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Ultraviolet Radiation Penetration Through Clothing

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Ultraviolet Radiation Penetration Through Clothing

Abstract

Occupational exposures to solar ultraviolet (UV-AB) radiation can result in significant health risks including accelerated skin aging, sun burn and skin cancer. Personal protective clothing has been shown to provide useful barriers against such radiation exposures. However, the protection offered by clothing can vary significantly depending on layering, stretch, composition, color, and moisture content. Controlled laboratory tests were performed to determine the penetration characteristics of UV-AB radiation through selected textile materials including natural fibers as well as synthetic fibers. Effects of layering, stretch, color, and moisture content were assessed for an irradiance level (UV-AB) of 11.5 watts/m^2 . The results showed that layering decreased the UV radiation penetration exponentially for all fabric samples tested. The results also revealed that sample stretching increased UV radiation penetration by 4%, while white colored samples exhibited up to 5% higher penetration than the dark colored fabric samples. Adding moisture to the fabric samples also increased the penetration by an additional 2%. Considering this combination of factors, it becomes clear that protection offered by fabrics will vary greatly from one scenario to another depending on the combination of layering, stretch, color, and moisture content experienced. Therefore, current recommended ultraviolet radiation exposure limits should be adjusted to accommodate this knowledge.

Keywords

Exposure, ultraviolet radiation, protective eyewear and clothing

Disciplines

Environmental Public Health

Ultraviolet Radiation Penetration Through Clothing

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Introduction

- Exposure to ultraviolet radiation can result in significant health risks
- The primary organs affected are the eyes and the skin
- Eyes: Inflammation of the cornea and conjunctiva
- Skin: Erythema, sunburn, accelerated aging and cancer
- Protective eyewear and clothing can reduce injuries
- Effectiveness of clothing in reducing ultraviolet exposure was investigated

