

Snow-melting and Deicing System Using Underground Thermal Energy

1. Introduction

In snowy regions that account for some 60% of the Japanese land-mass, securing safe, stable mobility in wintertime is strongly desired. In addition, with mounting public awareness of the importance of environmental conservation and with the introduction of the concept of lifecycle costs, there is growing demand for a snow-melting and deicing system that uses natural, environmentally friendly energy sources and helps reduce the running costs of snow-melting and deicing equipment.

With an eye on geothermal energy—a natural energy source which is stable even in winter, Nippon Steel Corporation has developed and commercialized a new snow-melting and deicing system that utilizes this clean and plentiful energy source.

2. System Configuration

This system, which uses inexpensive electrical power as its main power source for snow-melting equipment, consists of a ground source heat pump unit and a latent thermal storage tank. Ordinarily, the system uses the electric power for the snow-melting system to operate the ground source heat pump unit and thereby melts snow. For two hours in the evening, during which the supply of electrical power for snow-melting equipment is stopped, the system utilizes the heat stored in the latent thermal storage tank to melt snow.

3. Features

(1) Use of stable, clean geothermal energy as a heat source

The system utilizes natural geothermal energy. Therefore, this abundant natural resource offers a sufficient and stable quantities of heat even during the cold winter months. In addition, the system employs a high-performance ground source heat pump to cut running costs and reduce CO₂ emissions.

(2) Improvement of heat exchanger efficiency

In the heat exchanger, a double-U-shaped pipe system is employed. Compared to conventional a heat exchanger filler, NSC's original heat exchanger obtains about 20% more geothermal heat.

(3) Stable snow-melting performance

The use of a low-temperature, phase change material for the latent heat accumulator permits the lowering of the phase change temperature from 47°C (used in the field of air conditioning) to 32°C. This has makes operation of the ground source heat pump very efficient.

(4) Reduced running costs

The utilization of inexpensive electric power for the snow-melting system and the improvement in the coefficient of performance (COP) of the entire system have dramatically reduced running costs to about 30% of that of conventional systems using heating wire.

4. Application Example

In 1999, when the public was invited by the Tohoku Regional Bureau, Ministry of Land, Infrastructure and Transport to join in a contest for development of “technology utilizing natural energy to melt snow on roads,” our system was adopted to melt the snow around the Sekiyama Tunnel on National Road No. 48.

The snow-melting system was installed in 2002. The results of two years of system operation (during the winter months) show that the system ensures good road surfaces for drivers even in the snowy winter weather of that area of Japan.

5. Official Registration

Because of the achievements illustrated above, NSC's new system has been tentatively registered in the New Technology Information System (NETIS) of the Ministry of Land, Infrastructure and Transport.

The technology name attached to this new system is the “Ground Source Heat Pump Snow Melting and Deicing System using Latent Thermal Storage Tank.”

Tentative registration number: TH-040009.

References

Inoue, Miyama, Isobe: Ground Source Heat Pump Snow Melting and Deicing System using Latent Thermal Storage Tank. Cold Region Technology Conference. Vol.19, 2003.11

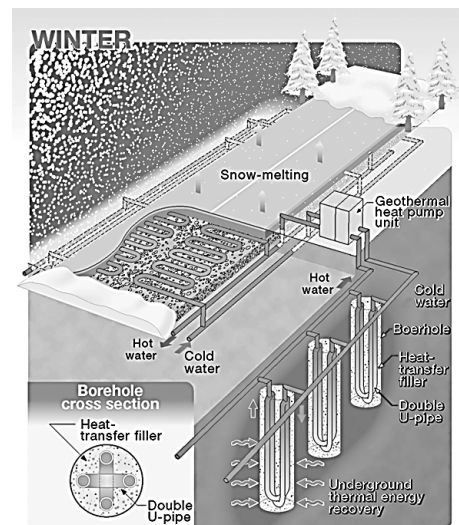


Fig. 1 System flow



Fig. 2 Road conditions of snow-melting area

(For further information, contact
Energy Facilities, Civil Engineering & Marine
Construction Division)