Moving Knowledge from Research to Impact

SUCCESS STORY

NIJ and JENSEN HUGHES:

Advancing the Forensic Analysis of Ignitable Liquid Fuel Fires

"Dr. Gottuk's work has reduced the number of inaccurate arson determinations based on low burns and holes in the floor. It has even played a role in reversing some wrongful convictions based on the misconception that ignitable liquids burn holes in floors."

–John Lentini, CFI, D-ABC
Scientific Fire Analysis, LLC

Synopsis of Problem and Solution

In the United States, municipal fire departments respond to an estimated 160,000 fires per year that are ignited by flammable or combustible liquid. These fires cause more than 450 deaths, 3,900 injuries, and $1.5 billion in direct property damage.[1] Investigating fires with "liquid fuel" is particularly challenging, as the combustion of building materials often conceals the presence of the fuel. More comprehensive insights into the burning dynamics of these types of fires will help fire scene investigators determine if accelerant was used to start the fire.

JENSEN HUGHES, led by Dr. Daniel Gottuk, evaluated the differences in fire dynamics and fire damage between ignitable liquid fuel fires in open-burning and enclosed scenarios, with and without furnishings. Full-scale testing was conducted to identify optimum sampling locations within fire patterns to identify ignitable liquid residue (ILR). The study provides fire investigators with new methods and guidelines for conducting calcination depth measurements and analyzing heat impact on gypsum wallboard (sheetrock) relative to fire patterns.

NIJ Research

Dr. Daniel Gottuk received a National Institute of Justice award (2008-DN-BX-L168) to examine fire dynamics and damage caused by ignitable liquid fuel fires in enclosed and open areas, looking at the use of related fire patterns for area of origin and cause analysis. Other topics addressed were the analysis of clean burn patterns and the analysis of flashover. Dr. Gottuk developed a reliable and accurate method of obtaining calcination depth surveys with a, portable, hand-held measuring tool developed for improved fire pattern analysis. The study also evaluated the presence of ILR to identify optimum sampling locations within a given scenario.

Key Benefits

- Increases the likelihood of positive ILR identification on typical building materials (composite furniture materials, plywood, vinyl, and carpet/pad).
- Enables investigators to objectively assess burn patterns on various flooring materials to determine whether the source of the pattern is the burning of flammable liquid or other combustible materials, such as furniture or plastic toys.
- Provides a means to measure the calcination depth of gypsum wallboard for pattern analysis to aid in fire origin determination and fire impact severity.

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More Information

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Disclaimer

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Bringing Research to Practice

The results of this work have been incorporated into the Society of Fire Protection Engineers (SFPE) Handbook of Fire Protection Engineering (5th edition, 2016)[2] and the National Fire Protection Association (NFPA) 921 Guide for Fire and Explosion Investigations (2017).[3] This work has also been presented to the forensic community, including at the International Symposium on Fire Investigation Sciences and Technology, the National Fire Protection Association Annual Conference, and a leading insurance company's fire investigator training course.

The Future

In 2017, in recognition of their excellence, *Consulting-Specifying Engineer* magazine ranked JENSEN HUGHES sixth out of the top 100 mechanical, electrical, plumbing, and fire protection engineering firms in the United States.[4] JENSEN HUGHES's research and expertise in fire reconstruction, origin and cause investigation, engineering analysis, testing, and code compliance will continue to influence fire pattern analysis and litigation support to the arson community for many years to come. Going forward, arson investigators now have new tools and guidelines for fire pattern analysis, a means to estimate the initial fuel spill size based on burn patterns, and a new fundamental understanding of burn rates for fuel spill fires.

Resources

[1] Hall, J. R., Jr. (2014). *Fires starting with flammable or combustible gas or liquid*. Retrieved from http://www.nfpa.org/~/media/files/news-and-research/fire-statistics/major-causes/osfiresstartinggas.pdf?la=en

[2] Hurley, M. J., Gottuck, D. T., Hall, J. R., Jr., Harada, K., Kuligowski, E. D., Puchovsky, M., Torero, J. L., Watts, J. M., Jr., & Wiezorek, C. J. (Eds.). (2016). *SFPE handbook of fire protection engineering*. Available at http://www.springer.com/us/book/9781493925643

[3] NFPA. (n.d.). *List of NFPA codes & standards*. Retrieved from http://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=921

[4] *Consulting-Specifying Engineer*. (2017). *MEP Giants Program.* Retrieved from https://www.csemag.com/index.php?id=3011

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