實驗報告
燃燒試驗法

實驗日期：_____

學生姓名：_____

班別：_____

評分：_____

實驗目的

測試加熱對不同的紡織纖維/布料的影響。

簡介

燃燒纖維或布料樣本是用來辨別纖維的種類的方法之一。根據布料的「熱塑性」或「非熱塑性」性質，把纖維和布料進行分類。熱塑性指纖維遇熱會融化或變軟。'

物料及儀器

（一）物料

6 個樣本，每個樣本由 6 條紗線組成（長 10 厘米）

（二）儀器

酒精燈, 鐵夾，防火實驗枱墊，放大鏡

步驟

1. 將樣本捻成鬆散束狀。
2. 慢慢逐漸移近酒精燈的小火焰。
3. 觀察纖維束靠近火焰時有無收縮和融化現象。
4. 再移入火焰中觀察纖維束的燃燒現象如燃燒的難易，火焰的大小及顏色，煙霧濃度以及燃燒時產生的氣味等。
5. 最後離開火焰觀察樣本是否繼續燃燒以及燃燒後殘留物的特徵。

注意事項

1. 應在空氣流通的地方進行試驗。
2. 進行實驗的範圍要保持整潔。
3. 纖維要不含油脂或塵粒。
4. 試驗後把酒精燈妥善存放。

結果

纖維名稱	靠近火焰時	接觸火焰時	離開火焰	燃燒時的氣味	殘留物特徵
羊毛	沒有融化或收縮	燃燒速度緩慢，纖維縮細	自行熄滅	燒頭髮的氣味	易於壓碎的黑色灰燼
棉	沒有融化或收縮	燃燒速度快	有殘光，燃燒至化為灰燼	燃燒紙張的氣味	灰色的灰燼
聚丙烯腈纖維 / 亞古力	融化及收縮	燃燒及融化，有黑煙	繼續燃燒及融化	燒焦肉的氣味	留下無法弄碎、堅硬的黑色小珠
醋酸纖維	融化及收縮	燃燒及融化，火焰穩定呈黃	繼續燃燒及融化	帶酸的氣味	留下易碎、形狀不規則黑色球體
聚酯	融化及收縮	燃燒及融化	難以燃燒，會自行熄滅	微甜的氣味	留下易於壓碎、形狀不規則的黑色小球體
尼龍	融化及收縮	慢慢燃燒	火焰減弱，會慢慢熄滅	「西芹」的氣味	留下堅硬的淡黃褐色圓球

討論

不同的纖維對熱的反應都不同。大多數合成纖維是熱塑性，天然纖維則是非熱塑性。纖維素的物料最易燃，火焰熄滅後會發出紅光。發出紅光是非常危險的，代表火焰熄滅後，物料仍然會繼續燃燒。動物毛髮如絲綢和羊毛是防燃物料，火焰熄滅後會停止燃燒。合成纖維布料會在短時間內停止燃燒，布料會融化和掉落。因此，合成纖維和動物毛髮一樣具有阻燃性。

除物料外，布料結構也會影響易燃性。表面平順的布料的燃燒速度較表面凸起的布料慢，因為凸起的表面積存的空氣較多，而且突出部分一般較為易燃。因此，結構鬆散的布料會較結構緊密的布料更易燃燒。

對於決定製成品的最終用途，易燃性這個特點是很重要的。熱定型會永久改變由熱塑性纖維所製成布料的形狀，並改善其尺寸穩定性，可用來在熱塑性布料上製造永久性的褶皺和折痕。另外，經熱定型的纖維、紗線和布料在低溫下表現穩定，但在高溫下可能受損。棉花和羊毛是非熱塑性的，但暴露於過熱的環境下，棉花也可能燒焦，而羊毛則會變脆。

這個測試的結果準確性受樣本的紗線數量及成分和個人主觀性等因素影響。使用多於一種纖維成分的紗線，結果可能有偏差。所以，應使用單一纖維樣本進行測試或將樣本的不同纖維分開再作實驗。為了能更準確地，可做進一步測試確定纖維種類。例如顯微鏡測試。

結論

纖維或布料的易燃性對決定一件製成品的適用性是非常重要的，而纖維的性質和布料的織造方法、重量及加工潤飾，均會影響易燃性。纖維素纖維及布料，如棉及麻都是非常易燃的物料。再生纖維雖然是易燃的物料，但燃燒速度及時間較纖維素慢及長。動物性和合成纖維及布料是非易燃物料更可防燃。因此，製造不易燃或阻然的紡織品時不應選擇纖維素布料，應選用羊毛、絲或合成纖維。但是，纖維素布料的舒適度較合成纖維高。為了保持纖維素的舒適度又可以減低纖維素的燃燒性，可在布料上加上防燃的加工潤飾。

參考資料

《Textiles Technology to GCSE》，J Down，牛津大學出版社(Oxford University Press), New York，1999 年,，第 129 頁。

香港棉紡業同業公會《紡織手冊 2007》（第二版），香港棉紡業同業公會，香港，2008 年

V. Elsasser，《Textiles: Concepts and Principles》（第一版），Delmar Publishers, New York， 1997 年

Laboratory Report
Burning Test

Date:： _____

Name： _____

Class： _____

Marks： _____

Objectives

To examine the effect of heat on different fibres or fabrics.

