B86 The Body as a Fuel Load in Fatal Fire Scenes

Elayne J. Pope, MA, University of Arkansas, 330 Old Main, Anthropology Department, Fayetteville, AR 72701; and Carl Chasteen, BS, and Ron J. McCardle, Bureau of Fire and Arson Investigations, Division of State Fire Marshal, Tallahassee, FL 32333*

After attending this presentation, attendees will understand that the body should be considered a fuel load that contributes to the burning process for structural and vehicular fires.

This presentation will impact the forensic community and/or humanity by improving fire death investigation by understanding how the body contributes to fire dynamics.

In a sense, every person brings something to his or her own death that affects the process of postmortem tissue break down, fire being no exception. Independent of the burning environment (car, structural, or other) the body consists of different combustible materials that burn at different times and rates. At the most basic level, heat penetrates through layers of skin and exposes layers of fat rendering into grease. Just as each fire scene is unique, burn patterns on the body also provide important information about the fire's progress and interaction with the victim. Inherent variables of individual fire scenes such as the spatial relationship to wicking materials; be it clothing, furniture, flooring, and other combustibles can affect how the body's fat contributes to the burning process.

Three human cadavers were burned in structural and vehicular fires to observe the body's contribution as a fuel load. Times and temperatures were correlated with the concurrent destruction of the body and surrounding materials. This study utilized instrumentation and software available from the Yokogawa Electric Corporation - Darwin DAQ 32 Plus collecting data from a DA100 unit remotely cabled to a DS400 unit equipped with the DV100-21 thermocouple relay. Type K thermocouples (from Omega Scientific) were connected between the DS400 and the points of temperature measurement. The unit and thermocouples were checked for continuity and reliability with the use of ambient temperatures and flame.

For this experiment, approximately 1000 mL aliquot of gasoline was poured across the chest area to initiate combustion. The gasoline provided the initial accelerant, but once consumed, heated body fat rendered into grease and acted as a fuel source and as an accelerant with burn rates close to results predicted by DeHaan and Nurbakhsh (2001). Following the first three minutes, the fire began to normalize and moderate to slower consumption of the cotton clothing progressively burning toward the cadaver's lower extremities. Heat turned deeper layers of the body's fat to grease and the cadaver was burning as a self- sustaining fuel source. The liquefied fat began to pool on the carpet beneath the cadaver and burned in a self-sustained combustion in a "wicking" fashion. For the entire four hours of observed burning, temperatures varied as the fire traveled from the upper body to the middle and lower with peaks between 500°C and 780°C (Figures 7-15).

In a fire, as one area of the body burns it heats the next, creating a new fuel source of liquefied fat. This grease can leach into absorbent clothing, carpeting, wood flooring, and charred muscle. For the human body, the wick effect occurs, but not directly burning on top of the body like a candle as the term implies, but instead occurs around and below the body wherever the grease pools. It should be noted that body fat needs to be absorbed or "wicked" into a natural, synthetic, cellulous, charred materials, or charred tissues to effectively burn in addition to heat and oxygen. The test was concluded after four hours of burning and could have continued longer as there were fires still burning in sections of the body. The cadaver, that had originally weighed 81.6 kg (180 lbs), had been reduced to 21.1 kg (46.5 lbs). This indicates a mass loss of 60.5 kg (133.5 lbs). The calculated mass loss rate was 15.3 kg/hr or 33.8 lbs/hr and is close to the expected rate discussed by DeHaan and Nurbakhsh (2001).

Two vehicles obtained by the Washington County Sheriff's Office were used to simulate car fires with a victim in the driver's seat. Unique environmental variables produce differential burning effects to the body. Car fires are fast, hot contained spaces capable of burning at temperatures of 1100-1600º Fahrenheit for 45 minutes to an hour. There was a concurrent process of destruction to the vehicle and fire, with the body contributing as a fuel load, increasing the burn time and destruction. The fire became fully involved before significant changes were visible to the body. Both body and vehicle were differentially destroyed by the fire's progress; but maintained their basic structural integrities for later forensic analysis.

Tissues experienced extensive destruction from heat convection and ample oxygenation as remains of the bulkier torso were suspended upon the wire support frame after all upholstery had burned away. The car fire naturally extinguished an hour after complete combustion of manufactured synthetic materials. Following this, tissues of the body continued to burn on their own for an additional hour and a half concentrated primarily around the torso and from liquefied body fats, creating the wick effect and producing additional sources of fuel.

Throughout these experiments, body fat melted and pooled around the body and became a fuel source for the fire, burning upwards and causing additional body fat to render into more grease. A person's weight and body-fat contributes to the burning process. DeHaan and Nurbakhsh (2001) investigated the effects of body fat during combustion experiments using pig models. While the anatomy may differ, the properties of fat melting into grease and burning as a fuel source remain valid.

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