ABSTRACT

The interaction between water mist systems and ventilation systems in tunnel fires was modelled by creating a MATLAB program to solve a system of equations generated using comprehensive thermodynamic control volume analyses. The program uses input values for relevant variables in order to estimate the number of jet fans required to prevent smoke backlayering in a tunnel fire. The input variables include tunnel dimensions, water mist system characteristics, and fire size.

A case study was performed on a 6 x 6 x 600 m tunnel in keeping with previous research. It was found that the use of a water mist system had a mixed impact on the number of fans required to prevent backlayering. At heat release rates lower than approximately 15 MW, it was found that the water mist system increased the number of fans required. The main reason for this was determined to be the resistance caused by accelerating the relatively large mass of water introduced into the tunnel. At heat release rates larger than approximately 15 MW, it was found that the water mist system reduced the number of fans required. This was determined to be due to the ability of the water mist system to reduce the heat release rate and to reduce the downstream temperatures.

Several recommendations for future work were made. They mostly concerned collecting more full-scale experimental data in several areas, including: determining the relationship between water mist system characteristics and heat release rate, determining what proportion of water spray evaporates in a tunnel fire, measuring the throttling effect of a fire on longitudinal airflow, and determining the relationship between longitudinal ventilation velocity and water mist systems.