Khalid Alnasser

Thesis

Mathematical Investigation of Heat Transfer in Industrial Crude Oil Tank during a Fire

Abstract

A mathematical study of heat transfer in an industrial crude oil storage tank during a fire leading to boil over has been conducted. Boil over, which might happen during a fire of an open top industrial storage oil tank, is caused by the enormous water vapour generated as the hot front (hot zone) in the crude oil reaches the water located at the bottom of the tank. This water consists of water that settled at the bottom of the tank over time, or water added during the firefighting operations. To solve the governing partial differential equations for heat transfer and fluid flow in crude oil and the water layer, a computational fluid dynamics (CFD) model has been developed. The model solves the governing equations of mass, momentum, and energy using an implicit control-volume formulation method with the SIMPLEC algorithm. The studies conducted using the model focus on calculating the transient, coupled heat and mass transfer taking place in the tank as result of exposure to external radiation due to the fire. The model predicts the liquid heat transfer profiles. Besides the predictions of the container conditions, the model estimates the effect of various parameters on the heat penetration rate and the time needed to reach the water layer.

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