Abstract

With a few high profile tunnel fire incidents happening in recent years, fire safety has been a serious issue in tunnels. Several tunnel fire safety components have been invented, tested and implemented in many tunnels. However, the interactions between these components are not fully studied and understood. This thesis studies the impact of tunnel longitudinal ventilation system together with water mist system and fire by varying a few key parameters.

Fire Dynamics Simulator (FDS), which is a Computational Fluid Dynamics (CFD) software widely used in fire safety engineering field, is used to simulate a full-scale heavy good vehicle fire close to jet fans in a 600 m long tunnel, with water mist systems. The vehicle height, number of water nozzles, location of water nozzles, design fire size and water droplet size are all individually studied in order to attempt to have a comprehensive understanding on how these factors affect smoke backlayering, which is the main criteria when designing longitudinal ventilation system.

The result shows that lesser jet fans are required to prevent backlayering when the vehicles are taller, more water nozzles are used, fire size is smaller or water droplet size is smaller. Various cooling mechanisms and tunnel fire dynamics involved in these interactions shall be discussed.

This thesis seeks to serve as a general practical guide when designing tunnel fire safety system by providing an overview of how various factors affect each other. Further research should be conducted to validate the results and to formulate the relationships quantitatively.