

Analysis of Extreme Accidents in Large-Scale Molten Salt Storage Tanks: Catastrophic Consequences and Safety Assessment of Molten Salt Leakage and Foundation Seepage

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Abstract : In the operation of large-scale molten salt storage tanks, foundation seepage due to rising groundwater levels or extreme rainfall can lead to uneven settlement and foundation instability. Coupled with thermal shock and thermal fatigue on the tank's bottom plate, such conditions may result in local cracking or even tank collapse, causing severe environmental pollution and economic loss. This study constructed a 1:100 scale molten salt storage tank foundation system in the laboratory to investigate the effects of floodwater, groundwater, and molten salt mixtures on the tank's bottom plate and foundation materials. High-temperature strain gauges and three-dimensional temperature sensors were used to capture the thermal shock patterns and specific thermal stress values (ranging from -200 to 150 MPa) experienced by the tank's bottom plate during accidents. The study confirmed that the thermal conductivity of the foundation materials could increase by 2 to 5 times their original values. Additionally, uniaxial compression tests revealed trends in changes to the foundation materials' elastic modulus and compressive strength. Finally, combining experimental results with numerical simulations, a systematic safety assessment method for complex accidents in large-scale molten salt storage tanks was proposed.

Keywords : thermal energy seorsge, tank, safety assessment, molten salt leakage

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