

Design, Construction, Validation And Use Of A Novel Portable Fire Effluent Sampling Analyser

Authors : Gabrielle Peck, Ryan Hayes

Abstract : Current large scale fire tests focus on flammability and heat release measurements. Smoke toxicity isn't considered despite it being a leading cause of death and injury in unwanted fires. A key reason could be that the practical difficulties associated with quantifying individual toxic components present in a fire effluent often require specialist equipment and expertise. Fire effluent contains a mixture of unreactive and reactive gases, water, organic vapours and particulate matter, which interact with each other. This interferes with the operation of the analytical instrumentation and must be removed without changing the concentration of the target analyte. To mitigate the need for expensive equipment and time-consuming analysis, a portable gas analysis system was designed, constructed and tested for use in large-scale fire tests as a simpler and more robust alternative to online FTIR measurements. The novel equipment aimed to be easily portable and able to run on battery or mains electricity; be able to be calibrated at the test site; be capable of quantifying CO, CO₂, O₂, HCN, HBr, HCl, NO_x and SO₂ accurately and reliably; be capable of independent data logging; be capable of automated switchover of 7 bubblers; be able to withstand fire effluents; be simple to operate; allow individual bubbler times to be pre-set; be capable of being controlled remotely. To test the analysers functionality, it was used alongside the ISO/TS 19700 Steady State Tube Furnace (SSTF). A series of tests were conducted to assess the validity of the box analyser measurements and the data logging abilities of the apparatus. PMMA and PA 6.6 were used to assess the validity of the box analyser measurements. The data obtained from the bench-scale assessments showed excellent agreement. Following this, the portable analyser was used to monitor gas concentrations during large-scale testing using the ISO 9705 room corner test. The analyser was set up, calibrated and set to record smoke toxicity measurements in the doorway of the test room. The analyser was successful in operating without manual interference and successfully recorded data for 12 of the 12 tests conducted in the ISO room tests. At the end of each test, the analyser created a data file (formatted as .csv) containing the measured gas concentrations throughout the test, which do not require specialist knowledge to interpret. This validated the portable analyser's ability to monitor fire effluent without operator intervention on both a bench and large-scale. The portable analyser is a validated and significantly more practical alternative to FTIR, proven to work for large-scale fire testing for quantification of smoke toxicity. The analyser is a cheaper, more accessible option to assess smoke toxicity, mitigating the need for expensive equipment and specialist operators.

Keywords : smoke toxicity, large-scale tests, iso 9705, analyser, novel equipment

Conference Title : ICFSSST 2024 : International Conference on Fire Safety Science and Technology

Conference Location : London, United Kingdom

Conference Dates : September 19-20, 2024