An investigation into the physical and functional properties and sew ability of Faux leather

Nashwa Mostafa Hafez Mohamed
Assistant Professor, Faculty of Applied Arts, Apparel Department, Helwan University, Egypt
Nesreen Nasr Eldeen Hassan
Assistant Professor, Faculty of Applied Arts, Apparel Department, Helwan University, Egypt

Abstract:

Synthetic leather via natural is one of the most common synthetic leather with higher quality. Real leather goods are preferred by many customers because of their excellent properties, such as good water vapor permeability, and wearing comfort. Therefore, the development of synthetic leather via natural with excellent performance as a supplement of real leather has gained increasing attention and has become a widely interesting research topic. Synthetic leather via natural can be described as faux leather which has been emerged in recent years and became the most ideal substitute for real leather. Continuous development in this research area led to an expansion of faux leather applications.

In this study three different types of synthetic leather via natural were examined before and after sewing with superimposed seam. Tests were applied to determine the physical properties like thickness and stiffness, the functional properties like tensile strength, elongation, crease recovery, air permeability, vapor permeability, abrasion resistance, and colorfastness to light in addition to the seam properties like seam thickness, seam stiffness, seam tensile strength, seam pucker and seam appearance. All tests were done according to standards and took place into conditioned atmosphere of 21ºC and 65% RH. Comparisons have been made among them; this was done with reference to durability, efficiency and appearance.

Keywords:
- ***synthetic leather***
- ***via natural,***
- ***faux leather,***
- ***real leather,***
- ***sew ability***

Paper received 25th of January 2015, Accepted 12th of February 2015 Published 1st of April 2015

Introduction

It is no doubt that synthetic leather via natural is animal friendly fabric. It consists of split leather combined with a layer of polyurethane PU which is embossed onto the surface. It also referred to faux leather which has some similarities to real leather. Real leather is durable, of superior quality and will mostly last a very long time. Faux leather on the other hand is manmade and looks and feels a lot like real leather. Whereas it is less durable than real leather, it is considerably cheaper and is used to produce great looking and affordable products. [(1)] Although properties such as the aesthetical behavior of this faux leather and those of real leather are similar, a relatively deep gap exists between them in the terms of several other properties, especially water vapor permeability. The main reason for the difference between the hygienic property of synthetic leather and real leather is that more hydrophilic groups exists in the collagen fibers of real leather than those in synthetic leather.

Several exploratory studies regarding the modification of synthetic leather have been carried out to solve this problem. By integrating numerous published reports, it was found that increasing the internal active groups of synthetic leather is the most effective modification method. This method can be divided into two directions according to the two components of synthetic leather. In other words, modified polyamide fiber and modified polyurethane. [(2)]

1.1. Comparison between synthetic leather via natural and real leather

There is a difference between real leather and synthetic leather via natural. The main differences between real and faux leather are the quality and durability. Spotting the difference between faux and real protected leather can be difficult because they can look very similar. There are several techniques that are used to identify faux leather. In the past, faux leather is considered as fake substitute with very low value. Only real leather can be seen as high-end luxury products. High-end fashion brands would never use the synthetic one. However, due to the advance development of the synthetic leather in the past few years, the quality and functions of faux leather have been greatly improved. It is increasingly popular in the apparel industry due to its highly leather-like appearance

and texture. [3] It is now made to be a wide range of apparel product and people are more willing to wear them. In the future, adding value to this leather will be a significant study in the apparel industry. In order to evaluate the possibility of replacing real leather by synthetic leather via natural, basic knowledge of synthetic leather via natural should be gained before going any further. [4] Comparing the properties of both types of leather is useful to analyze the application and difference between real leather and synthetic leather via natural. Another main issue needed to be considered is the environmental as well as animal right aspects. Nowadays environmental impact is one of the biggest concerns in many industries, including the apparel industry. More and more designers tend to use the eco-friendly materials to show their environmental awareness. Especially by thinking deeper about where real leather comes from and how it is made, it would be no more natural. Therefore faux leather may be a better alternative. [5]

1.2. Properties of synthetic leather via natural

- Synthetic leather via natural based products really looks great, last long and need little care. While real leather needs regular care and is quite expensive.
- Their products do not wear easily even though they do not last as long as real leather.
- They will however need regular care such as cleaning to remove dirt and dust and other contaminants.
- They also tend to stretch more than real leather.
- When their products get damaged, they can easily be repaired and more easily be replaced. While real leather is great costly and needs regular maintenance.
- Their products are more affordable, durable, and reliable and look greater than other synthetic products. [6]

