Experimental study on the influence of different thermal insulation materials on the fire dynamics in a reduced-scale enclosure - DTU Orbit (03/01/2019)

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Four scaled (1:5) fire experiments with two identically classified types of commercially available sandwich panels incorporating either stone wool (SW) or poly-isocyanurate (PIR) foam as cores were conducted using a modified version of the ISO 13784-1 (Reaction to fire tests for sandwich panel building systems — Part 1: Small room test) standard. This was to assess the suitability of scaled experiments for assessing sandwich panel fire behavior. In the modified version of the test standard (scaled and full experiments), the fire severity was increased to simulate fires that could occur in commercial premises. This was achieved by prolonging and doubling the heat release rate output of the gas burner at the end of the experiments. Furthermore, non-structural damages such as screw-hole damages were applied to the enclosures to reflect real life observations.

The results showed differences in the fire behavior, depending on whether the enclosures were constructed of panels filled with SW or PIR insulation material. The mass losses of the insulation materials showed significant contribution from the PIR cores, regardless of fire load and the non-structural damage. The qualitative behavior with respect to the “flashover” failure criterion, as stated in the ISO 13784-1, was successfully obtained in all of the scaled experiments. As such, the scaled experiments mimicked the behavior of the full scale SW experiments to a satisfactory degree. However, the PIR compartments failed considerably earlier in the full scale tests than in the scaled experiments. Therefore, it can be concluded that when the energy contribution from the core material remained negligible compared to the gas burner, the measured parameters matched quite well. Therefore, if the insulating core material does not dominate the fire dynamics of the compartment and the energy from the gas burner dictates the fire scenario then the scaled set-up will predict the temperature in the full scale compartment. Based on this and with further development with respect to, especially, time, this kind of scaled experiments could be a valuable testing method for assessment of the behavior of sandwich panel, and therefore merit further studies and eventually increased use.

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