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Truck Insurance v. MagneTek: Lessons to Be Learned Concerning Presentation of Scientific Information

by
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Recently, a U.S. Court of Appeals decision was made in Colorado[1] which is very unfortunate and which may make it more difficult for fire investigators to deal with ignition of fires which have been caused by long-term, low-temperature heating of wood. I have not had personal involvement with this case and know of the facts only as presented in the Court decision. Thus, my objective here is not to discuss whether justice was served for the parties involved, but, rather, to point out some implications for fire investigators and to offer some ways of coping with the new legal impediments that have been created.

The case concerned a ceiling which may have been set on fire by a fluorescent light ballast. The Court did not understand the difference between short-term heating of wood, where the concept of a roughly-known ignition temperature is applicable, and long-term, low-temperature heating behavior. When cellulosic substances which are capable of smoldering are exposed to sustained heating at temperatures which are much lower than the 'ignition temperature' applicable to short-term heating, under some conditions they may still ignite. This phenomenon is not newly-discovered or scientifically disputed. A scientific treatise[2] was already published in 1984, although it is so highly mathematical that it would not be comprehensible to most investigators. Instead, the Court took as fact that wood has an ignition temperature of "approximately 400ºF" [204ºC] and rejected the plaintiffs' case out of hand, because they could only demonstrate that, under normal conditions, the ballast would reach 232ºF [111ºC] and, under failure conditions, 340ºF [171ºC]. But the fact that smolderable combustibles may become ignited at temperatures much lower than an ignition temperature obtained during short-term heating has been known for over 100 years, as demonstrated by 19th century studies on spontaneous-combustion fires onboard ships carrying coal[3].

The Court specifically rejected the plaintiffs' claims because it concluded that the plaintiffs were presenting what it called a "pyrolysis theory." It then went on to state that it found "the long-term, low-temperature ignition theory" to be "unreliable" and, therefore, excludable under *Daubert*. The implication to fire investigators now is that any time they encounter a case involving the long-term, low-temperature ignition of wood, their presentation might be thrown out of court. To avoid this, it is important to realize how the scientific presentation was made in the *MagneTek* case (or at least how it was interpreted by the court), and to make presentations in future cases which avoid such an out-of-hand rejection by the court.

"Pyrolysis" is not a theory, it is a **definition**. As such, it cannot be right or wrong (but, as with any definition, can be adhered to widely, or not). Analytical chemists define[4] "pyrolysis" as "Transformation of a compound into one or more other substances by heat alone, i.e., without oxidation". If oxygen does play a role, then chemists refer to the process as "oxidative pyrolysis," and the latter term is widely used in the thermal-analysis branch of chemistry. In fire science, we normally define "pyrolysis" as stated in my *Ignition Handbook*[5]: "The chemical degradation of a substance by the action of heat." Thus, the slight difference is that, in fire science, we include both oxidative and non-oxidative pyrolysis in the general definition.

But "pyrolysis" does not explain anything concerning long-term, low-temperature ignitions of wood. It is an observable fact that wood is a material which will pyrolyze, as opposed to, say, gold, which can be raised to quite high temperatures without suffering chemical degradation. That fact, by itself, says nothing as to whether it can even ignite, much less under what conditions it will ignite. To determine under what conditions something can ignite, in principle, we can do one of two things: (1) use a scientific theory to make a calculation; or (2) consult observational data collected on the topic.

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1 Truck Insurance Exchange v. MagneTek, Inc. (No. 03-1026), U.S. Court of Appeals, Tenth Circuit, Appeal from the U.S. District Court for the District of Colorado, D.C. No. 00-RB-2218(CBS), Filed Feb. 25, 2004.

2 Bowes, P. C., **Self-Heating: Evaluating and Controlling the Hazards**, Her Majesty's Stationery Office, London (1984).

3 Rowan, T., **Coal Spontaneous Combustion and Explosions—Occurring in Coal Cargoes—Their Treatment and Prevention**, E&FN Spon, London & New York (1882).

4 Lewis, R J. sr., Hawley's Condensed Chemical Dictionary, 14th ed., p. 941, Wiley, New York (2001).

5 Babrauskas, V., **Ignition Handbook**, Fire Science Publishers/Society of Fire Protection Engineers, Issaquah WA (2003).

The problem with the plaintiffs' case was that they evidently tried to provide a theory, which did not serve them well. There are many events in the natural sciences which are well documented, but lack a theory. We have very good documentation that Mount St. Helens last erupted on May 18, 1980. We have no theory that can explain why it erupted on May 18th, instead of May 15th. But that fact does not stop us from being entirely, scientifically correct when we point out that Mount St. Helens did erupt on May 18, 1980. The same tack should have been taken in the present case. As documented extensively in the *Ignition Handbook* (which, by the way, was peer-reviewed and was published under the aegis of the Society of Fire Protection Engineers), ignitions due to long-term, low-temperature heating of wood members are documented down to a temperature of 170ºF [77ºC]. For temperatures above 212ºF [100ºC], documentation is not only reliable, but copious. Based on these facts, it should have sufficed for the plaintiffs to demonstrate that the product imposed temperatures on wood in excess of these. If this is demonstrated, then it directly follows that such a product is unsuitable for use where it would be in contact with wood for an extended period of time, and that it creates an imminent danger of fire. This, of course, must be accompanied by good fire investigation which excludes other potential energy sources as an ignition source for the fire.