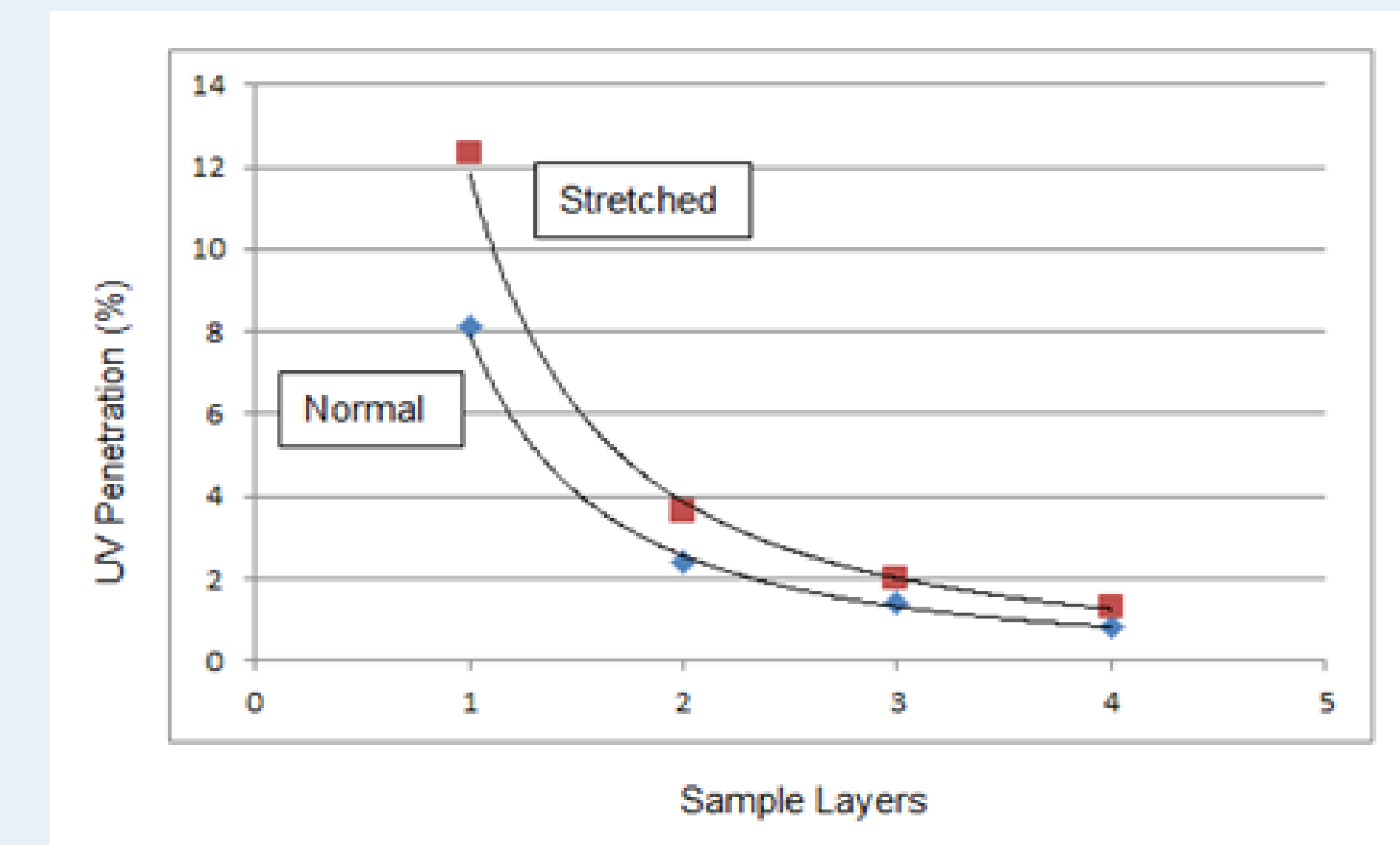
