CADDET energy efficiency
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Mine water as energy source

Geothermal mine water as an energy source for heat pumps

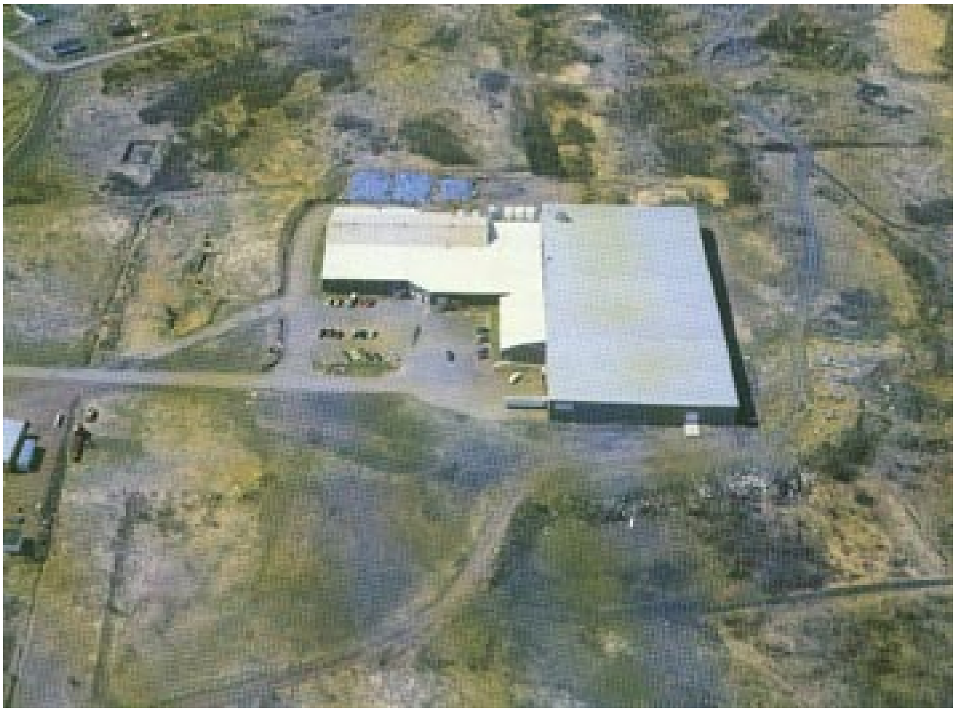
Summary

Ropak Can Am Ltd., a manufacturer of plastic packaging products, is using geothermal energy from floodwater in abandoned mines to provide heating and cooling at the company's facility in Springhill, Nova Scotia, Canada. Ropak is the first industrial site in Canada to demonstrate the economic and technical viability of this energy source.

Mine water at a temperature of 18°C is pumped at a rate of 4 L/s from a flooded mine and passed through a heat pump system before reinjection into another separate (but linked) mine. Annual energy savings, compared to conventional systems, are approximately CAD 45,000 or the equivalent of about 600,000 kWh.

Highlights

- **Reduced capital costs compared to a conventional system**
- **Annual energy savings of CAD 45,000**
- **Energy source is non-polluting**



Aerial view of Ropak.

Aim of the Project

The project involved collaboration by two parties, the town of Springhill and Ropak. Springhill was interested in attracting industry with the incentive of low cost heat. Ropak, an established organization, was interested in reducing plant energy costs, particularly since the firm was planning an expansion that would more than double the original plant size. To achieve these goals, the project developed a cost effective heating/cooling system that harnesses the geothermal energy from flood water in abandoned mines.

Although the use of mine water as a heat source is not a new concept in other parts of the world, there were no similar installations in Canada. The system was therefore intended to demonstrate the application of a mine water heat pump system. The results will be used to guide subsequent applications.

The Principle

Over 200 years of sub surface coal mining in Nova Scotia has left many square kilometres of old workings, often located directly beneath the towns that grew at the pitheads. Over the years, these workings have gradually filled with water.

The skilled work force once employed by the mines requires the growth of new industries to provide employment. Such industries would benefit strongly from an inexpensive energy supply.

The mine water can provide this energy supply. The old workings are a particularly effective means for transferring geothermal heat, at great depths, to mine water. Gravity circulation within the workings then brings this heated water up closer to the surface where it is accessible through short drilled wells, thus providing a suitable energy source for ground source heat pumps.

Environmental problems with this system are minimal. Water is pumped from the workings in a closed loop system, and is returned to the mines via injection wells. As a result, aquifer integrity is preserved.

The Situation

Prior to Ropak Can Am Ltd.'s decision to expand the company's old 6,039 m^2 facility by an additional 7,432 m^2, the company obtained a grant from the Atlantic Canada Opportunities Agency to explore the possibility of utilizing geothermal energy from the mine water. With this funding, the Springhill Geothermal Committee initiated an engineering study in 1986. A subsequent test drilling program in 1987/88 confirmed that energy savings as high as 70% could be attained from the warm (18°C) mine water.

Two wells were surveyed and sited for the Ropak plant by the Nova Scotia Department of Mines and Energy; the Town of Springhill undertook the drilling of the wells.

The warm water supply well taps into the main haulage of the No. 2 mine, which extends 4 km into the earth at a 32° angle. The mine water is pumped into the plant from about the 140 m level of the No. 2 mine, at a rate of 4 L/s. During the heating season, the heat pumps extract the heat from the 18°C water, lowering its temperature to 13° C. The water is then returned to the 30 m level of the No. 3 mine via an injection well (see Figure 1).

