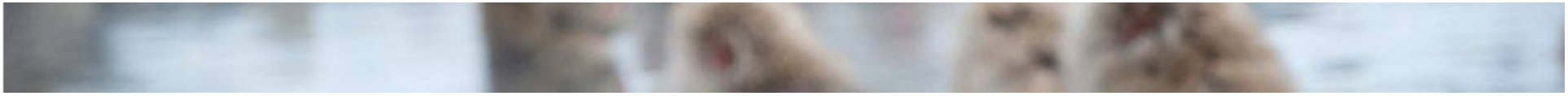

Sustainable Mining

Investigation of Geothermal Energy from Mine Water – A Study of the Renström Mine, Boliden

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KTH VETENSKAP OCH KONST

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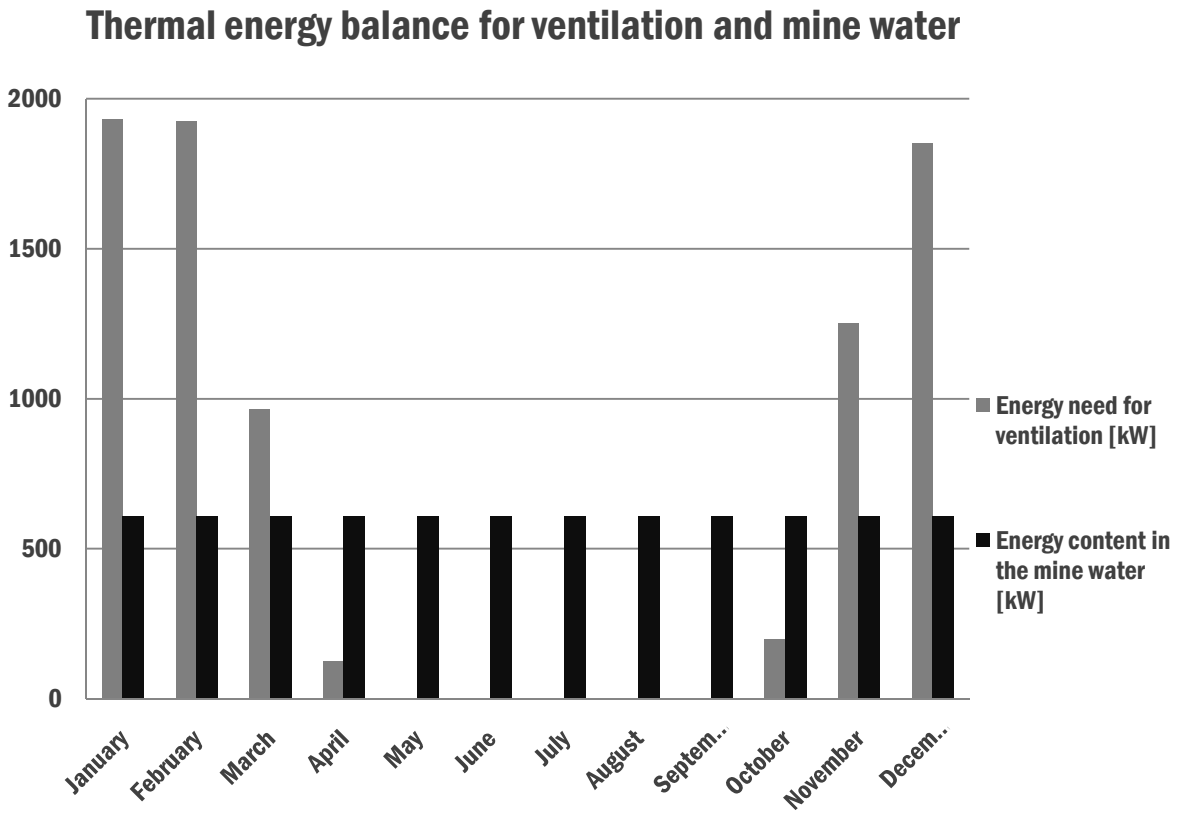
NEW BOLIDEN

PROBLEM

Oil is used to heat the ventilation air entering the underground mine. It is costly and bad for the environment. What could be done?

There is an increasing demand for more sustainable and energy efficient practices in energy intensive industries, such as the mining industry. One major issue for underground mines is the energy usage for heating during wintertime. As the inlet air entering the mine must be heated, not to freeze the wellheads.

Today the inlet ventilation air is heated with oil and the need is focused to the wintertime, as displayed in the figure, for the Renström Mine.