Introduction

The burning of fibre or fabric samples can be used to identify the type of fibre, either 'thermoplastic' or 'non-thermoplastic' properties. Thermoplastic means fibres melt or soften when exposed to heat.

Materials and Apparatus

(a) Materials: 6 samples (6 pieces of yarn each and 10 cm long)
(b) Apparatus: alcohol lamp, tongs, heatproof mat, magnifier

Procedures

1. Unwind the sample a little bit.
2. Bring the sample to the flame slowly.
3. Observe any shrinkage or melting.
4. Move the sample over the flame; observe the flammability of the fibre, the size and the colour of the flame, density of smoke and smell.
5. Remove the sample from flame, see whether the sample keeps on burning or not and observe the characteristics of residue.

Precaution

5. The test should be conducted in a well-ventilated area.
6. Keep the area for testing clean and tidy.
7. Samples should be free from grease or dust before conducting the test
8. Store the alcohol lamp properly after use.

Results

Name of fibre	Close to flame	Over the flame	Away from the flame	Smell	Residue
Wool	Does not melt or shrink	Burns slowly with some shrivelling	Stops burning	Smell of burning hair	Leaving a black crushable ash
Cotton	Does not melt or shrink	Burns rapidly	Afterglow, burns to completion	Smell of burnt paper	Fine grey ash
Acrylic	Melts and shrinks	Burns and melts with a sotty flame	Continues to burn and melt	Smell of burning meat	Hard and unbreakable black residue
Acetate	Melts and shrinks	Burns and melts in a flame yellow flame	Continues to burn and melt	With an acidic smell	Leaving an irregular hard brittle black bead
Polyester	Melts and shrinks	Burns and melts	Difficult to burn, may self-extinguish	With a sweetish smell	Leaving an hard black bead
Nylon	Melts and shrinks	Burns slowly	Flame diminishes and tends to die out	With a ‘celery’ smell	Leaving a round fawn-coloured bead

Discussion

Fibres react differently to heat. Most synthetic fibres are thermoplastic. Natural fibres are non-thermoplastic. Cellulose materials burn rapidly and they have afterglow. Afterglow is dangerous as the materials will continue to burn after the flame is gone. Animal hairs, such as silk and wool are flame resistant materials as burning will stop after the flame is gone. Synthetic fibres will stop burning within a short period of time as they melt and drip. Therefore, they are also flame resistant which is similar to animal hairs.

Besides material, fabric construction will also affect flammability. Plain surface fabrics burn slower than raised surface fabrics. The raised surface traps more air and the protruded parts are more flammable. Similarly, fabrics which are constructed loosely may burn more easily than fabrics which are constructed tightly.

Flammability is an important factor in determining the suitability of finished products. Heat setting

will permanently change the shape and improve the dimensional stability of fabrics made from thermoplastic fibres. This can be used to create permanent pleats and creases on thermoplastic fabrics. Besides, heat-set fibres, yarns and fabrics are stable at low temperature and may be damaged by high temperature. Cotton and wool are non-thermoplastic but they can be damaged by exposure to excessive heat. Cotton may start to burn and wool will become brittle.

The accuracy of the results of this test may be affected by the number and fibre composition of the yarn and personal subjectivity. The result will be deviated if yarn made of more than one type of fibre is used. Therefore, yarn with only one type of fibre should be used or to separate the yarn into different fibres for different testing.

Conclusion

Flammability of fibres and fabrics is very important for deciding the suitability of a finished product. The properties of fibres, method of fabric construction, thickness of farbics and fabric finishing can affect the flammability of a finished product. Plant fibres such as cotton and linen are very flammable. Regenerated fibres are also flammable but the burning speed is slower and more time is needed than plant fibres. Animal and synthetic fibres are non-flammable and flameproof. Therefore, when making non-flammable or flameproof textile products, wool, silk and synthetic fibres should be used rather than plan fibres and regenerated fibres. On the other hand, plant fibres have a better comfortability than synthetic fibres. In order to retain the comfortability and reduce the flammability of plant fibres, flameproof fabric finishing could be used.

Reference

《Textiles Technology to GCSE》, J Down, 牛津大學出版社(Oxford University Press), New York, 1999 年,, 第 129 頁。

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