A140 Watching Paint Dry: Hypothesis Testing of Ignition Scenarios Involving Spontaneous Heating

John J. Lentini, BA, Scientific Fire Analysis, LLC, 32836 Bimini Lane, Big Pine Key, FL 33043*

After attending this presentation, attendees will understand some principles of spontaneous heating and fires caused by spontaneous heating to ignition. They will be aquainted with experimental means of hypothesis testing.

This presentation will impact the forensic community by making analysts aware of situations in which simply identifying a material that is subject to self-heating is insufficient to demonstrate the cause of the fire.

In many cases, an actual experiment will be necessary. This presentation will describe experimental means for testing hypotheses involving spontaneous ignition.

In many fire investigations, it is necessary to at least rule out the possibility that spontaneous ignition was the cause of the fire. Fires in restaurants, health spas, and spray painting booths require an examination of this possibility. Most fires that occur in clothes dryers also need to be examined for the possibility of spontaneous ignition.

Spontaneous ignition occurs when material that is subject to self- heating is configured in such a way that the heat from the exothermic reaction is incapable of being dissipated to the environment. This may be due to the fact that the environment is hot, but is more often due to the configuration of the material on a cellulosic substrate. Samples of such substrates are frequently submitted to forensic laboratories for chemical analysis, and using techniques described in the literature, the analyst can derivatize the fatty acids present on the substrate and characterize them as vegetable oil residues using GC MS.[1] In the case of certain well-known hazards like linseed oil, this may be all that is necessary.

In other cases, however, it is necessary to demonstrate that under the conditions that obtained at the fire scene (the combination of the material on the substrate, the configuration of the substrate, and the ambient temperature), the package is capable of not only self-heating, but of reaching the ignition temperature of the substrate material.

Most vegetable oils are subject to self-heating at some level. The Differential Mackey test (ASTM D3523) can be used to demonstrate experimentally that a particular oil is subject to self-heating, but in most cases, no ignition will be observed. This test is generally insufficient for demonstrating that ignition can occur.

The Department of Transportation (DOT) promulgates a pair of tests, described at 49 CFR, part 173, Appendix E, designed to test the potential of materials for spontaneous heating, which is far more rigorous, and much more likely to lead to dramatic results. Although the test is designed for powders, and can be directly applied to paint overspray particles, it works well with oil-saturated towels or shop rags. If the material is capable of causing a fire in any configuration, this test will reveal that.

Thus, starting with the null hypothesis that the material in question is incapable of causing spontaneous heating to ignition, the DOT test will disprove that hypothesis if it is capable of being disproved. Once it has been shown that a material can cause spontaneous ignition, the test conditions need to be made more similar to those that obtained at the fire scene. This can result in tests that may last four days or more. Time-lapse photography and a dedicated sprinkler are useful in such situations.

Materials that include solvents (most stains and coating materials) can take an exceedingly long time to exhibit any sensible heating because the solvent absorbs the heat given off by the polymerization reaction, leading to vaporization. Only after the solvent has evaporated significantly will be temperature of the substrate increase. In some situations, it is not unusual to see the temperature increase slightly, then decline, then increase again. The reactions taking place within pile of cotton rags are anything but homogeneous, making it necessary to be very cautious with the design of the experiment and the interpretation of results.

Reference:

[1] Stauffer,E, .A Review of the Analysis of Vegetable Oil Residues from Fire Debris Samples: Analytical Scheme, Interpretation of the Results, and Future Needs, J Forensic Sci, September 2006, Vol. 51, No. 5

Fire Investigation, Spontaneous Ignition, Hypothesis Testing

 ** Presenting Author*