

Clothing on Fire: Health Risk Assessment

Nikki Falcon

School of Public and Population Health, Boise State University



Background

Clothing fires are a significant public health challenge globally. Thousands of deaths and injuries occur each year from the ignition of flames in clothing. Approximately two million persons suffer burn injuries each year and over 100,000 require hospitalization. Young children and older persons are at greatest risk. Healthcare providers are frequently asked to provide recommendations for reducing such risks. However, information about the flammability properties of commonly used fabrics is generally not available. The objective of this study was to develop a simplified method for quantifying and ranking the flammability characteristics of various fabrics.

Methods

Fabric Samples:

A total of fifty fabric samples were tested in this study

- Ten 100% Silk samples
- Ten 100% Polyester samples
- Ten 100% Nylon samples
- Ten 100% Cotton samples
- Ten 100% Wool samples.

Each sample was 20cm in length and 5cm in width

Equipment Used:

- Laboratory fume-hood
- Mettler balance
- I-phone Stopwatch

Measurements Steps:

1. Weight of each fabric sample was determined
2. Each sample was exposed to a standard flame
3. Each burn cycle was timed
4. Weight of each sample (including ashes) was determined again
5. Fabric weight loss due to combustion was calculated

Experiments



Figure 1. Illustration of the fabric materials evaluated in the study. Each sample was 20cm long and 5cm wide.



Figure 2. Illustration of a fabric sample burning inside the fume hood and the combustion time being recorded.

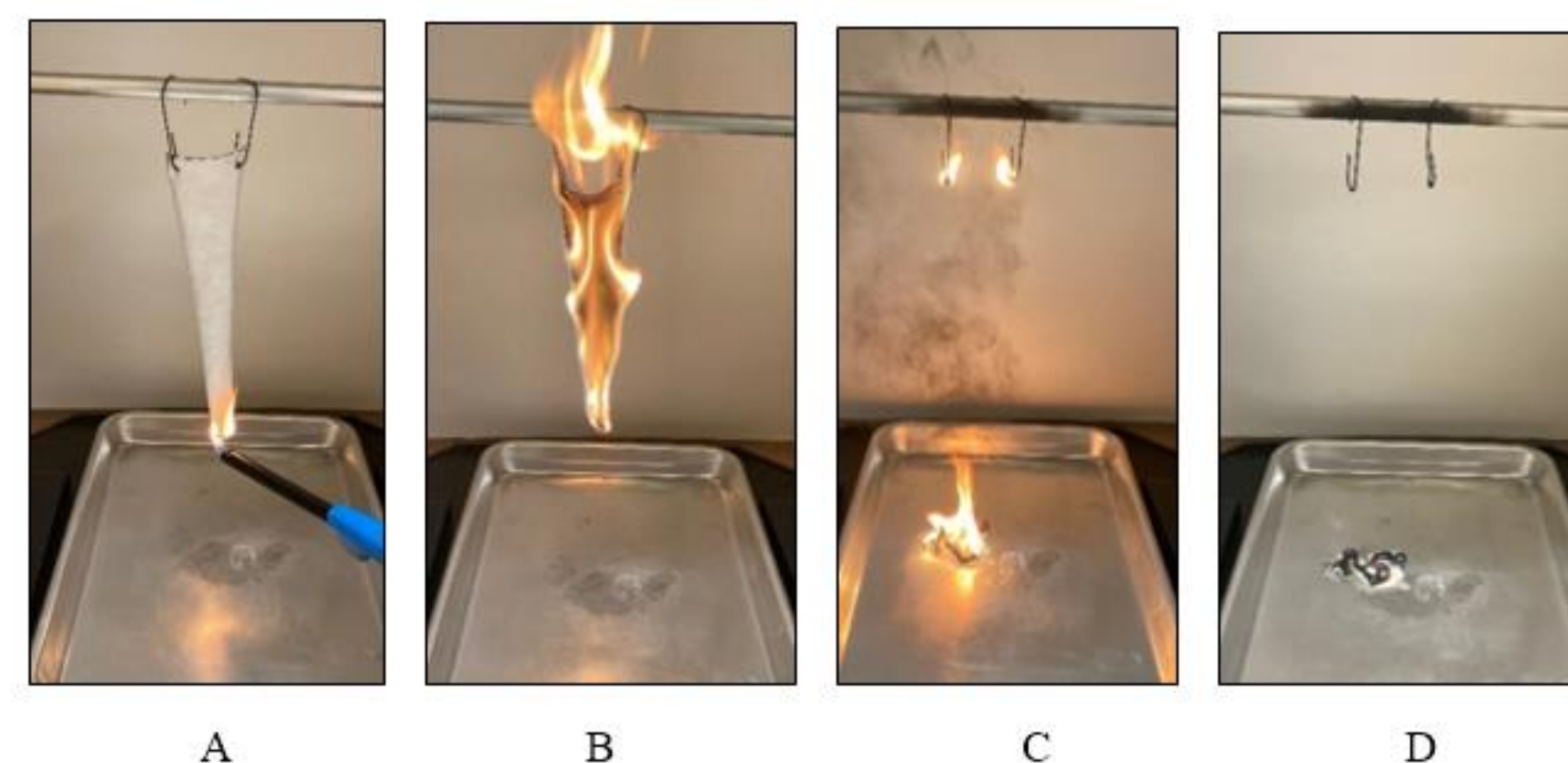


Figure 3. Illustration of a typical fabric fire combustion cycle including the initiation phase (A), the propagation phase (B) the termination phase (C) and the smoldering phase (D).

Results

Table 1.

Summary of fabric sample weight changes, burn times, material consumption and combustion rates.

Fabric Sample	Initial Fabric Weight (g)	Burn Time (sec)	Fabric Material Consumed (%)	Combustion-Rate % /sec
Silk	0.7885g	14 sec	40.6 %	2.8 %/sec
Cotton	0.7138g	44 sec	98.7 %	2.2 %/sec
Wool	1.3120g	78 sec	97.3 %	1.2 %/sec
Polyester	1.8933g	6 sec	4.5 %	0.8 %/sec
Nylon	1.2842g	33 sec	18.9 %	0.6 %/sec

Table 2.

Summary of fabric flammability risk categories based on flame exposure intensity and burn times.

	Low Risk	Medium Risk	High Risk
Exposure Time	○ Polyester ○ Silk	○ Cotton ○ Nylon	○ Wool
Heat Intensity	○ Polyester ○ Nylon	○ Wool	○ Silk ○ Cotton

Conclusions

- Polyester fabric exhibited the lowest risk of burn injury
- Wool and Cotton fabrics exhibited the highest risk of burn injury
- The assessment method was simple and repeatable

Limitations

- Fabric samples were obtained from used clothing only
- Fabrics were 100% of the same material. However, most clothing consist of combinations of various blended fiber types, both natural and synthetic fibers.

Faculty Advisor:

- Uwe Reischl, PhD, MD
Professor, SPPH