● Topics

Data Center Energy-Conservation System Using Heat Pipes and Cold Ambient Energy

Fujikura has proposed an innovative energy conservative systems for data center that will promote energy saving for data center facilities, which is increasingly gaining momentum in number and power demand. The proposed systems make use of heat pipes that the company has been developing since 2008.

In existing data center cooling systems, air cooling plays a major role, and their power usage effectiveness (PUE), defined as ratio of total power consumed by data center facility to the server power consumption, which is an energy-saving indicator, ranges from 2.0 to 3.0. Organizations such as research institutes are conducting research and development with an aim of reducing the PUE.

We, at Fujikura, have developed data center energy-saving systems based on our experience with the food storage systems, developed in 1993, that use frozen soil as cold energy storage system with heat pipes as heat transfer devices. In the designed system, these special heat pipes utilises cold winter ambient temperatures to produce ice or cool water which can be used for cooling data centers.

One of the proposals is “Emergency cooling system for data centers using natural cold energy with heat pipes”. This system is intended to provide an emergency cold energy storage consisting of ice produced by heat pipes using below zero temperatures in winter. Compared to existing cold water storage method, heat pipe based system will only need 14% of cold energy storage size.

Another proposal includes “heat pipe based pre-cooler system that will use natural cold energy for downsizing energy-extensive data center chiller electric demand“. This system proposes a cooling design methodology in which a heat pipe pre-cooler will be installed before data center chiller such that the coolant will be cooled by heat pipes before passing through the chiller thereby reducing power consumption of chiller.

For the case when the ambient temperature becomes high in summer, the thermal diode characteristic (i.e. one directional heat flow capability) of heat pipes will avoid any heat flow from ambient into the cold storage. Thus, the proposed systems can store or transfer cold ambient energy without using any control equipment or power.

As cloud computing configurations are increasingly being adopted, Fujikura intend to aggressively introduce and implement these energy efficient systems into public offices, data center construction clients, server manufacturers, general contractors, and similar potential clients and, while doing so, will make fruitful efforts to popularize this sustainable technology and to actively contribute in reducing greenhouse gases emissions thereby preventing global warming.

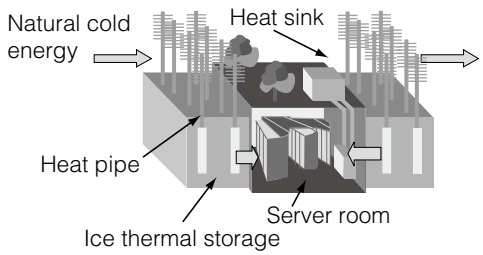

Fig. 1. Basic Concept of Emergency Ice Thermal Storage for Data Center Using Natural Cold Energy with Heat Pipes.

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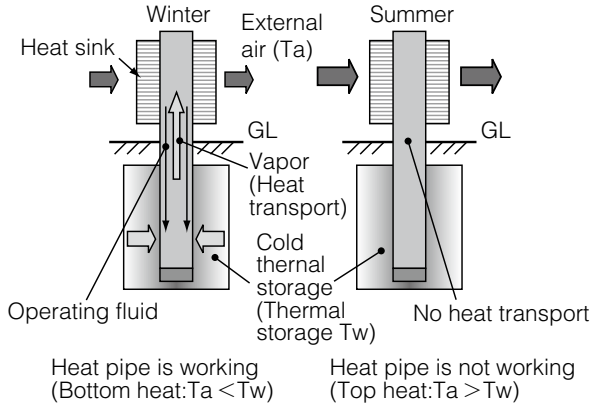

Fig. 2. Principle of Cold Thermal Storage with Thermal Diode Type of Heat Pipe.

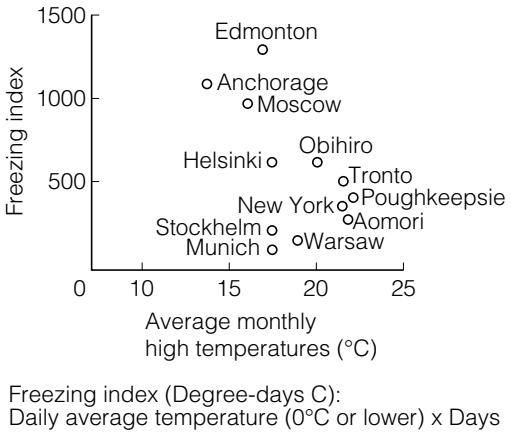

Fig. 3. Freezing Index.

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