Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

Experimental investigation of migration and solidification of molten salt leaking through tank cracks

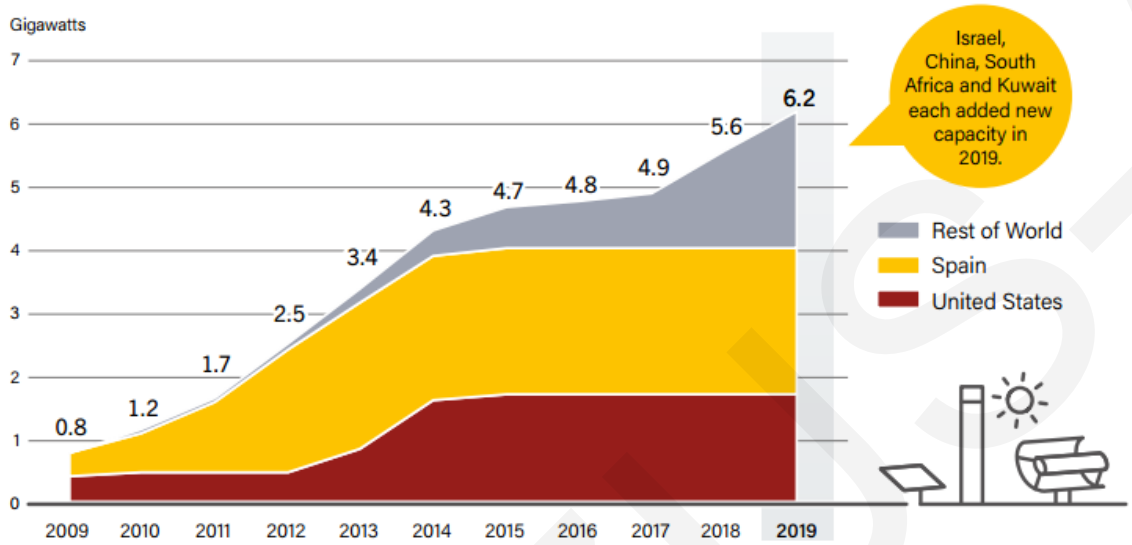
Hua Shi, Hao Zhou, Peng-nan Ma, Jian-kang Wang, Hao Fang, Jia-wei Luo, Kun-zan Qiu

Key words: Molten salt; leaking; migration; crack; foundation material

Cite this as: Hua Shi, Hao Zhou, Peng-nan Ma, Jian-kang Wang, Hao Fang, Jia-wei Luo, Kun-zan Qiu, 2021. Experimental investigation of migration and solidification of molten salt leaking through tank cracks. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 22(12):979-991. https://doi.org/10.1631/jzus.A2100011

Research Background

- Concentrating solar thermal power global capacity, by country and region, 2009-2019



[Andre T. Renewables 2020 global status report[M]. 2020]

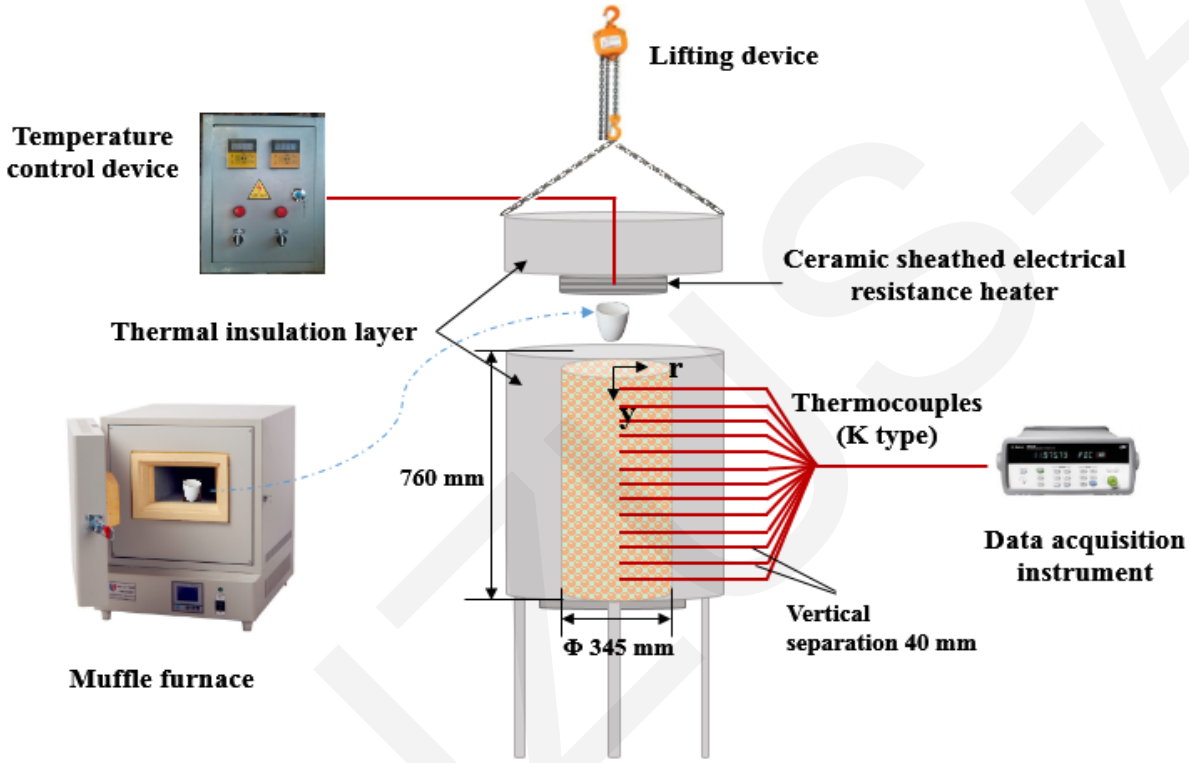
Molten salt thermal energy storage technology has developed into one of the most attractive energy storage methods for concentrated solar power systems.

