

# Examining the Efficacy of Fire Retardant Sprays



Kathleen C. Brown<sup>1</sup>, Captain Steve Ellis<sup>2</sup>, Captain Jan Rader<sup>2</sup>  
<sup>1</sup> Marshall University Forensic Science Program,  
<sup>2</sup>Huntington Fire Department,  
 Huntington, WV 25701



## Abstract

Fire retardants are commonly used to treat household objects to prevent the start of fire. Little scientific research has been done to compare fire retardant sprays. This project examined the efficacy of three fire retardant sprays, No-Burn, Fire'z Off, and a homemade spray. After treatment, the fabric samples were burned before and after machine washing with soap, fabric softener and bleach. All three sprays were found to be successful in preventing ignition when unwashed. However, machine washing the treated fabrics greatly lessened the fire retardants' ability to prevent the spread of fire. According to these results, flame retardant sprays are only effective in the preventing the start and spread of fires before the treated fabrics are washed.

## Materials and Methods

- 100% Cotton fabric in 5" x 5" squares
- Three fire retardant sprays
- Fabric was sprayed according to the manufacturer's protocol
- Samples were separated into groups and laundered following different procedures
- Samples were burned in accordance with ASTM D6413
- Burn rates and temperatures were recorded and analyzed

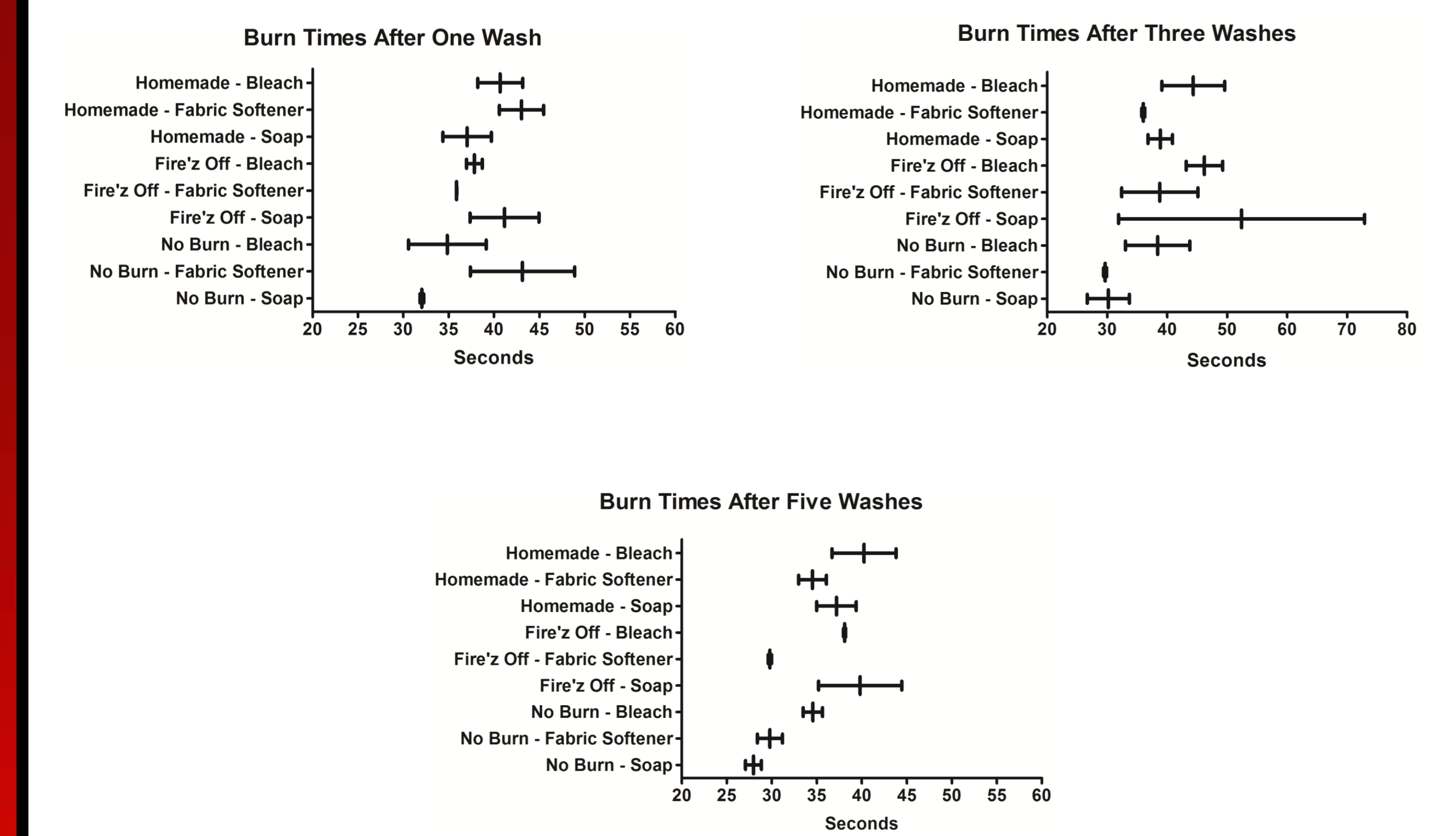
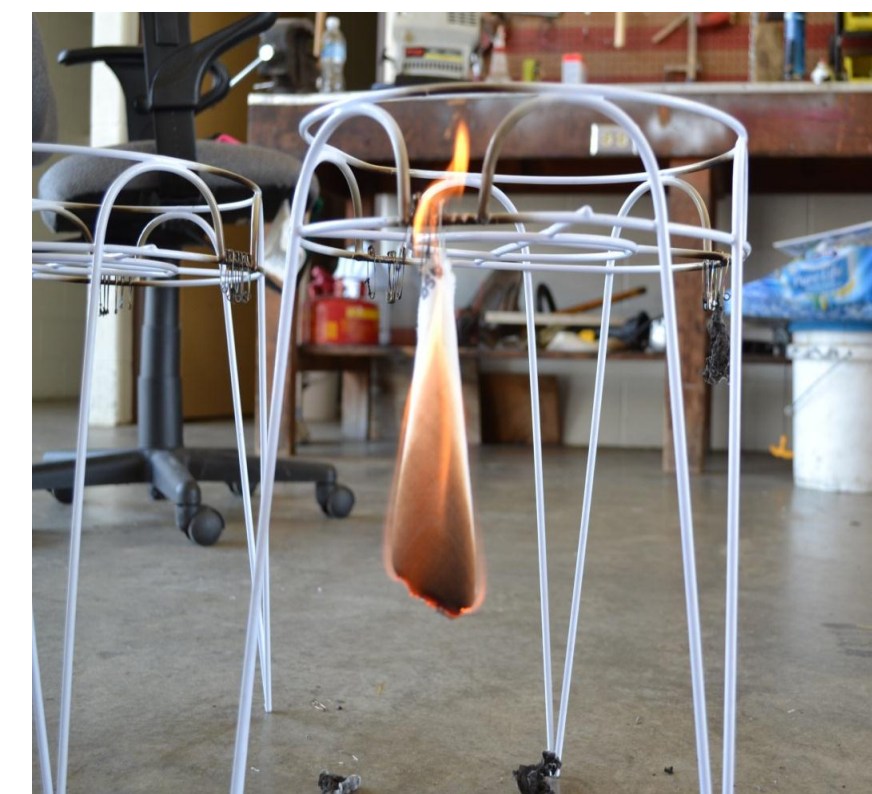


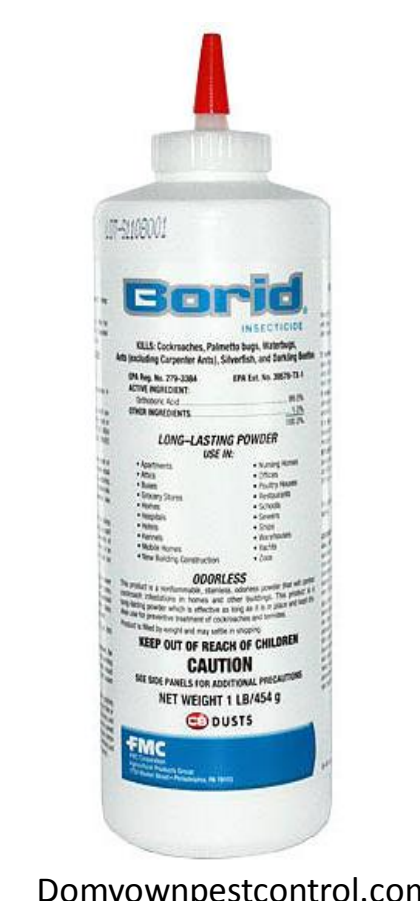
Figure 3: Comparison of the fire retardant sprays showed that the number of washes had little to no effect on burn time.