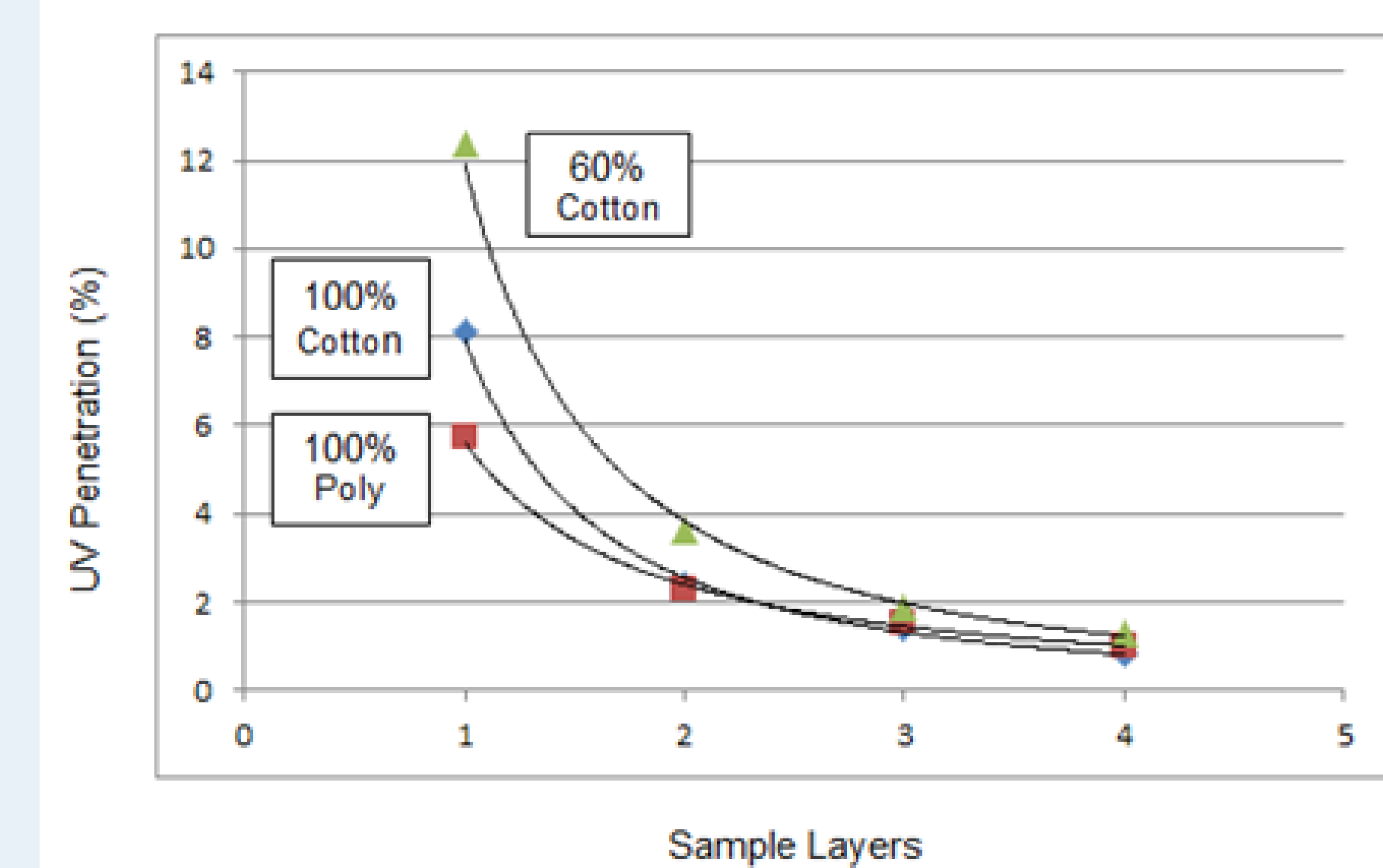
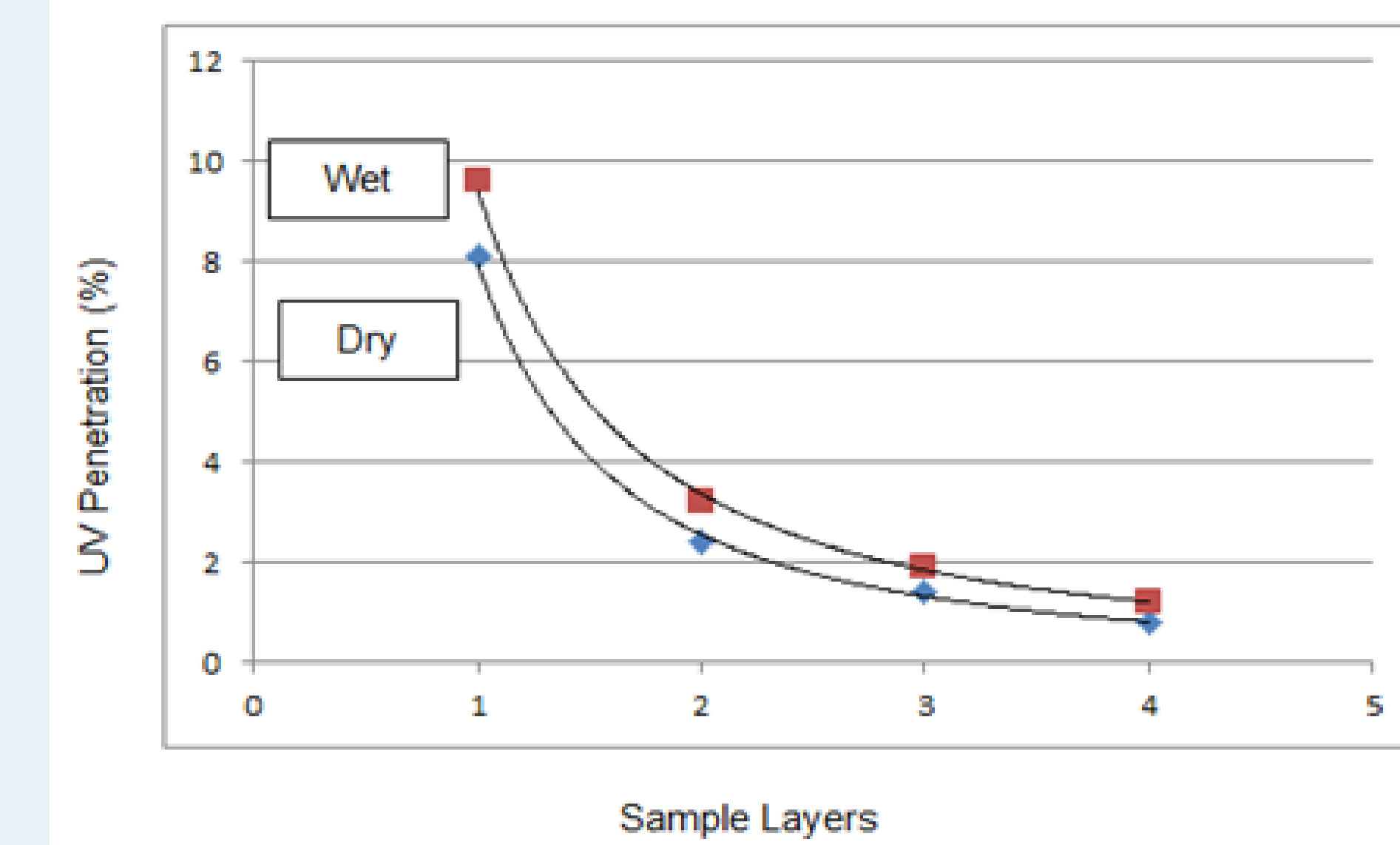
