CFD model predictions of the near-field dispersion behavior in the Jack Rabbit II experiments

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In the Jack Rabbit II 2015 chlorine experiments, the dispersion behavior in the near-field was very complex, featuring a two-phase jet which impinged on the ground causing some of the liquid to rain-out. The jet that spread radially outwards from the impingement zone was highly turbulent and the dispersing cloud of vapor and aerosols was strongly influenced by the presence of the nearby Conex containers. These features are difficult to analyze using integral dispersion models, such as DRIFT and PHAST, which do not account for the turbulence generated in the impingement zone, nor the channeling of the cloud between obstacles.

To investigate these effects, HSL has developed a Computational Fluid Dynamics (CFD) model of the Jack Rabbit II experiments using the ANSYS-CFX software. The model uses an Eulerian-Lagrangian two-phase jet source consisting of vapor and evaporating liquid droplets. Turbulence is modeled using a Reynolds-averaged Navier Stokes approach and the geometry of the nearby obstacles is included directly in the model.

A significant source of uncertainty is the interaction of the two-phase jet with the concrete pad, and the formation of an evaporating pool. CFD models do not yet have the capabilities to accurately model the physics of this droplet impingement process. Model sensitivity tests have therefore been performed using several simplified approaches to investigate the phenomena for Jack Rabbit II Trial 1. The modeling approach that worked best for Trial 1 has then been tested for Trials 2 to 5.

The purpose of developing the CFD model is to help understand the physics of the near-field flow behavior and aid the development of simpler (and faster) dispersion models. This presentation will provide an overview of recent developments in the CFD model and a comparison of various model predictions to the Jack Rabbit II 2015 data.

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