EFFECT OF UV WEATHERING ON THE COMFORT AND PHYSICAL PROPERTIES OF ABAYA CLOTHING

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Abstract: *Ultraviolet rays from the sun are the major reason to cause physical damage to the clothing in warm countries. The typical clothing "Abaya" worn in Arab countries are affected by this strong UV rays. In this research the properties like comfort, air permeability and drape property will be examined for the clothing before and after artificial weathering. Special accelerated artificial weathering machine form company "Atlas" will be used and the samples will be tested under repeated cycles of UV light. This accelerated weathering will give us a real condition of clothing after years of wearing under sun. The thermo-physiological properties of the fabric are analysed before and after weathering. The results show significant decrease in drape, air permeability and water vapour permeability, whereas a minor change is observed for the thermal resistance.*

Keywords: *Clothing, comfort, UV, comfort.*

1 INTRODUCTION

Climate has adverse effect on the material properties, which leads to product failure. The major reason of product failure is UV degradation of the material. In most cases the functionality and the durability of the product is significantly decreases due to natural weathering. Most of the product made from synthetic polymers possesses great functional properties but the effect of natural weathering is usually unavoidable [1-4]. In this research typical Middle East clothing for women (Abaya) is selected. The photo of standard Abaya is shown in Figure 1.

Figure 1 Standard Middle Eastern woven ABAYA

1.1 Factors that affect weathering of material

Many factors influence the functionality of material under different climatic condition, in general its usually solar radiation, temperature and moisture. But some other factor like pollution makes it more worst. The list of factors effecting weathering can be described as [4-6]:

- water
- pollution
- temperature
- sunlight
- physical interaction
- air impurities

The sun is the source of the radiation energy naturally. The energy can be described by following equation:

$$E = h.C/\lambda \quad (1)$$

where h is Planck constant, C is velocity of light in vacuum and λ is wavelength.

1.2 Ultraviolet light wavelength

The UV spectrum of solar light consists of 3 regions [5-8]:

UVA: The wavelength is between 315 to 400 nm and it is source of polymer damage

UVB: The wavelength is between 280-315 nm, it causes severe polymeric damage

UVC: the wavelength is between 100-280 nm, it is filtered out by the atmosphere.

1.3 The effect of UV on materials

Photo degradation is closely connected with the UV light, the absorbed UV energy higher than the bond energy of the polymer causes the breakage of the bonds and impact significantly on the overall life time of the materials [9-11].

The textile garments are made from multiple thin layers of polymers, stitched together with polymeric threads. The overall life time, durability and comfort of the garment is highly affected by the climate. This naturally weathering reduces the overall look, comfort properties and the durability of the garment [12-16].

1.4 Types of weathering [17]

There are 2 major kinds of weathering:

1) Natural weathering

The natural weathering is performed naturally available condition around the word. Usually tropic regions are used for high humidity condition, Deserts for extreme UV radiation condition and European regions for cold and UV conditions. The temperature and humidity depends on the region used for testing. The sample is placed at a 15° angle for maximum sunlight facing.

2) Artificial lab weathering

Besides natural weathering, several test methods have been developed using artificial light sources to provide accelerated test procedures. All methods are based on the regular observation of characteristics reflecting an ageing process such as mechanical properties or visible characteristics. The artificial weathering is done either on natural weathering stations or artificial accelerated weathering chambers.

Because there is a need for more rapid evaluations of the resistance of materials to weathering than can be obtained by outdoor exposure tests, devices with artificial light sources are generally used to accelerate the degradation. These sources include filtered long arc xenon, fluorescent, metal halide lamps and carbon arc. Less commonly used light sources include mercury vapor and tungsten lamps. These laboratory accelerated weathering tests are sometimes and perhaps more appropriately, referred to as artificial weathering [16-17].