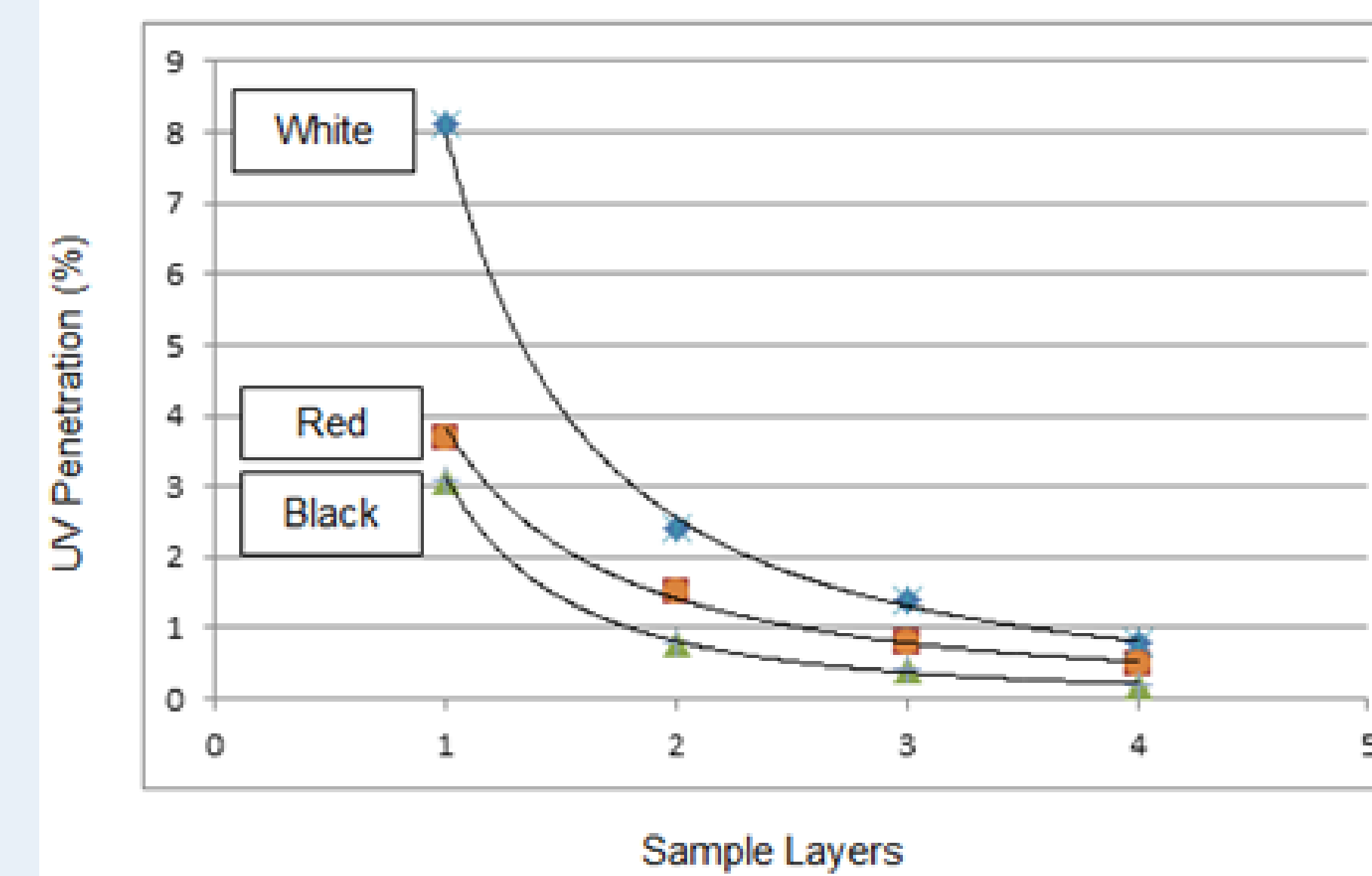
Background