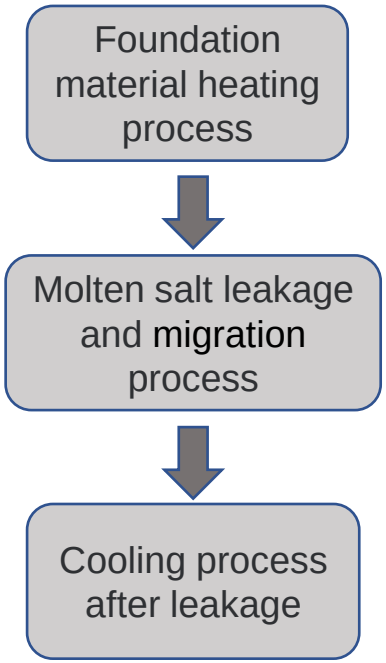
Molten salt leakage and transport in porous material with solidification is an important issue for molten salt application.



Experimental System

- Experimental system of molten salt leakage and migration in hot foundation materials

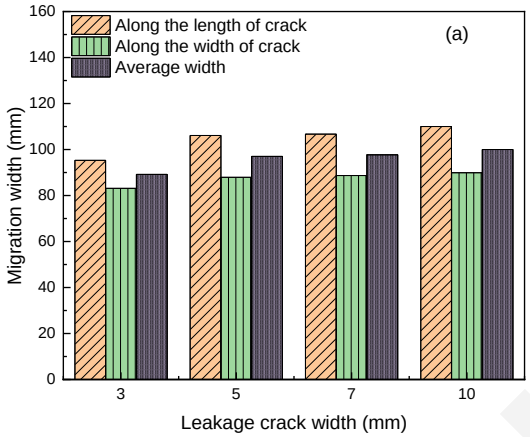


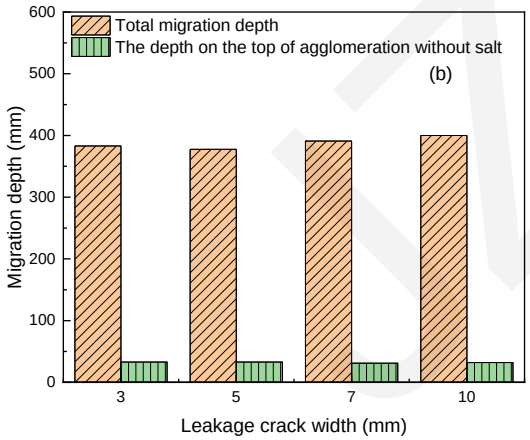


The present work experimentally studies the migration characteristics of molten salt leaking into thermal steady-state foundation materials through storage tank cracks.

