Spontaneous Combustion - Explained

The methods of occurrence of spontaneous combustion; what is and is not likely to ignite, and why.

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Spontaneous Combustion is often misunderstood by adjusters, attorneys, and investigators. The following information is a brief summary of some of the facts associated with the phenomenon called "spontaneous combustion."

Under a variety of conditions, the temperature of certain materials can increase without drawing heat from surroundings. If the temperature of the material reaches its ignition temperature, spontaneous ignition is said to occur.

In most cases, spontaneous heating occurs when a material reacts with oxygen from the air. The reaction is known as oxidation, and results in the evolution of heat. In most cases the oxidation process is very slow and the amount of heat generated in the material is so little that the temperature of the material does not change in a measurable way. A classic example of an oxidation reaction that is not susceptible to spontaneous ignition under normal temperatures is the rusting of iron.

Many materials, however react vigorously with oxygen and significant heat can be generated. When this occurs the temperature of the material will increase until the rate of heat generation equals the rate at which the heat is carried away from the material. In some cases the material is sufficiently insulated to prevent significant heat dissipation and the temperature of the material can quickly reach its ignition temperature.

Cotton rags soaked in linseed oil are very susceptible to spontaneous ignition. This is because the reaction of oxygen and linseed oil (oxidation) is fairly rapid and evolves considerable heat. Spontaneous ignition of the cotton rags can be prevented by restricting the amount of oxygen reaching the rags (placed in sealed metal container) or by providing sufficient ventilation (hanging on a clothesline) to quickly dissipate the heat.

Spontaneous heating of a substance does not always involve reaction with oxygen. For example if sodium metal is placed in a glass of water, the resulting reaction produces heat and hydrogen. The heat of the reaction is sufficient to ignite the hydrogen being evolved at the surface of the water.

Biological activity within certain materials of vegetable origin have also been shown to initiate spontaneous heating of the material which ultimately leads to ignition of the material.

A number of chemical and physical mechanisms have been shown to create spontaneous heating, a thorough discussion of which is beyond the scope of this article. However, it is important for the fire investigator to recognize that the phenomenon of spontaneous heating and ignition will occur under a very specific set of conditions.

To accurately determine if spontaneous ignition occurred, the fire investigator should first establish that the materials involved are susceptible to spontaneous heating. For example, it may be alleged that an oil soaked rag was found near the origin. If oil is of vegetable or animal origin, then the combination is truly susceptible to spontaneous heating. However, if it is determined that the oil is of petroleum origin, then spontaneous heating will not occur. Note: petroleum oils will spontaneously ignite when in contact with a stronger oxidizer such as chlorine. In many cases
it may be necessary to provide a list of materials and substances present in and around the area of origin to a chemist to determine if spontaneous heating can occur.

The investigator should also evaluate the configuration of materials to determine if sufficient heat can build up in order to reach the ignition temperature of the material. This is often hard to do since the fire may destroy any remnants of the original material. When this is the case it may be possible to determine the likely configuration through interviews with the person or persons knowledgeable of the area prior to the fire. In many cases samples from the area of the origin can be analyzed to confirm the identity of materials that were believed to be the cause of the fire.

Note: Readers may obtain a list of materials that are subject to spontaneous ignition by contacting F.J. Spinelli at POB 163, Troy, NY 12182.