1.3. Production of synthetic leather via natural

Synthetic leather via natural is produced by coating polyurethane paste to textile materials. This faux leather is unthinkable without the textile substrate. In most cases it is knitted fabrics which transfer their properties to the final properties of it. Since they are materials mostly used as outerwear fabrics in apparel, their physiological properties are essential. Air, water and water vapor permeability, their strength and durability depend on the properties of individual properties of coated materials and final products. Since structured multilayered materials consist of different materials and various binders, besides material comfort it is important to pay great attention to their compatibility in different conditions. [7]

The target product to meet market requirements can be produced by appropriate selection of recipes for polymer coating, and by determination of construction parameters of the textile fabric as well as raw materials and production conditions. [3]

The selection of polymers is very important to obtain desirable properties of the finished product, and the coating composition is determined according to the application of the finished product. The coating consists of the basic polymer and additives. In the selection of the basic polymer, the properties are as follows: thermo plasticity, mechanical properties of polymers, possibility of film formation, stiffness, good adhesion, abrasion resistance, heat, water and air conductivity, resistance to solvents and hydrolysis, resistance to UV radiation, melting point etc. [7]

The basic polymer is mostly polyurethane that may be strong and rigid, soft and elastic.

Polyurethanes belong to the group of very durable plastic materials. The main property of polyurethane is its wide application. It can be coated to leather, in solution or dispersion, as granules or powder. Softness or hardness can be obtained by varying polymer structures. [7] Fig.1. Shows schematic of polyurethane coating for production of synthetic leather via natural. [3]

Polyurethane has good wash proof ness and cleaning resistance, good adhesion to the fabric, good durability at low temperatures, it is possible to use it without softeners, it has good viscosity and abrasion resistance, at the same time it has a pleasant and soft touch, a low specific mass, resistance to oils and fats. [8]

1.4. Uses of synthetic leather via natural in apparel

In recent years, synthetic leather via natural is increasingly popular. It has been used by many fashion designers to create apparel products such as jackets, jeans, skirts, tops and their complementary like handbags and shoes. [8]

2. Experimental work

2.1. Synthetic leather via natural specifications

Three types of faux leather were examined with knitted fabric base of 100% polyamide 6.6; single jersey structure. Their appearance and texture was similar to types of natural leather. Faux leather1 (brown) is like **lamb nappa for its** soft and light-weight**, (lamb nappa** is taken out from a lamb or young sheep) faux leather2 (yellow) is like goat suede for **its** velvet-like surface (goat suede is generally the inner side of hide or skin next to

meat of animal, buffed to a smooth finish), while faux leather3 (off white) is like **cow nappa** for its smooth and soft surface (**cow nappa** is taken out from the outer skin of the cow)**.** The following table1 illustrates the specifications of the tested faux leather

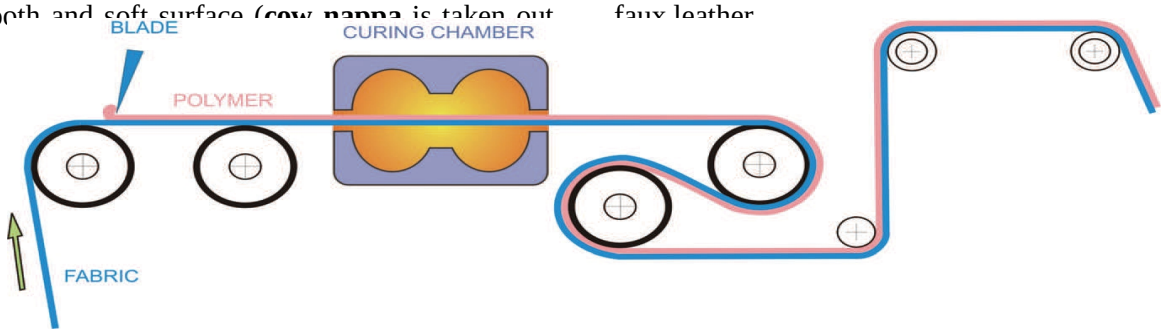

Fig.1. Schematic of polyurethane coating for production of synthetic leather via natural [3]

Table1 Synthetic leather via natural specifications

Faux leather type	Faux leather color	Stitch Wales/cm	Stitch courses/cm	Mass(gm/m^2)
Faux leather1	Brown	15	18	290
Faux leather2	Yellow	20	22	306
Faux leather3	Off white	19	21	302

2.2. Sewing specifications

Each type of faux leather was sewed separately by using Japanese Mitsubishi sewing machine model LS2-1150 with speed 220 volt, 2850 cycles per min, and 5000 stitches per min and by using plastic presser.

