Fact Sheet

HYBRID THERMOSYPHONS

PROBLEM

Foundations of buildings, pipelines, highways, railroads, airfields, and other structures built on permafrost must be designed to prevent thawing of the underlying frozen soil. In Alaska, cracks have developed in building walls, severe potholes have formed on highways, and railroad tracks have become twisted due to thaw settlement of foundations built without thermal protection.

One thermal protection device is a thermosyphon. It is simply a closed pipe with a refrigerant inside, which removes heat from the soil and transfers this heat to the air. One limitation of passive thermosyphons, such as the 120,000 units used on the Trans Alaska pipeline, is that they operate only during cold months when the air temperature falls below the permafrost temperature.

SOLUTION

To provide for year-round operation, a hybrid thermosyphon has been developed at the Army's Cold Regions Research and Engineering Laboratory (CRREL). These heat transfer devices can operate as a standard passive thermosyphon during cold months and as a mechanical refrigeration unit during warm months. This is achieved by incorporating a heat exchanger in the passive unit. A hybrid thermosyphon capitalizes on the advantages of a passive operation with no operating costs and eliminates the disadvantage of not operating in warm months.

RESULTS

Laboratory tests at CRREL have proven the viability of using hybrid units in foundation design on permafrost. The U.S. Air Force used hybrid units under the power plant building at Gakona, Alaska.

U.S. Patent Nos. 4,961,463; 5,327,734; and 5,339,893 have been granted for thermosyphons. Two other patents for thermosyphons are pending.

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