EXPERIMENTAL AND COMPUTATIONAL ASSESSMENT OF HOT SMOKE AND MORE REALISTIC FIRE TESTS IN LARGE ENCLOSURES, Part 1: Experimental Results

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ABSTRACT

An experimental program has been undertaken to compare hot smoke tests with more realistic fire scenarios. Polyurethane and wood crib are used as the fuel for more realistic cases in a series of experiments conducted in two warehouses. Seven hot smoke tests, five polyurethane and two wood crib fire tests have been carried out in these large buildings. To demonstrate repeatability, four hot smoke and three polyurethane tests have been done in the smaller building, and three hot smoke tests, two polyurethane and two wood crib tests in the larger building. Flame and gas temperatures, radiation and total heat fluxes, gas velocity, species concentration and mass lost rate have been measured. Video recordings are used to monitor smoke lowering.

As an example, the fire scenario in the second building is illustrated in Figure 1 along with the ceiling vents. The warehouse is 55.2 m in length and 13 m in height with ceiling openings located in the double-pitched (not shown) ceiling. The width is 30.2 m. In Figure 2, heat release rate calculations are shown for one of the polyurethane tests in this building. In this figure, heat release rate is shown as calculated from radiation heat flux and gas concentration measurements [1]. The heat release rate as calculated from radiation heat flux transducers at different distances from the fire source lead to similar results. The difference between these and the heat release rate calculated from gas concentration measurements is due to the residual O_2 in the double-pitched ceiling cavity. Better agreement with these two sets of results is obtained for the smaller warehouse which has a flat roof.

In Figure 3, smoke lowering during hot smoke, polyurethane and wood crib fire tests is plotted for comparison with each other. The experimental results from polyurethane and wood crib tests indicate similar smoke lowering characteristics. However, hot smoke test results indicate faster smoke lowering than those with more realistic fuels.

REFERENCES

[1] Janssens, M. and Parker, W.J. 1992, “Oxygen Consumption Calorimetry” chapter 3, Heat Release in Fires, Elsevier Science Publisher Ltd.

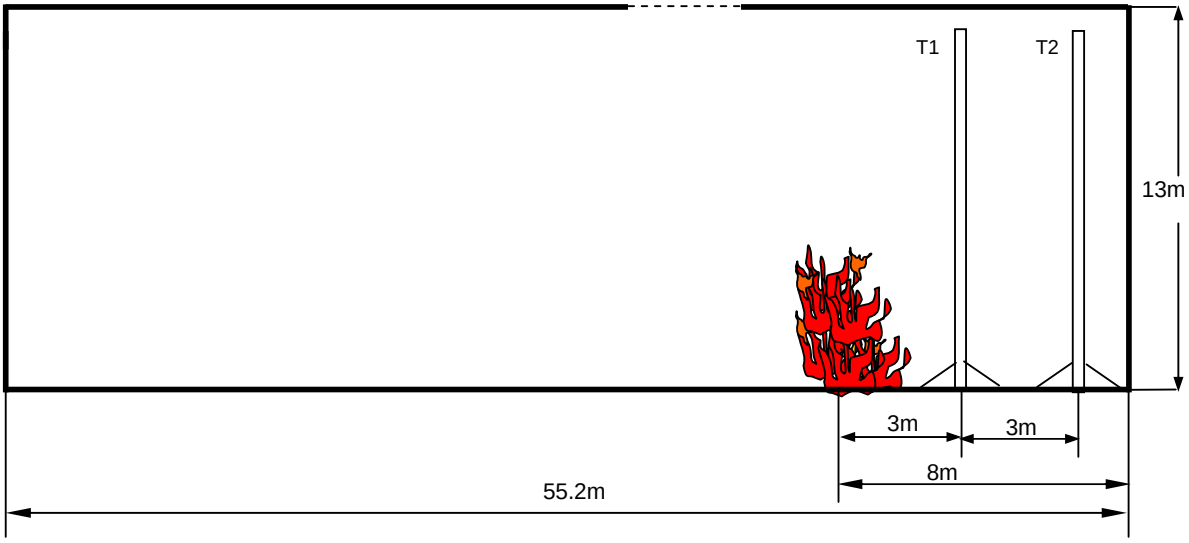

Figure 1. Schematic representation of the mid-plane of the second warehouse and the fire scenario (not to scale).