## Introduction

The National Fire Prevention Association (NFPA) governs the standards that regulate which fabrics are suitable for items such as mattresses, carpets, and rugs. However, there is no national regulation of items such as bedding, draperies, and upholstery [1]. This lack of regulation, in part, has contributed to the formulation and marketing of many commercial spray-on fire retardants. Yet, some studies have concluded that fire retardants may in fact make fabrics burn more vigorously [2]. This study sought to examine the effectiveness of three fire retardant sprays.

## Fire Retardant Sprays

The homemade spray used in this experiment consisted of two boron compounds, boric acid ( $H_2BO_3$ ) and sodium borate (Borax,  $Na_2B_4O_7 \cdot 10H_2O$ ). Boric acid tends to suppress smoldering while Borax reduces flame spread, producing a synergistic effect [3].



Fire'z Off (RDR Technologies, Oklahoma City, OK) is a plant-based "green" fire retardant with no volatile organic compounds or brominated ethers. Fire'z Off works to create a thermal insulation barrier to prevent both the spread of flames and smoke [4].



No-Burn Fabric Fire Gard (No-Burn, Inc., Wadsworth, OH) is a traditional, water-based fire retardant spray composed of alkaline salts. Both Fire'z Off and No-Burn Fabric Fire Gard have been externally tested and classified as Class A fire retardants [4, 5].



## Other Factors

Research shows that even the most effective fire-retardant fabrics can be adversely affected by laundering with additives such as liquid fabric softener and bleach. Both fabric softener and bleach are flammable on their own, and after repeated washings, they tend to accumulate on the fabric and increase its flammability. This accumulation can adversely affect many flame retardant fabrics [6].