The state-of-the-art of fire science is that we do not have a model that can predict this phenomenon. That is to say, if the scientist is told that the piece of wood has a certain size and configuration, and the hot object has certain known characteristics, he cannot make computations along the lines of "It will take 5.9 months for fire to break out." The physics and chemistry (and biology!) of wood are very complicated. We have a certain understanding of factors that play a role in this, but the understanding is nowhere near progressed to where numerical computations can be made. The long time scale involved and the fact that cracking evidently plays a crucial role (but is extremely hard to model) are factors that contribute to the difficulty. Computations on the spontaneous combustion behavior of some other substances, where the phenomena are less complicated (for example, powdered milk[6]) have been made. The size/temperature relations needed for powdered milk to ignite can reasonably be estimated, although even in the best of circumstances estimating the time interval—which may be of greatest importance to the fire investigator—is hard to do reliably, because existing theories differ widely. The mathematical details of this are discussed in the *Ignition Handbook*.

Hopefully, the next time the issue arises in court, the expert who is presenting the material will be armed with the knowledge that, in the general case, scientific truth can be demonstrated either by using a theory or by pointing to the collected set of observations on the topic. But in the case of long-term, low-temperature ignition of wood, the first option is not available, so the second one perforce must be used. This does not devalue the presentation. Despite the incorrect view of some laymen that "science" means "a collection of equations," this is not true. The basic dictionary definition[7] of science is: "A branch of study that deals with a connected body of demonstrated truths." Geology is a good example of a science where there are many facts that have been demonstrated to be true, but few equations exist for calculating anything.

Finally, since a theory of long-term, low-temperature ignition of wood is not available, obviously it should be urged that research be carried on so that one day this might become possible. This will have to be preceded by laboratory experiments. In that connection, a caution must be offered. Because of the microscopically-irregular nature of wood, and the fact that cracking plays a role, one has to be prepared for a wide range of data spread. In other words, if a number of experiments were to be made where a wood member is ignited from a hot surface applied for a long time, the expectation is that the times to ignition will show a wide range of values. In addition, it will be found that some specimens will fail to ignite, while others, held at conditions as identical as possible, ignite. This has been observed for other substances where extensive laboratory tests were made[5].

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6 Beever, P. F., Spontaneous Ignition of Milk Powders in a Spray-Drying Plant, *J. Society of Dairy Technology* **37**, 68-71 (1984).

7 **The New Shorter Oxford English Dictionary**, Clarendon Press, Oxford (1993).

(SIDEBAR) NFPA 921 guidance on the topic

NFPA 921 points out (Sec. 5.3.1): "If the fuel is to reach its ignition temperature, the heat source itself must have a temperature higher than the fuel's ignition temperature. Spontaneous ignition is an exception." The correct message is conveyed although the chosen term, "spontaneous ignition," is not the best, because in a later section (Sec. 5.3.2.5) the same term is used in an entirely different sense, meaning unpiloted ignition during short-term, external heating. To make matters worse, Sec. 5.3.6.1 describes spontaneous combustion due to self-heating and states that "In this type of reaction, self-heating of a material to its ignition temperature will result in self-ignition." This is misleading because, if a material ignites as a consequence of long-term, low-temperature heating, the concept of "**its** ignition temperature" is wholly incorrect, since the temperatures involved are very sensitive to size, geometry, and ventilation conditions and there can be no handbook temperature which is a property of the fuel alone. But the 2004 edition has helpfully added a new section (Sec. 5.3.6.2.7) specifically on wood, stating that: "Exposure temperatures needed for wood self-heating to ignition are significantly lower than those shown in Table 5.3.5 for flaming ignition of fresh wood." Unfortunately, another new section, Sec. 18.3.2 states: "A competent ignition source will have sufficient temperature and energy and will be in contact with the fuel long enough to raise it to its ignition temperature," overlooking self-heating as a competent source of ignition.

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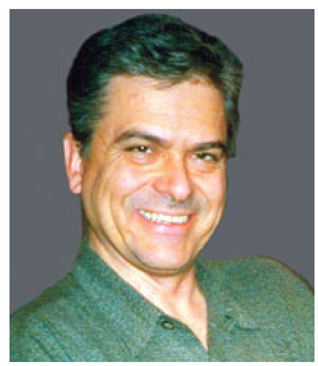

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