5 MW_t . The energy from mine waters will be used for hating of historical complex of old mine worker’s houses which are renovated. It is innovative approach to sustainable management of energy in whole Upper Silesian region.

2.2 Heerlen (the Netherlands)

Heerlen is situated in the south of the Netherlands. The last mines closed 30 years ago and still the city is struggling with the consequences of the closure. Heerlen has approximately 100.000 inhabitants. In the center and north of the city there are two development areas above two old mines, the Oranje Nassau 1 and 3. The ON3 is 835 meter deep and the ON 1 is 500 meters deep. In first the area temperatures of water in the mine reach 35°C, while in

second area about 20°C. The buildings on both areas will be constructed with low temperature heating (25°C and 35°C) and high temperature cooling (18°C and 22°C). Because of the strict insulation measurements in the building law, cooling is and in the future will be a bigger problem than heating. Taking climate change into account, energy use as business as usual is not an option anymore. The exact numbers of energy content must be found in a study because the mines in Heerlen are totally closed. The minewater is still rising but there is no danger for flooding. For using the minewater pipes must be drilled into the old mines for extracting the minewater. First there will be a study to the measurements that are needed to realise the minewaterproject. After that the minewater will be realised. This will be a project of many years. The minewater can be seen as an energy transition. It is use to make a transformation from an conventional energy infrastructure in Heerlen towards a sustainable energy infrastructure.

2.3 Midlothian (United Kingdom)

In Scotland Midlothian Council is also developing a minewater project. Shawfair is a new town of some 5000 homes planned for construction to the south-east of Scotland's capital Edinburgh. The new town is centred on the former coal mine of Monktonhall which ceased production in the early 1990s. The mine is continuously dewatered to prevent groundwater rebound and approximately 100 kg/s of minewater at 13°C is dicharged to a local water course. Midlothain Council intend that Shawfair should be a model of sustainable development and supplying the town's energy from a sustainable source is a key element in delivering this aspiration. The Council propose to use the low grade geothermal energy resource available in the minewater as an energy source for a district heating network supplying the new town. The minewater will not be used directly in the district heating network but as a heat source for large heat pumps which will be capable of producing hot water at 60°C; this will be heated up to a temperature of 80°C for distribution in the district heating network using gas engine CHP units which will also generate electricity for supply to the town via a private wire electrical network. The cooled minewater will be discharged back down into the coal workings at return points approximately 2 km away from the abstraction shaft at Monktonhall.

3. ENVIRONMENT OF POST-MINING AREAS

The closure of mines and the transition of mining communities and economies is a common issue for already 4 decades. Both for the local communities, for the regional and national administrations and also for the EC this is a strong binding element. With the arrival of new member countries, new mining communities will be involved. The integration of their economies in the EU is expected to lead to transitional economic issues like before in Western-Europe. Ongoing processes of restructuring of mining industry in Eastern and Central Europe present large, complex field for innovative activities in social, economical and technological aspects of post-mining areas transformation. Mining regions and municipalities in Eastern and Central Europe are looking for partnership cooperation and exchange of experiences with (former) mining municipalities in Western Europe. The solidarity and exchange of experience will create new values in relations between East and West, and it is expected to be an important factor for the dissemination of results and new approach to use of Reneweable Energy Suply (RES) program from this project towards the new members of the EU.

The new European countries can learn from other post-mining areas in Western Europe. Also in Western Europe post-mining areas are difficult to develop. Not only because of the environmental quality, also because of the social aspects. In Heerlen the last mine closed 30 years ago. The people, old miners but also politicias can echange a lot of experience of what went good (economy, developing parks and business parks) and wrong (disregard the social, cultural aspect and the feelings of the people) regarding the mining areas the last 30 years.

Climate change is a case of us all. It is one of the European commission policies not to be fully dependend to energysources like oil. In the coming years oil and gas still stay an important energy source but we must think of an energy transition base on sustainable sources. Both from a view of economy and the problems of climate change. Minewater is a change we must not miss!

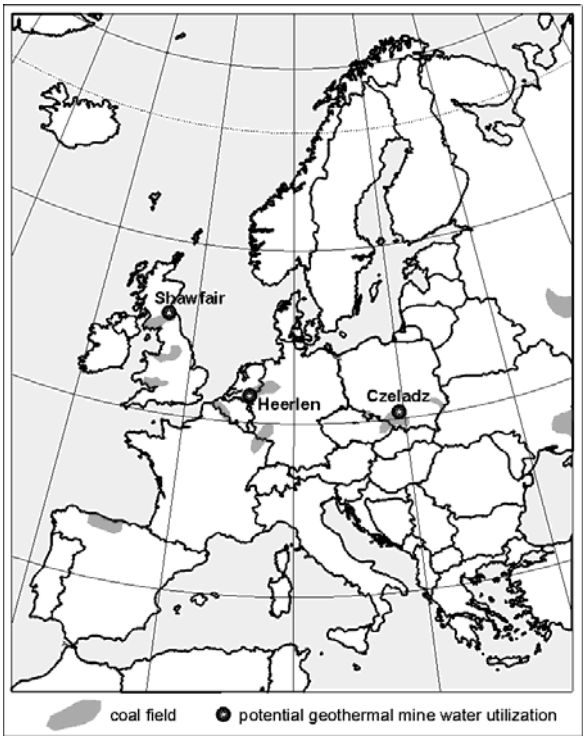

Figure 1: Location map of coal mining fields in Europe showing potential geothermal mine water installations.

4. CONCLUSIONS

Geothermal systems based on mine water can and should be widely applicable across mining areas of Europe. In recent decades, coal mining has declined in many regions, causing abandonment of underground mines. Problems of reclamation and utilization of surface and underground remains of former mines arise as an important aspect of sustainable development of post-mining and industrial areas. There are many abandoned coal fields around the Europe. Mines in France, Germany, United Kingdom, the Netherlands, Poland, Spain, Slovakia and the Ukraine are the subjects of detailed studies and development of geothermal utilization in abandoned workings.

Potential areas of utilization of mine water can be located above disused and abandoned underground mines where groundwater floods out old mineworkings. Feasibility studies should be based on site specific conditions of mining area. Crucial factor is presence of appropriate

hydrogeological conditions for water inflow into the mine, however these are well recognized during exploration prior to mining activity. In most cases temperature of mine water exceeds local temperature at certain depth due to water circulation in mineworkings and reaches as much as 50°C at 1000 m in some places. Relatively simple accesses to the source of warm mine water through remaining mine shaft pipe installations or eventually shallow wells significantly enhance abandoned mines as geothermal resource. Several examples of geothermal systems using mine waters show that the source is more effective for heat pump installations than common ground heat exchangers.

Energy recovered from mine water as geothermal energy in general is local resource and the most essential requirement for this utilization is renewable energy demand of local users so it is very important to demonstrate that mine water systems can be feasible in many post-mining communities. Legal and regulatory environment of utilization of mine water is strictly dependent on sustainable development policy of local governments and should be subject of the mining law in certain mining fields. Local authorities working together with miners on transformation of post-mining areas very often seek for new ideas. Examples from the coal fields in Poland, the Netherlandes and UK show that geothermal utilization of huge amount of warm water discharged from mines in dewatering process and released to rivers, is very interesting for the post-mining communities.

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