2 OBJECTIVES OF THE RESEARCH

The main objectives of the research were to analyze the following comfort properties of clothing before and after artificial weathering. The tested properties include:

- Drape test
- Air permeability
- Water vapor resistance
- Thermal resistance

3 METHODOLOGY

Six different Abaya clothes (3 woven and 3 knitted) were tested before and after artificial UV weather for air permeability water vapor resistance, drape percentage and thermal resistance by testing machine. For the weathering of samples we used the Atlas UV weathering machine, 15 hours of the Atlas UV weathering machine is equal to 1 month of outside UV weathering and to get 1 year weathered sample we put our samples for 7 days in to the machine by ATLAS UV2000 (ISO 11507).

Air permeability was measured by device FX3300 using standard ISO 923 and the water vapor resistance was measured using the Atlas Sweating Guarded Hot Plate using standard ISO11092.

The details of woven samples are given in Table 1 and the details of knitted samples are given in Table 2.

Table 1 Abaya woven fabric composition

Fabric	**1**	**2**	**3**
Composition	**100% PES**	**100% PES**	**60/40% PES/CO**
Weave design	twill	satin	plain
Thickness [mm]	0.58	0.15	0.5
Fabric mass [g/m^2]	205	80	140
Warp yarn count [tex]	15	5	10
Weft yarn count [tex]	14	5	18
Ends/cm	60	100	60
Picks/cm	40	40	54

Table 2 Abaya knitted fabric composition

Fabric	**1**	**2**	**3**
Composition	**100% Nylon**	**50/50% Wool/Nylon**	**100% Wool**
Knit design	interlock	single jersey	single jersey
Thickness [mm]	1.1	0.72	0.5
Fabric mass [g/m^2]	320	120	154
Yarn count [tex]	19	17	18

4 RESULTS AND DISSCUSION

The samples were tested before and after artificial UV weather for air permeability water vapor resistance, drape percentage and thermal resistance by standard test procedures.

4.1 Drape test results

Drape test is performed on all samples (before and after UV) using standard BS EN 9073.

It is observed as shown in Figures 2 and 3, that UV weathering has significant loss of drape ability of woven as well as the knitted fabric. The effect can be because of the adverse effect of the UV on the surface of the man-made fibers. Finally causes the stiffness of the material.

Drape is important property while choosing Abaya. As comparison to both the graphs it can be stated that the effect is more for the knitted fabric as compared to the woven. It might be due to fact that the woven fabrics are already tightly packed as compared to knitted fabrics.

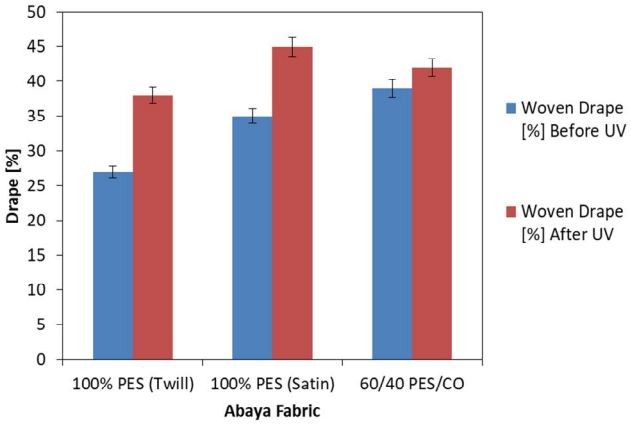

Figure 2 Effect of UV on drape of woven ABAYA

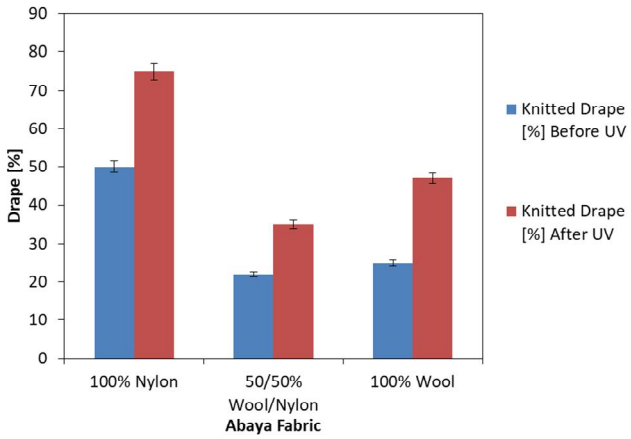

Figure 3 Effect of UV on drape of knitted ABAYA

4.2 Air permeability

Air permeability is very important factor for the Abaya clothing, It is seen form Figures 4 and 5, that the air permeability of both knitted and woven fabric is significantly decrease after UV weathering. The UV weathering causes the damage on the surface of the fabric and this rough structure and broken fibers may have decreases the flow of air.

