Novel air-cooling pipeline embankment prevents permafrost thaw disasters for buried warm-oil pipelines

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During the operation of the China-Russia Crude Oil Pipeline (CRCOP), underground pipelines crossing permafrost regions often face challenges

including frost heave, thaw settlement, and other permafrost disasters. In addition, the oil temperature of the CRCOP has been steadily increasing over the years. Therefore, effective mitigation of thaw settlement disasters caused by high oil temperature has become paramount for ensure the stable operation of the CRCOP.

A research team led by Li Guoyu from the Northwest Institute of Eco-Environment and Resources of the Chinese Academy of Sciences presented a novel inverted T-shaped crushed-rock pipeline embankment (ITCPE) structure that utilizes the inherent heat of the pipe to enhance convection, thereby more efficiently dissipating heat from the pipeline and cooling the permafrost. Results were published in the journal *Energy*.

The researchers conducted long-term numerical predictions to evaluate the thermal effects of the ITCPE, unprotected pipeline embankment (UPE), and traditional horizontal crushed-rock pipeline embankment (THCPE) structures during pipeline operation.

The results show that neither the insulated buried pipeline structure, nor the UPE, nor the THCPE adequately address the thaw settlement. However, the novel ITCPE structure demonstrates remarkable effectiveness in mitigating thaw settlement, which significantly maintains the artificial permafrost table beneath the pipeline embankment over a 50-year operational period.

This study not only provides valuable technical support to the CRCOP, but also offers guidance for the design and maintenance of pipeline projects in permafrost regions worldwide.

More information: Yapeng Cao et al, Thaw bulb formation

surrounding warm-oil pipelines and evaluation of the cooling performance of a new air convection pipeline embankment structure, *Energy* (2024). DOI: 10.1016/j.energy.2024.130668

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