- Workers exposed to intense outdoor sunlight conditions are at increased risk of UV related injuries
- Safety criteria have been established by the American Conference of Industrial Hygienists (ACGIH)
- To determine the protective clothing required, knowledge about UV penetration characteristics is needed
- Laboratory experiments were conducted to determine these characteristics

Methods

- Controlled laboratory experiments were performed to assess UV penetration through selected fabric materials
- 15cm² samples were exposed to 11.5 Watts/m² radiation intensity level
- Each sample was measured three times and the average calculated
- Samples were measured for dry, wet, and stretched conditions
- The equipment used for conducting the tests is illustrated in Figure 1

Analysis

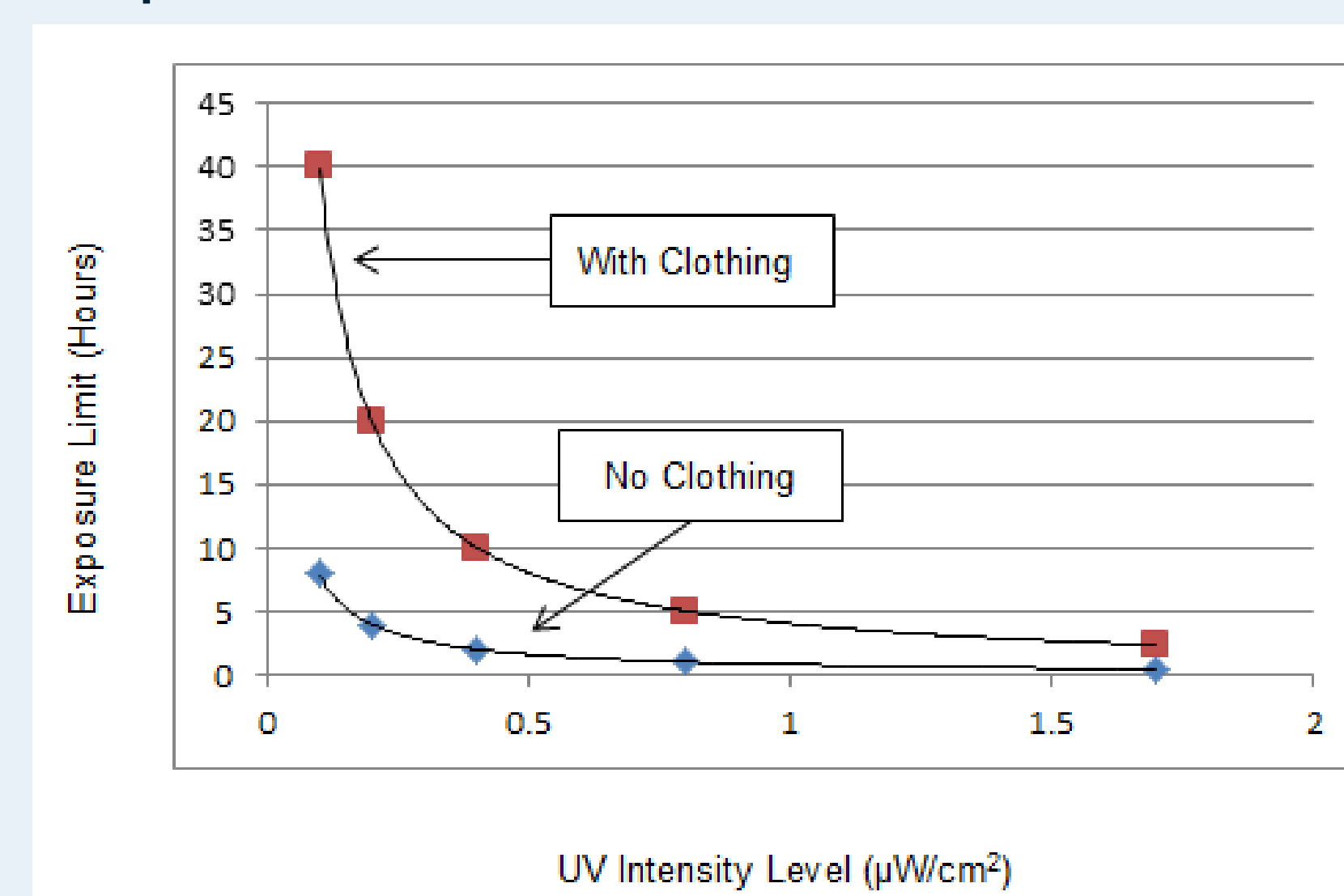


Results

Garment Sample	Ultraviolet Radiation Penetration (%) (Single layer)
100% Cotton	
○ White	8.1
○ Red	3.7
○ Black	3.1
100% Cotton	
○ Dry	8.1
○ Wet	9.6
100% Cotton	
○ Normal	8.1
○ Stretched	12.3
Cotton	
○ 100%	8.1
○ 60% / Polyester	12.4
Polyester	
○ 100%	5.7
○ 40% / Cotton	12.4
Human Hair	
○ Dry	4.9
○ Wet	4.8

Conclusions

- All fabric samples tested exhibited good UV penetration protection
- Light colored fabrics exhibited lower UV protection than dark fabrics
- Synthetic fabrics provided more protection than natural textiles



Equipment

Figure 1. UV Measurement Equipment