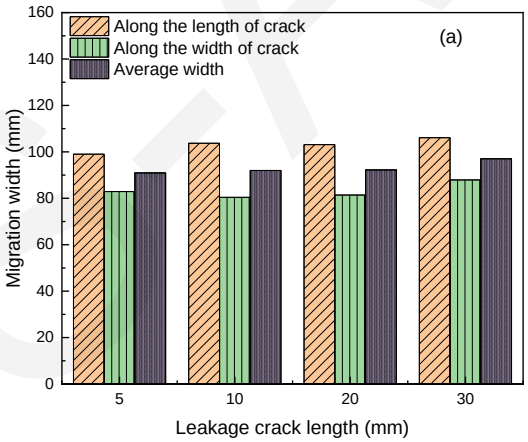
Rusults and Discussion

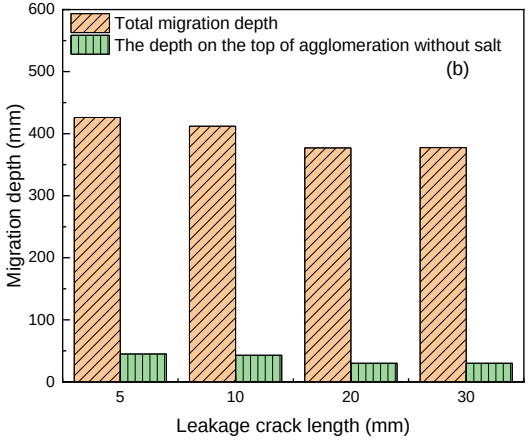
- Effect of leakage crack width on migration process





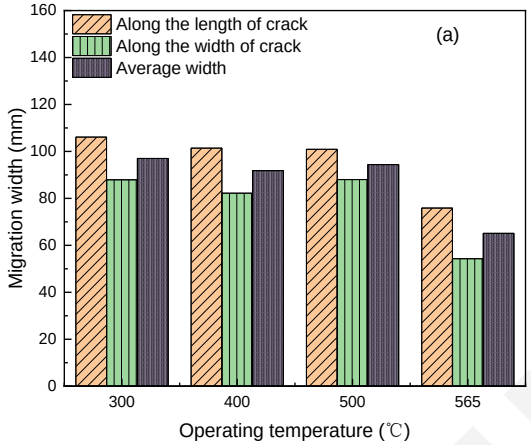
- Effect of leakage crack length on migration process

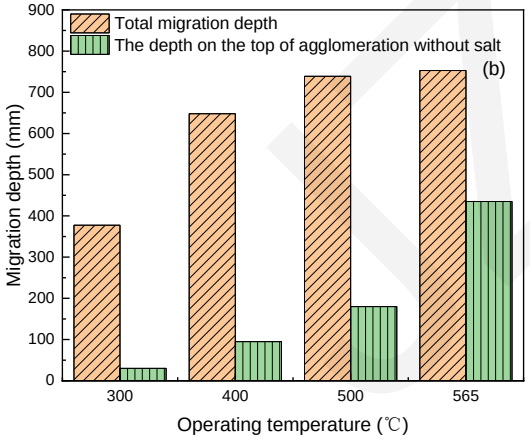




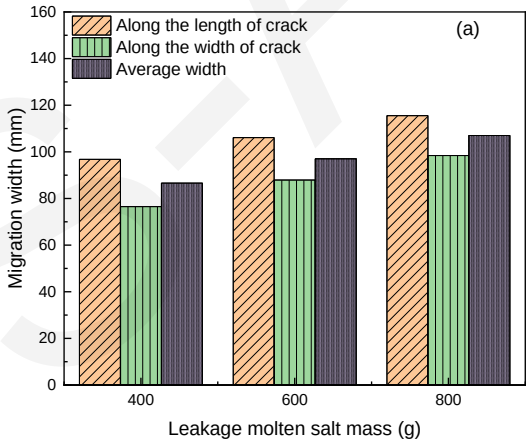
Rusults and Discussion

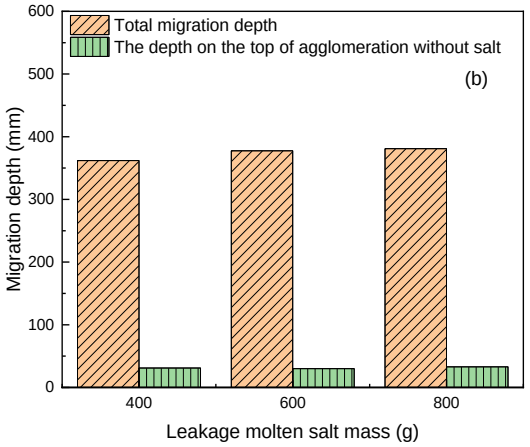
- Effect of operating temperature on migration process





- Effect of leakage molten salt mass on migration process





Conclusions

The following conclusions are drawn:

- Experimental results show that the crack width and length slightly affect the seepage depth, but directly affect the shape of the agglomeration of solidified salt and porous foundation material.

- The most important factor affecting the migration depth of molten salt leaking through cracks is the tank operating temperature. As the operating temperature of the storage tank rises from 300 ℃ to 500 ℃, the distance from the top of the agglomeration to the leaking location increases from 30 mm to 180 mm, and the total migration depth increases by 95.8%.

- The increase of leakage molten salt mass in a certain range has little influence on the molten salt migration depth. Furthermore, the thermal stable temperatures of the porous foundation material after the leaking accident increase with an increase of the leakage molten salt mass.