Airbag Deployment: Infrared Thermography and Evaluation of Thermal Damage

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Abstract

The performance of airbag and its deployment are based on a fast exothermic-chemical reaction. The hot gas resulting from the chemical reaction which results in airbag deployment can cause thermal damage and skin burning for the car passenger. The thermal burns due to airbags are of two types: burn due to direct contact with the airbag surface; and burn resulting from exposure to the hot gas leaving the deflation vents of the airbag. In this research, for experimental study of the burn resulting from exposure of the skin to airbag, using infrared thermography, the extent of temperature rise of the airbag surface was detected and measured from the zero moment of its inflation. Next, using Henriques equation, the extent of thermal damage caused by airbag deployment and its resulting burn degree was calculated. The results indicated that during the inflation of airbag, the maximum temperature of its surface can be 92±2°C. Further, if the vehicle's safety system functions within the predicted time intervals, the risk of thermal damage is virtually zero. However, if even a slight delay occurs in detachment of the passenger's head and face off the airbag, second and third-degree burns could develop.

Keywords

Airbag Deployment, Hot Gas, Temperature Rise, Thermal Damage Function, Skin Burn

1. Introduction

Airbag is one of the vehicles' safety equipment which is deployed during accidents to prevent collision of passengers with the internal parts of the vehicle. Today, installing airbag along with seatbelts and pretensioner systems has become mandatory in most countries. According to reports, application of airbag along with seatbelt has led to 28% reduction in the fatalities resulting from accidents compared to accidents in which vehicles use seatbelts alone [1,2]. The mechanism of action of airbags involves a central control unit which controls the sensors in the vehicle. Among these sensors are accelerometer, impact sensor, side pressure sensor, wheel speed sensor, gyroscope, and brake pressure sensors [3]. When the values related to the sensors exceed the allowable limit, the central control unit rapidly blasts a gas generator in order to inflate a bag made of Poly Amide (PA) or Poly Ethylene Terephthalate (PET) with the produced gas. As soon as the passenger ~~collides~~ crashes into the airbag, the intensity of impact declines, and through the pressure exerted by the passenger's head and face to the airbag, the hot gas is discharged in a controlled way from the small vents devised in the rear of the airbag.

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