BURIED FACILITIES HEAT EXCESS REMOVAL SYSTEM

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Abstract

Double-circuit buried facilities temperature stabilization and heat excess removal system have been considered. The system has been made as a thermosiphon.

KEYWORDS

Temperature, heat removal, thermosiphon

INTRODUCTION

The provision of microclimate required in rooms of facilities buried in the ground with thermal emitting equipment and instrumentation by traditional methods through systems including heaters or calorifers, refrigerating machines, drying units, as well as parameters control and adjustment systems requires sufficient energy consumption, additional rooms for arrangement of units and communication means. A continuous thermal insulating screen allows to reduce the influence of fencing structures penetrating into rock mass and ground of season and day atmospheric air temperature fluctuations to temperature of the buried room. However, in presence of an internal heat source, the screen adds to overheating of the room.

The overheating can be reduced by application of ventilation holes or shafts with forced ventilation or natural aeration, that is not always advisable due to depressurization of the facility. It leads to necessity of search and development of other methods and thermostating units of buried facilities.

DOUBLE-CIRCUIT SYSTEMS

Not power-consuming double-circuit temperature stabilization systems have been considered as such units [1].

Canals or pipes of the internal circuit are arranged along the buried fencing of the pier tower or installed into it. It is necessary to maintain steady, generally, positive temperature in this room or element of the structure. Pipes of the circuit are filled with water. In the upper part, they are combined into a joint manifold, in which tubular elements of vertical external circuit pipes entering the atmosphere filled with uncongeable carrier kerosene oil are lowered, in order to avoid freezing of water in the heat-exchanging unit, the water circuit including the manifold is located below the frost zone of the ground.

The double-circuit system has sufficient advantages. Kerosene oil, as a thermal carrier, allows to implement practically completely the atmospheric air temperature change range. At the same time, the presence of the water circuit reduces fire hazard of the cooling system being an integral element of the facility structure.

The availability of a double-circuit system provides its operability practically throughout the whole atmospheric air temperature range observed throughout the country territory. The cooling of the facility occurs automatically during the whole time of the year, when its temperature is higher than the ambient air. The application of a temperature stabilization unit allows to exclude supercooling effect, for under water temperature reduction in the manifold below 4 ^{0}C, in which water has the largest density, the water circulation based on gravitational convection ceases. The intensity of heat removal depends on geometry of the system, temperature drops in the facility and on the ambient air and thermal emissions capacity. Under reverse temperature differential, the heat exchanger “locks up”, heat flow from the outside does nor occur.

PROCESS CONTROL

Taking into account variableness in time, as the ambient air temperature, so the process equipment and instrumentation operation mode, the necessity appears to provide for control heat transfer from the facility. Therefore, the cooling system is being developed for the maximum heat removal under unfavorable conditions. Control is implemented by alteration of the flow section through locking up of the heat carrier circulating inside the system with the help of a diaphragm, a valve or by other method.

Auto control of the flow section for a liquid heat carrier can be carried out by a control device made in the form of a conical valve located in the support part of the pipe of the kerosene circuit. The upper part of the kerosene pipe at the support area represents a siphon, at the upper bottom of which the valve stem is fixed. Guides in the form of a cross-piece providing for reliable passage of the heat carrier and centering adjustment of the valve in the support part of the pipe of the kerosene circuit are located in the lower part of the valve.

The device operates in automatic mode, i.e. produces automatic decreasing or increasing of the heat carrier volume in the siphon. Thus, when cooling the external air, temperature of kerosene filling the cooling circuit elements extending outside, including the siphon, reduces. Its volume reduces, the siphon squeezes, the conical valve secured at the stem moves jointly with the siphon bottom and decreases the flow section of the gap. The intensity of kerosene circulation and heat removal reduces. In case of the external air temperature built-up, the heat carrier goes expanding, the siphon length increases, increasing simultaneously the gap of the flow section. The intensity of the heat carrier circulation and heat removal from the manifold grows up, and head removal from the facility carries out in self-control mode. Thus, the flow section area of the kerosene circuit pipe is proportional to movement of the stem, which is determined by ratio kerosene volume temperature change to the siphon section area. The flow section of the valve is calculated through unfavorable conditions of heat removal, i.e. for summer time.

The upper part of the kerosene circuit pipe has a protective screen secured at the support flange through brackets. The screen protects the protruding end of the kerosene pipe from the direct effect of solar radiation and forms a gap with the pipe serving for air flow and heat removal to the atmosphere.

This system has been designed for independent automatic maintaining of optimal temperature mode of buried and underground facilities.

The system allows to provide for temperature stability at the level required, as in space (within the facility volume), so in time under change of external temperature conditions during long term operation. This system more successfully in comparison to a conditioner, solves problem of control removal of heat from facility, for it does not practically require any external source of energy for its operation, excludes fire hazard, does not require maintenance and, therefore increases factors of operational dependability.

When developing the temperature stabilization system, the following problems were solving: efficiency increase of cold accumulation by the primary circuit in hot time of the year, heat exchange regulation in the primary and secondary circuits, heat exchange intensification, decrease of some assembly dimensions, increase of reliability etc. When a facility is located in a cold region, where temperature of the ground is close to minimum permissible or lower, the system pipelines can be used to provide for even heating of rooms by traditional heating means.

CONCLUSION

The double-circuit system considered can provide for the temperature mode required in facilities buried in the ground with minimum energy costs from an external source. The temperature stabilization at a certain level under presence of process heat emissions in rooms is carried out automatically and independently.

References

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