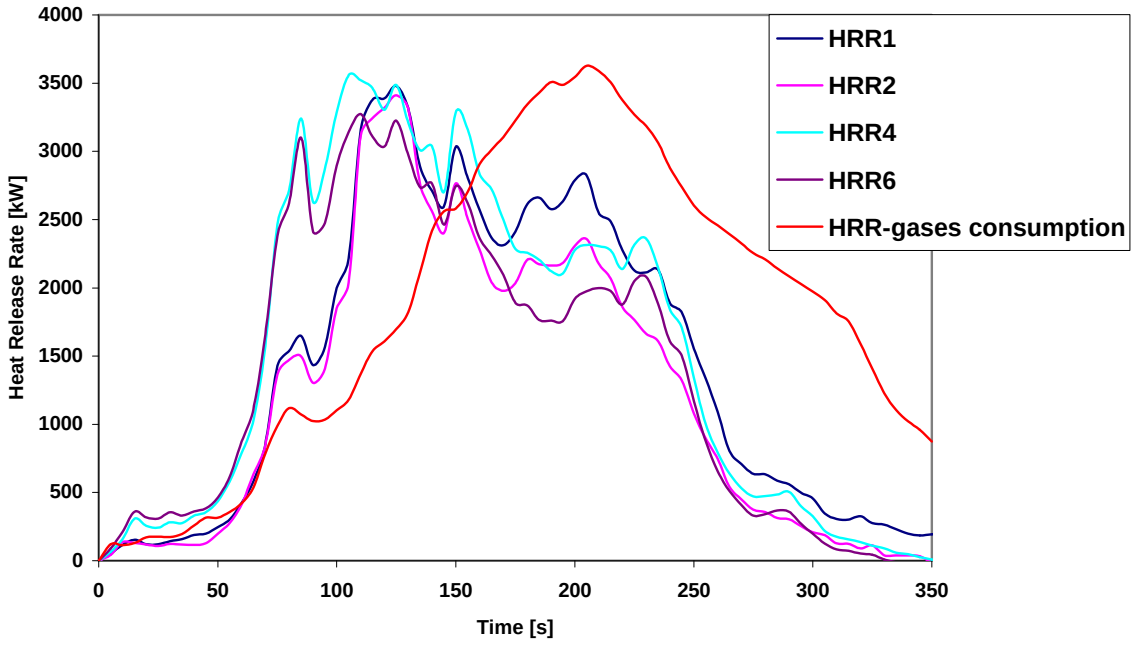

Figure 2. Heat release rate calculations from radiation heat flux (as measured by four transducers) and the concentrations of O_2-CO_2-CO gases. Polyurethane fire test 2.

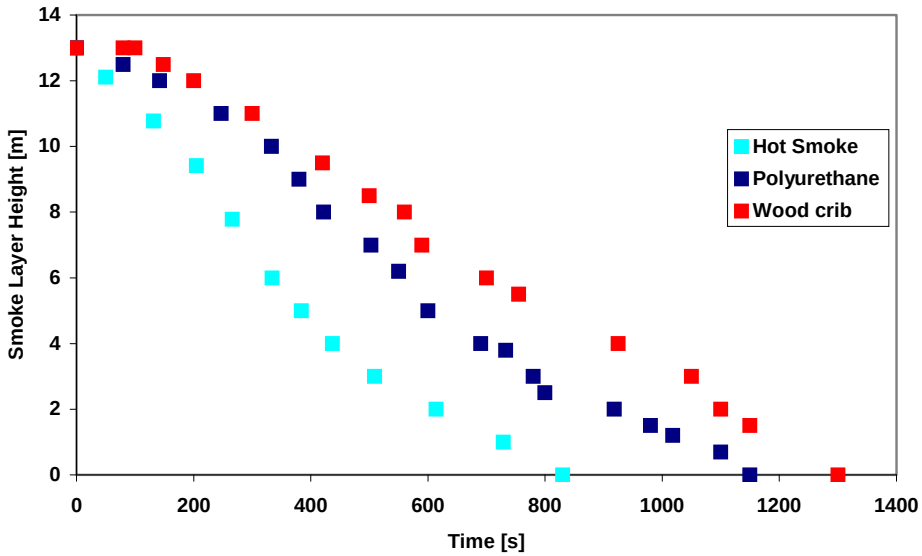

Figure 3. Smoke lowering results from hot smoke, polyurethane and wood crib tests in the second warehouse.