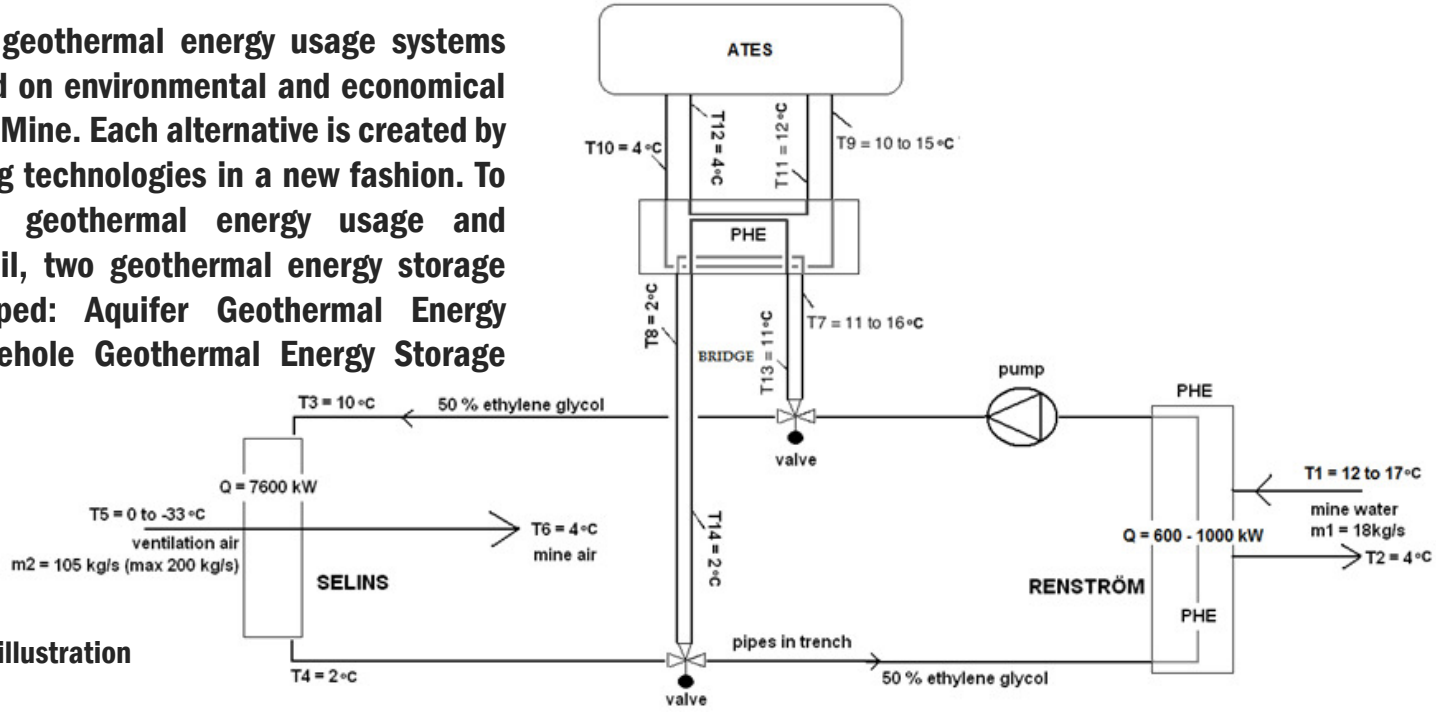


SOLUTION

To create a sustainable energy system for underground mines oil can be exchanged with geothermal energy, which exists all over the world.

Geothermal energy is naturally generated in the ground and transported up the mine in the ground water (mine water) and exhaust air as warmth. Today, the mine water is simply released and the geothermal energy is lost. There are examples of closed flooded mines, used as energy storages, where low grade geothermal energy is transferred to water and utilized for direct heating above ground. It is possible to utilize this low grade geothermal energy as a heating medium for the ventilation air in active mines as well. This is not a common practice and the usefulness of low grade geothermal energy in mine water is theoretically investigated for active mines in this thesis, with positive results.

Five technically feasible geothermal energy usage systems are created and evaluated on environmental and economical features for the Renström Mine. Each alternative is created by combining already existing technologies in a new fashion. To increase the usage of geothermal energy usage and completely replace the oil, two geothermal energy storage suggestions are developed: Aquifer Geothermal Energy Storage (ATES) and Borehole Geothermal Energy Storage (BTES).



ATES alternative illustration

RESULTS

All geothermal energy usage systems show improved environmental and economic effects, especially the geothermal energy storage alternatives.

It is concluded that it is technically, environmentally and economic possible to use mine water and geothermal energy in mining operations.

It is, however, difficult to compare environmental benefits with economic costs and returns. The environmental and economical factors can therefore not be directly compared to each other due to their different purposes and it creates an evaluation dilemma.

When considering the environmental features and the total 10 year costs the ATES alternative is the best for the Renström Mine, where geothermal energy from mine water is stored in an esker, to be used for the ventilation heating during wintertime. While the Ventilation at Renström scenario, which uses the old shafts right above the mine for ventilation and heat the air directly with mine water, provides the lowest payback time.