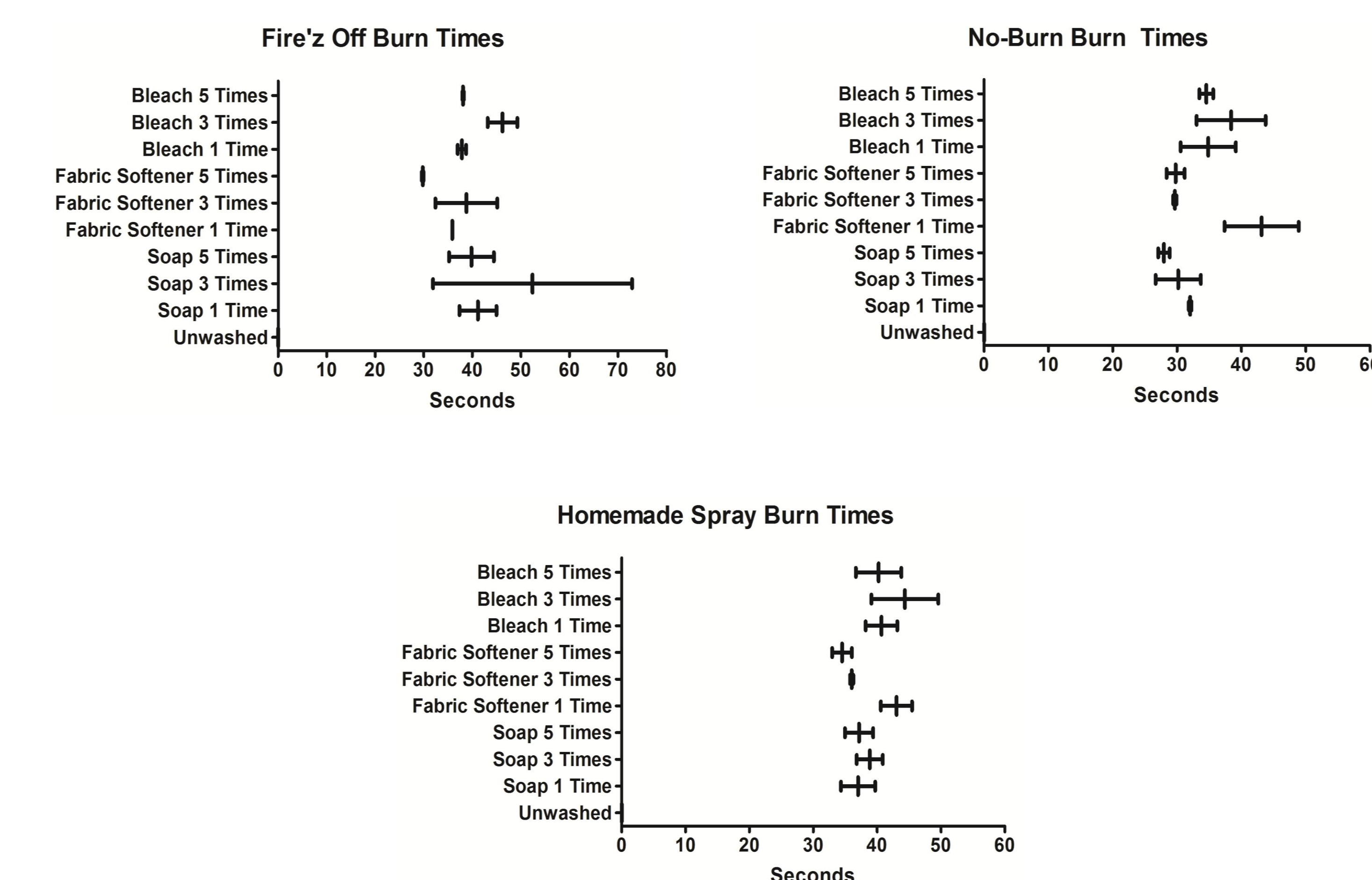


Figure 1: Independent examination of the sprays shows that washing the fabrics after the application of the sprays increased the burn times. Washing conditions, however, had little to no effect in the overall burn times of the fabric.