The air permeability of Abaya is one of the most important factor as less permeability will cause the wet microclimate and discomfort. It can be seen that PES twill structure is much more permeable and shows less impact even after weathering.

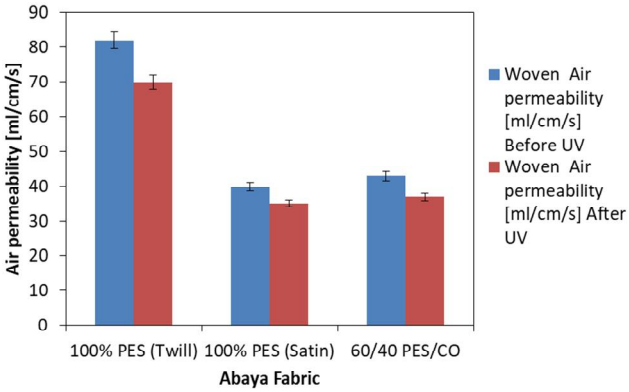

Figure 4 Effect of UV on air permeability of woven ABAYA

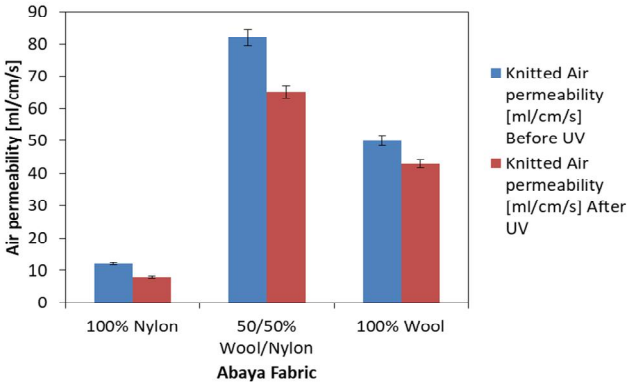

Figure 5 Effect of UV on air permeability of knitted ABAYA

4.3 Water vapour resistance

The water vapour permeability is very important property while choosing the clothing. It is seen in Figures 6 and 7, that the UV has great influence on increasing the water vapor resistance of the fabric. It is mainly due to the roughness and damage of the surface and hinders the flow of moisture. It is also possible that broken fibers and cracks may have made new channels for the flow of water vapors.

