Basic Facts

Research on Chemical Exposure and Flammability Risks of Upholstered Furniture and Consumer Electronics

Introduction

Flame retardants and other chemicals have been used for decades in the production of commercial and residential upholstered furniture and consumer electronics as a method for achieving fire protection.

UL Chemical Safety and Emory University, Rollins School of Public Health, conducted a three-year study to develop scientific data on exposure risks of flame retardants and other chemicals, and fire safety hazards related to consumer use of upholstered furniture.

The study was designed to measure the flammability characteristics of upholstered chairs and electronics during open flame burns; measure toxic hazards emitted during the open flame burns; and measure chemical exposure levels during normal use of upholstered furniture and electronics.

Results of the study, "Human Health in the Built Environment: A Study of Chemical Exposure Risk and Flammability of Upholstered Furniture and Consumer Electronics," are now available on UL Chemical Safety's website.

Key Facts

• Flame retardants (FRs), typically used in the polyurethane foams of furniture and other materials of consumer products, are added for fire protection. However, exposure to certain FRs has prompted concerns of potential health impacts including cancer and developmental, reproductive, and neurological problems.

• Little scientific data exists on how FRs used in products are released into the consumer environment and present themselves for human exposure. However, there is scientific data showing that FRs are present in in the bodies of consumers, demonstrating that exposure does occur.

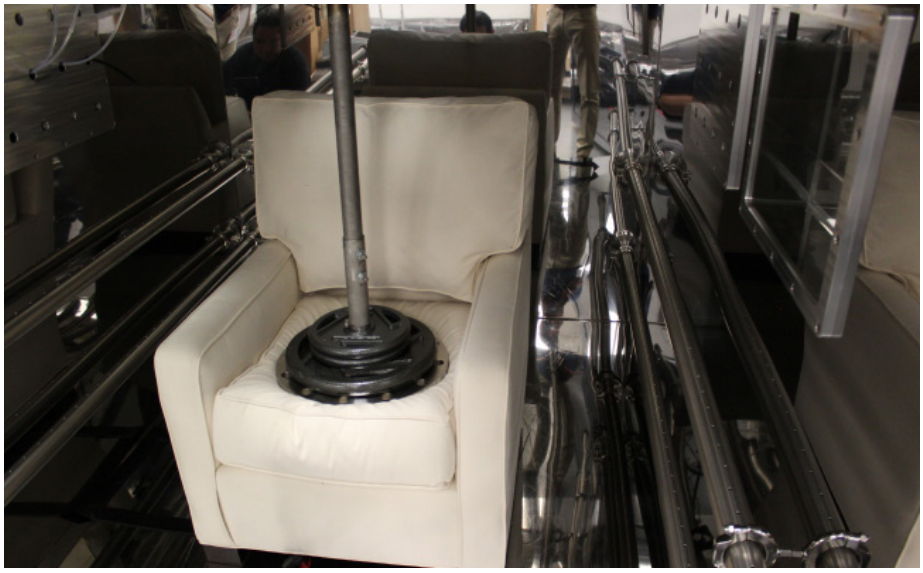
• Fire is a threat to humans since modern homes burn quickly and upholstered furniture is a fuel source to fire spread. This leads to the question of how to reduce fire risks without exposing consumers to hazardous flame retardants.

• Primary objectives of the UL Chemical Safety research were 1) to identify pathways for consumer exposure to FRs and other chemicals during the use of residential upholstered furniture; 2) to evaluate differing fire control strategies, with and without flame retardants, for their effectiveness in managing fire spread, while minimizing chemical exposure risks; and 3) to evaluate if chair age had an impact on chemical exposure and flammability.

• A commercially available upholstered chair was manufactured using four different flammability control technologies including: 1) no FRs added; 2) an organophosphate chemical FR added to the polyurethane foam; 3) a reactive chemical FR added to the polyurethane foam ; and 4) no FR added to the foam but a barrier material added between the foam and cover fabric. Two electronics, a television and laptop, obtained in the retail marketplace, were tested as comparisons to the furniture. A duplicate set of chairs was prepared for testing by mechanically aging to simulate a 10-year use age so that aged versus newly constructed chairs could be compared.

UL Chemical Safety, Underwriters Laboratories Inc.
2211 Newmarket Parkway, Suite 106, Marietta, Georgia 30067
W: ulchemicalsafety.org

An environmental chamber with an upholstered chair and an exposure agitation device.



• Methodologies were developed for measuring human exposure to FRs and volatile organic compounds (VOCs) by testing chairs in a controlled environmental chamber and simulating a person sitting in a test chair during testing. Inhalation, dermal, and ingestion routes of human exposure were monitored.

• Flammability performance of the upholstered chairs was evaluated using full-scale open flame burn tests measuring heat and smoke release rates, product weight loss, gas emissions, smoke yield, and chemical and dust emissions. Open flame testing performance was compared to CA TB 117-2013 smoldering results.

• FRs were detected in the air, settled dust, and dermal transfer samples from the chair with the added organophosphate FR, showing that inhalation, dermal, and ingestion were all potential exposure routes for humans. The most significant pathway measured was dermal exposure, but children's exposure was predicted to be the highest from ingestion due to frequent hand-to-mouth contact with settled dust.

• Operating electronics, for comparison, showed a range of halogenated and organophosphate FRs in air and settled dust but levels were low and could not be measured.

• Volatile organic compound (VOC) and aldehyde emissions were generally low during simulated consumer use for all chair types and would meet current indoor air guidelines. Emitting VOCs included chemicals such as formaldehyde, naphthalene, and toluene. The operating television showed higher levels of emitting VOCs including acrylates, phthalates, and siloxanes.

• There was no correlation between the CA TB 117-2013 (smoldering tests) and open flame test results for the chairs.

Due to the failure of some components of the chairs, none of the four types of chairs passed the TB 117-2013 acceptance criteria. In contrast, the chair with a barrier had a significant difference in the open flame performance than those chairs without a barrier. The use (or nonuse) of a flame retardant had little effect on the open flame test.

• During open flame testing, the chairs with a barrier material had a significantly lower peak release rate (31 kW average) in comparison to the maximum heat release rate of all the other chairs without a fire barrier (1400 kW average).

• No significant differences were found in the heat release rates of chairs made with and without FRs and no barriers. Each chair without barrier exceeded 1000 kW, which exceeded the 200 kW regulatory standard used for mattresses. Home electronics measured 10 kW or less.

• The use of a fire barrier reduced the average weight loss of the chair at 6 lb compared to the non- barrier chairs at 37 lb. The barrier also reduced heat generation and resulted in lower transmitted fire hazards such as temperature, smoke, and carbon monoxide.

• Chemical emissions during the product burn tests became much more complex than during consumer use for chairs, with over 500 individual VOC species detected in the burn emissions of the chairs. The organophosphate FR that was added to one chair type was measured at higher levels in the burn emissions than during normal consumer use. Benzene, a carcinogen, was detected at levels significantly higher than the allowable occupational exposure limit during chair burns.

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