Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Surface cooling mechanism of fire suppression by aqueous foam
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— We investigate the ability of room-temperature foam to directly cool the surface of a liquid fuel pool at burning conditions and to reduce the fuel vapor pressure. We solve an unsteady, one-dimensional heat conduction equation using the finite element method to predict the temperature within an aqueous foam layer above a liquid fuel (heptane) layer. The sharp gradients in temperature and thermal properties at the foam-fuel interface are treated approximately inside of a thin interfacial layer above the fuel surface. We predict a rapid, significant reduction in the fuel surface temperature due to the large initial temperature gradient and the foam thermal diffusivity. The predicted surface cooling leads to a significant decrease in the fuel vapor pressure in less than a second. The mechanisms of fire suppression by aqueous foams are not well understood and the model predictions show that direct surface cooling could provide an important contribution to fire suppression. Experiments are in progress to quantify the surface cooling effect on heptane pool fire suppression.

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Date submitted: 09 Nov 2012 Electronic form version 1.4