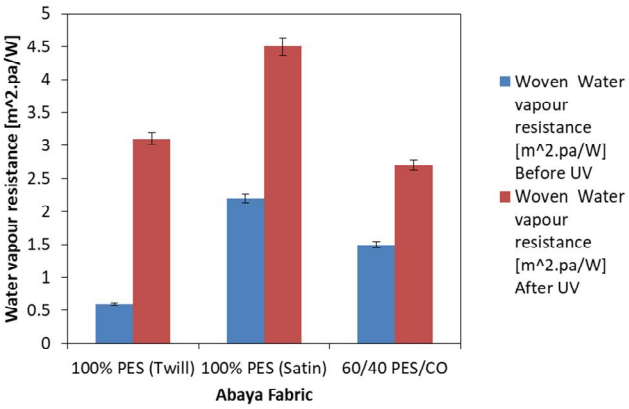

Figure 6 Effect of UV on water vapour resistance of woven ABAYA

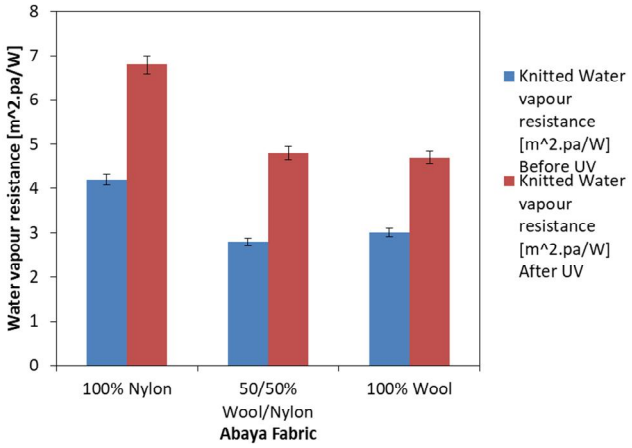

Figure 7 Effect of UV on water vapour resistance of knitted ABAYA

Water vapor resistance was much more impacted for the woven fabrics after UV weathering, which can be due to fact that knitted fabrics have more tendency for open channels after degradation.

4.4 Thermal resistance

The thermal resistance of Abaya clothing is important specially when worn in hot environment. It is seen in Figures 8 and 9, that the UV has great influence on increasing the thermal resistance of the fabric. It is mainly due to the roughness and damage of the surface and keep more air pockets and causes increase in thermal resistance.

Thermal resistance is crucial for the Abaya, when worn specially in hot climates. Woven fabrics are much impacted after UV weathering, which can be because of the trapped air spaces inside woven structure after degradation.

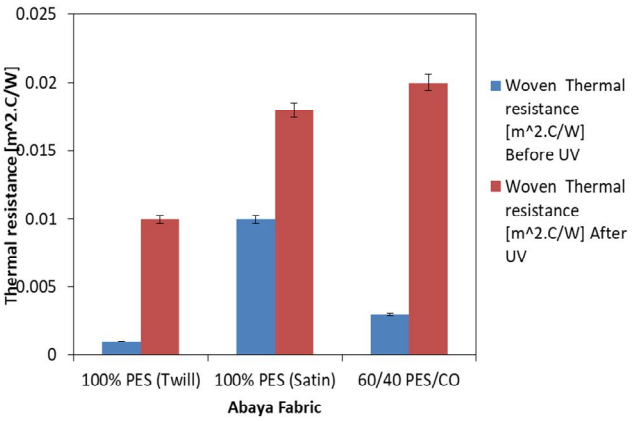

Figure 8 Effect of UV on thermal resistance of woven ABAYA

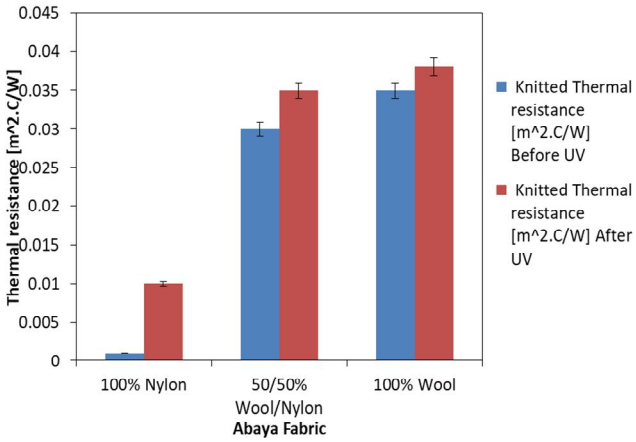

Figure 9 Effect of UV on thermal resistance of knitted ABAYA

5 CONCLUSION

It is concluded from this research that the UV has adverse effect on the Abaya clothing and causes significant decrease in drape, air and water vapor permeability of the Abaya clothing. These all properties are essential for choosing the comfortable clothing especially in hot and humid environment.

It is also observed that

- UV has similar impact on woven and knitted fabrics.
- The Abaya made from cotton and wool shows better performance, that is less water vapor resistance even after UV weathering.
- The UV weathering as adverse impact on the performance of the textile clothing. Also it affected the aesthetic property of garment specially the color, but this was not part of the current research.

Future works

In future following research will be studied.

- UV absorber coatings and textile covers to protect Abaya from weathering.
- Accelerated weathering with condensation can be useful for predicting the Abaya life time in different parts of the world.
- Accelerated weathering equivalent to 2 or 3 years can be useful in knowing the life time of garments.

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