World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:18, No:04, 2024

Using the ISO 9705 Room Corner Test for Smoke Toxicity Quantification of Polyurethane

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Abstract : Polyurethane (PU) foam is typically sold as acoustic foam that is often used as sound insulation in settings such as night clubs and bars. As a construction product, PU is tested by being glued to the walls and ceiling of the ISO 9705 room corner test room. However, when heat is applied to PU foam, it melts and burns as a pool fire due to it being a thermoplastic. The current test layout is unable to accurately measure mass loss and doesn't allow for the material to burn as a pool fire without seeping out of the test room floor. The lack of mass loss measurement means gas yields pertaining to smoke toxicity analysis can't be calculated, which makes data comparisons from any other material or test method difficult. Additionally, the heat release measurements are not representative of the actual measurements taken as a lot of the material seeps through the floor (when a tray to catch the melted material is not used). This research aimed to modify the ISO 9705 test to provide the ability to measure mass loss to allow for better calculation of gas yields and understanding of decomposition. It also aimed to accurately measure smoke toxicity in both the doorway and duct and enable dilution factors to be calculated. Finally, the study aimed to examine if doubling the fuel loading would force under-ventilated flaming. The test layout was modified to be a combination of the SBI (single burning item) test set up inside oof the ISO 9705 test room. Polyurethane was tested in two different ways with the aim of altering the ventilation condition of the tests. Test one was conducted using 1 x SBI test rig aiming for well-ventilated flaming. Test two was conducted using 2 x SBI rigs (facing each other inside the test room) (doubling the fuel loading) aiming for under-ventilated flaming. The two different configurations used were successful in achieving both well-ventilated flaming and under-ventilated flaming, shown by the measured equivalence ratios (measured using a phi meter designed and created for these experiments). The findings show that doubling the fuel loading will successfully force under-ventilated flaming conditions to be achieved. This method can therefore be used when trying to replicate post-flashover conditions in future ISO 9705 room corner tests. The radiative heat generated by the two SBI rigs facing each other facilitated a much higher overall heat release resulting in a more severe fire. The method successfully allowed for accurate measurement of smoke toxicity produced from the PU foam in terms of simple gases such as oxygen depletion, CO and CO2. Overall, the proposed test modifications improve the ability to measure the smoke toxicity of materials in different fire conditions on a large-scale.

Keywords : flammability, ISO9705, large-scale testing, polyurethane, smoke toxicity
Conference Title : ICSFSE 2024 : International Conference on Structural Fire Safety Engineering
Conference Location : Nicosia, Cyprus
Conference Dates : April 25-26, 2024