A146 Sustained Combustion of Bodies: Some Observations

John D. De Haan, PhD, Fire-Ex Forensics, Inc., PMB 314, 3505 Sonoma Boulevard, #20, Vallejo, CA 94590; and Elayne J. Pope, PhD, University of Arkansas, University of West Florida, Anthropology Building 13, 11000 University Parkway, Pensacola, FL 32514*

After attending this presentation, attendees will be able to observe combustion of human cadavers and large animal carcasses in a variety of fire exposures and learn their behavior as complex fuels. Knowing the size and duration of such fires is critical to correct interpretation of fire and medico-legal issues.

This presentation will impact the forensic community, the many forensic disciplines that may be involved in fire death investigations, and these professionals that are not familiar with fires involving bodies by familiarizing all practitioners with the qualitative and quantitative properties of such fires and reduce the likelihood of making critical errors in reconstructions or interpretations of fatal fires.

When a body is involved in a fire, it is often thought of by fire investigators as a passive target of heat and flame. In some cases, however, it becomes involved as a fuel package, contributing flames and heat of its own. It is, in rare cases, the major fuel package supporting flaming combustion in the vicinity of the body for much longer times than other fuels nearby. This paper will explore the combustion of human cadavers and similar large-animal carcasses as they burn in sustained fire environments. Previous tests have explored the thermal response and fuel characteristics in intense fires of relatively short exposure times. The tests discussed here will concentrate on fire tests where the body was the primary fuel package, but will also compare the results of fire exposures in well-fueled, well-ventilated fires in both vehicles and furnished rooms. These tests focused on long duration fires involving both intact human cadavers and torsos and whole pig carcasses of various sizes. Test fires included both fully involved vehicle and compartment fires, as well as non-accelerated, long-duration fires involving only the bedding and clothing (in the manner of typical accidental deaths where a dropped match ignites such materials).

It was observed that bodies are a complex fuel package offering several different fuels whose behavior and thermal properties vary a great deal. The subcutaneous body fat presented in nearly all bodies is, by far, the best fuel present. For it to contribute, however, the dermal layers have to shrink and split (from external fire exposure of several minutes duration), the body fat has to render out, and be absorbed by a porous, rigid substrate (often the charred remains of the bedding, clothing, upholstery, carpet or wood floor). The combustion then takes place where the body fat burns on the porous wick as a flaming fire. The size of the fire is determined by the surface area of the wick involved and the delivery rate of the fat. Fires of 20-60 kW heat output have been observed in tests where the body was the main fuel source. Given the right position of the body and wick, the flaming combustion of the body has been observed to be sustained for 4 to 8 hrs.

The limited size of the fires means that radiant heat to nearby target surfaces is insufficient to ignite them, and usually only enough to scorch or soften them, and that the air supply needed to sustain the fire is very modest. Radiant heat flux from fires involving the sustained combustion of a body has been measured in these tests to be less than 8 kW/m2. These observations mean that a sustained fire fueled by a body is capable of burning for extended periods of time without spreading to nearby fuels, unless those fuels are in direct contact with the small flames produced. Such fires can be maintained in ordinary rooms, even with doors and windows closed. The mass loss rate of such fires is very low, measured or estimated in these tests to be on the order of 0.7 to 3 g/sec (2.6-10.8 kg/hour). With extended burn times, this could result in significant consumption of the body mass. The small flames produced are capable of desiccation, charring, and calcination of exposed bone, with eventual collapse of exposed bony structures. Muscle and collagenic components will be charred and burned away if they are exposed to the direct flames.

The results of this research will aid both fire investigators and medico-legal professionals in the correct interpretation and reconstruction of fire death scenes involving fire damage to bodies.

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 ** Presenting Author*