In the cooling season, the heat pumps transfer heat from the warm building air to the mine water, thereby meeting the plant air conditioning requirements. Because the No. 2 and No. 3 mines are interconnected at various depths within the old workings, returned water is recirculated, thus providing Ropak with an endless energy resource.

Inside the new plant, 10 heat pumps with individual control thermostats provide heating and cooling. An additional heat pump services the office area and provides hot water for production cleaning and for domestic use. Together the 11 Delta water-to-air heat pumps provide all of the winter space heating and summer air conditioning requirements in the new plant and office.

The system has been a technical and economic success. Consequently, Ropak has also retrofitted its original building with a geothermal mine water heat pump system.

Two additional mine water systems have been installed in Springhill (serving a restaurant and a metal fabricating business) and another is

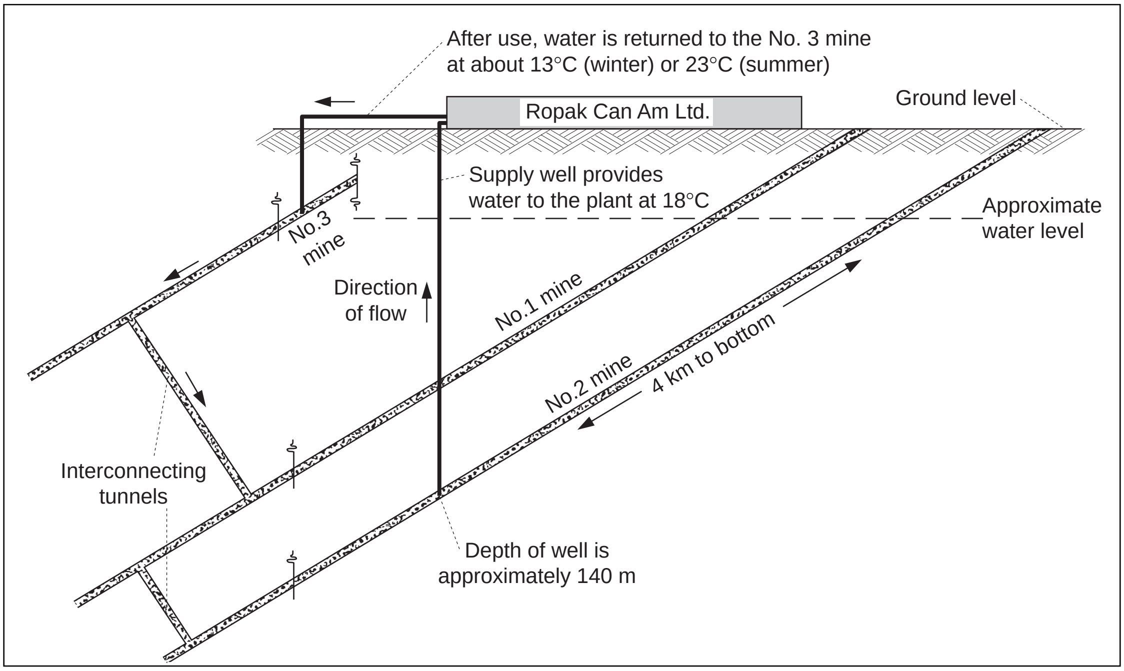


Figure 1: Schematic of the mine water system.

expected to be in service by the summer of 1992. A district heating system using the mine water has also been proposed.

The Company

Ropak Can Am is a manufacturer of plastic packaging products. Approximately 130 people produce rigid plastic pails and materials handling containers for fishing, agriculture and consumer use. The company's 1988 expansion provided room for two additional plastic molding units, a warehouse area and expanded office space.

Ropak was named a 1990 Regional Winner of the Canadian Electrical Association's Energy Efficient Industrial Award for its innovative harnessing of geothermal energy.

Economics

The cost of the heat pump system for the new plant was CAD 110,000, compared with a cost of CAD 70,000 for a conventional or propane heating system. This extra capital cost was, however, more than offset by a saving of CAD 110,000 - an expenditure that would have otherwise been required for dehumidifiers.

The Town of Springhill covered the CAD 15,000 cost of the drilling.

Gross annual energy savings (fuel oil and electricity) for the new plant are approximately CAD 65,000 (compared to what costs would have been with a conventional system). After deducting operation and maintenance costs (including the cost of electricity for the heat pumps), the net savings in the new plant are in excess of CAD 45,000 annually, equivalent to a saving of about 600,000 kWh.

Many additional benefits resulted from the project. As the new air conditioning provides healthier working conditions, the plant's employees are absent less often. Reduced maintenance and down-time, improved production efficiency (up 9% in 1989), and better staff morale have also resulted from the geothermal installation.

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* IEA: International Energy Agency
OECD: Organisation for Economic Co-operation and Development

IEA

The IEA was established in 1974 within the framework of the OECD to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among the 23 IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources, new energy technology, and research and development (R&D).

This is achieved, in part, through a programme of energy technology and R&D collaboration currently within the framework of 35 Implementing Agreements, containing a total of more than 60 separate collaboration projects.

The Scheme

CADDET functions as the IEA Centre for Analysis and Dissemination Demonstrated Energy Technologies for all IEA CADDET member countries.

This project can now be repeated in CADDET member countries. Parties interested in adopting this process can contact their National Team or CADDET.

Demonstrations are a vital link between R&D or pilot studies and the end-use market. Projects are published as a CADDET ‘Demo’ or ‘Result’ respectively, for on-going and finalised projects.

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