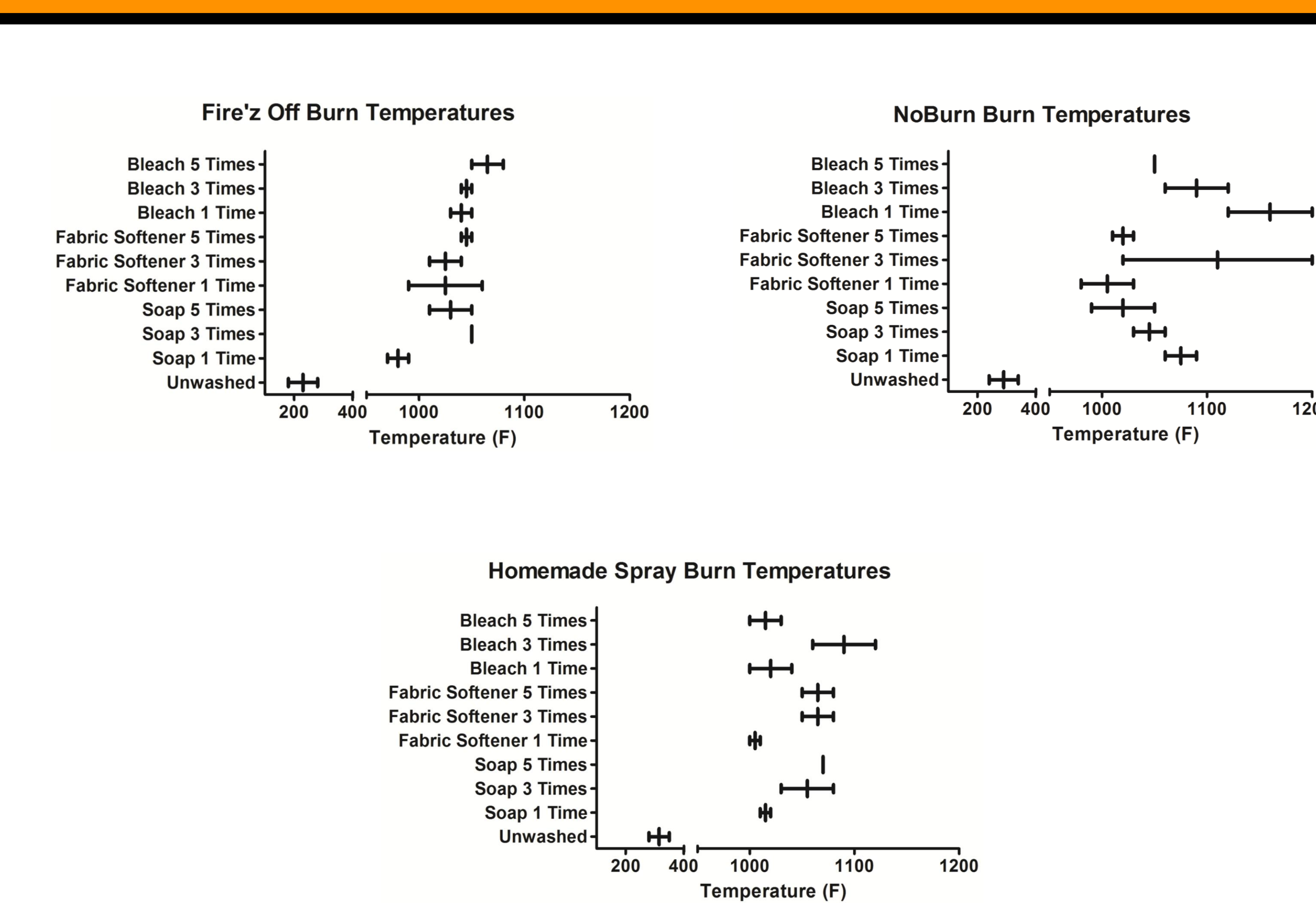


Figure 2: Independent examination of the sprays shows that washing the fabrics after the application of the sprays increased the burn temperatures. Washing conditions, however, had little to no effect in the overall burn temperatures of the fabric.

## Results & Conclusion

Each of the fire retardant sprays tested in this project worked to prevent the spread of fire after application to 100% cotton. However, laundering the fabrics negated any previous flame retardant properties. Yet, no differences in burn time or temperature were observed in fabrics washed with soap alone, soap and fabric softener, or soap and bleach. For the purposes of treated fabric that would be laundered repeatedly, the three fire retardant sprays are not feasible options for safety. Future studies should provide even more wash cycles to test how prolonged build-up of fabric softener and bleach may actually make the fabric more flammable. Similarly, the reapplication of fire retardant sprays to laundered fabrics should be tested. Other fire retardant sprays should be examined and fabrics of differing thickness and composition, such as flame retardant sleepwear for children, should also be tested for a more thorough overview.

## Acknowledgements

The author would like to acknowledge Dr. Graham Rankin for being topic advisor. Thanks to Carl DeMuth, Molly Corvo, and Jamie Lau for their assistance. Special thanks to the firefighters of the Huntington Fire Department, especially Chief Randy Ellis, Deputy Chief Ralph Rider, Lieutenant Charley Shumaker and Engineer Shane Masters, for their contributions.

## References

- 1) Stone J, Kadolph S. Facts about flammability. 2003.
- 2) Chow WK, Han SS. A study on heat release rates of furniture under well-developed fire. *Experimental Heat Transfer*. 2006;19(3):209-226.
- 3) LeVan SL, Tran HC. The role of boron in flame-retardant treatments. *International Conference on Wood Protection with Diffusible Preservatives*. 1990.
- 4) Fire'z Off Information and MSDS Sheet. <http://www.firezoff.com/> (Accessed May 9, 2011).
- 5) No-Burn Fabric Fire Gard Information and MSDS Sheet. <http://noburn.com/products/no-burn-fabric-fire-gard> (Accessed May 9, 2011).
- 6) Van Esch GJ, Flame retardants: a general introduction. *World Health Institute*. 1997.