FACTS

energy SCIENCES & TECHNOLOGY DEPARTMENT

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Field Application of GHP Grout

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www.bnl.gov/est/ghp111.htm

Thermally Conductive Grouts for Geothermal Heat Pumps

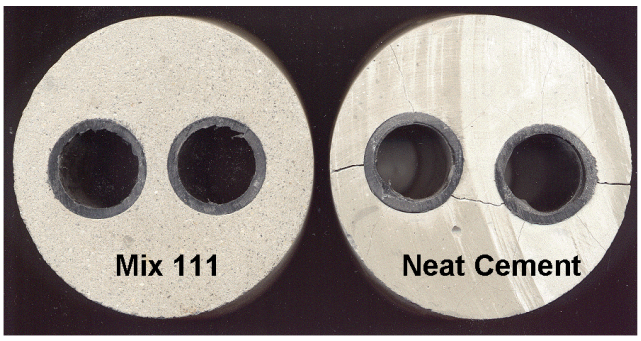
Geothermal heat pumps (GHPs) are highly efficient means of heating and cooling buildings that use the earth as a heat source or sink. Grout provides a heat transfer medium between the buried heat exchanger (U-loop) and surrounding formation and also acts as a sealant to prevent groundwater contamination. Increasing the grout thermal conductivity permits reduction in heat exchanger length and installation costs.

BNL's research focuses on development, analysis and demonstration of thermally conductive cementitious grouts. The activities cover experimental characterization of a wide range of grout properties, numerical modeling of grout behavior under thermal loads, field demonstrations and technology transfer to industry.

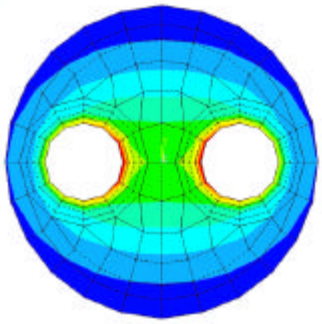
Thermal conductivities up to three times higher than bentonite and neat cement grouts were achieved through appropriate selection of grout ingredients and mix design. The developed grout is termed Mix 111 and consists of cement, water, silica sand and small amounts of superplasticizer and bentonite. The selection and mix proportions of grout ingredients controls the final properties.

Field tests show that thermal resistance decreased by 29 and 35% for Mix 111 compared with bentonite grout at two different sites. The superior performance of Mix 111, including reduced coefficient of permeability, lower infiltration rate, shrinkage resistance and better bond strength to U-loop, led to regulatory approval by the New Jersey Department of Environmental Protection. Field demonstrations and technical support in the use of Mix 111 have been given to contractors. Mix 111 has now been used in numerous commercial, school and residential projects throughout the US.

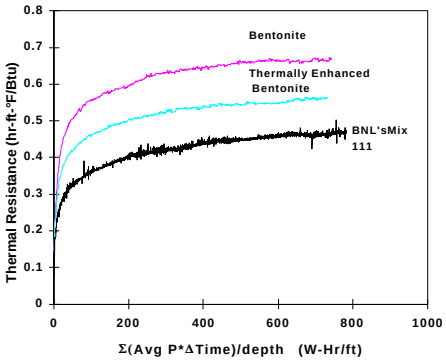
The success of this project demonstrates our ability to perform research of great practical use and to work together with industry members and regulatory agencies in providing solutions.



Grout/U-Loop Sections after Thermal Cycling



Thermal Analysis of Grouted Borehole



Field Test Results for Grout