Composite embankment with L-shaped, two-phase, closed thermosyphons influences permafrost deformation: Study

June 15 2023, by Li Yuan

Credit: Pixabay/CC0 Public Domain

Climate change and engineering disturbance cause degradation of permafrost, which affects infrastructure stability and transportation

safety. Two-phase closed thermosyphons (TPCTs) are widely used to tackle external disturbances by cooling the permafrost stratum in permafrost engineering.

However, due to the lack of long-term and spatiotemporal thermal deformation observation, the influence of L-shaped, two-phase, closed themosyphones (LTPCTs) on the development of embankment deformation remains unclear.

A joint research team led by Prof. Zhang Mingyi from the Northwest Institute of Eco-Environment and Resources (NIEER) of the Chinese Academy of Sciences (CAS) has built the first spatiotemporal thermal-deformation observation system to explore the spatiotemporal thermal-deformation characteristics of the composite embankment with LTPCTs on a permafrost slope. The study was published in *Acta Geotechnica*.

During the construction of the Gonghe-Yushu Highway in the permafrost regions of the Qinghai-Tibet Plateau (QTP), the research team carried out a full-scale field test to evaluate the spatiotemporal thermal-deformation characteristics of the composite embankment with LTPCTs on a permafrost slope.

The results showed that the LTPCTs could lower down the permafrost temperature, and the composite embankment with LTPCTs had a good cooling effect on the underlying permafrost in its middle. In the cold season, the maximum effective cooling scope of the LTPCT was no more than 2.0 m.

The composite embankment could reduce the centerline settlement after the second service year in the field experiment, and the total settlement after five service years was far less than that of the contrastive embankment due to the cooling capabilities of the LTPCTs.

However, a potential slump risk still existed under the long sunny slope of the composite embankment, as a continuously increasing deformation difference along the cross section may cause longitudinal cracks of the composite embankment, thus affecting the traffic safety.

"Our study not only reveals the thermal-deformation characteristics of the composite embankments with LTPCTs on a permafrost slope, but also provides more understanding for the design and application of the composite embankments with LTPCTs in permafrost regions," said Prof. Zhang.

More information: Mingyi Zhang et al, Field investigation on the spatiotemporal thermal-deformation characteristics of a composite embankment with two-phase closed thermosyphons on a permafrost slope, *Acta Geotechnica* (2023). DOI: 10.1007/s11440-023-01878-5

Provided by Chinese Academy of Sciences