The following table2 illustrates the sewing specifications

Table2 Sewing specifications

Seam type.	Thread type	Thread size	Needle size	Stitch type	Stitch density/cm
 Superimposed	100% spun polyester	Ne 22/3	16	Lock stitch 301	3

2.3. Experimental tests

Tested samples examined before and after sewing. All tests were done by standard test methods in conditioned atmosphere of 20ºC ± 2 and 65% ± 2 RH. Tests included thickness test which was carried out by using Erazier Pregision Instrument, according to (B.S.-2544). [9] Thickness before and after sewing was obtained from average of four readings. Stiffness test obtained before and after sewing. It was carried out by using Shirley stiffness tester according to (ASTM D 1388) [10]. Tensile strength and extensibility was carried out by using Tensile tester according to (EN ISO 13934-1) [11]; average of three readings has been obtained for each property. Abrasion resistance test was carried out by Taber 515 abrasion tester, according to the (ASTM D3884) [12] for a number of cycles, 100 cycles, and mass loss were achieved before and after abrasion process. Abrasive paper was used as abrading instead of standard fabric, with 12KP load on top of abraded sample. Air permeability test was carried out by using Electronic air permeability tester (FX 3300), according to (ASTM D737). [13] Vapor permeability test was carried out by using the Dynamic moisture permeation cell, according to (ASTM F2298). This test indicates how much moisture can pass through a barrier in 24-hour period. [14] Colorfastness to light test was carried out by Colorfastness tester, according to the (AATCC 16). Samples were exposed to light for 72 hours and the evaluation were done by using the blue scale. [15] Seam strength obtained according to (BS51-31) [16]. Crease recovery test based on Paramount crease recovery tester according to (BS 11313). [17] Angle of crease recovery, for both length and width directions have been viewed. Seam pucker has been evaluated, according to (AATCC 88B-1978) [18] and seam appearance; average of five readings has been obtained for each property.

3. Results and Discussion

3.1. Physical properties of tested synthetic leather via natural

Table3 illustrates physical properties of tested

synthetic leather via natural

3.1.1. Thickness of tested synthetic leather via natural

All kind of leather suitable for apparel should to have thin thickness don't exceed 1mm As shown in table3, fig.2 it can be noticed that faux leather2 gives the highest thickness then faux leather3 while faux leather1 gives the lowest value. This can be attributed to ***mass,*** *(there is a direct relationship between mass and thickness).*

3.1.2. Stiffness of tested synthetic leather via natural

Stiffness is defined as, the ability of a material to resist the deformation under stress. The greater the material stiffness, the less likely the material is to drape.

Table3, fig.2 indicates that faux leather2 gives the highest stiffness then faux leather1 while faux leather3 gives the lowest value, which can be attributed to ***elongation****. Generally, materials with less elongation as real leather tend to be stiffer than those with more elongation as faux leather.*

3.2. Functional properties of tested synthetic leather via natural

Table3 Physical properties of tested synthetic leather via natural

Physical properties	Faux leather1	Faux leather2	Faux leather3
Thickness (mm)	0.67	0.95	0.90
Stiffness (mg.cm)	193.28	235.62	162.4

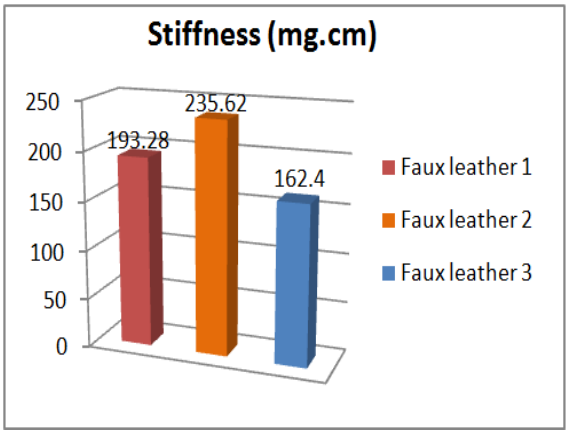

Fig.2 (b)

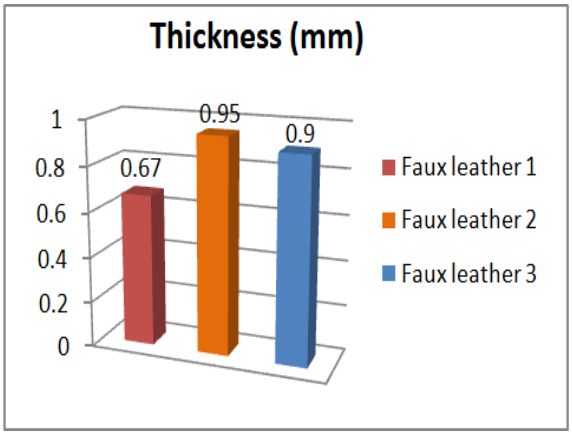

Fig.2 (a)

Fig.2. Physical properties of tested synthetic leather via natural

Table4 Functional properties of tested synthetic leather via natural

Functional properties	Faux leather1	Faux leather2	Faux leather3
Tensile strength (kgf)	57.2	62.2	46.55
Elongation (%)	43.49	41.15	56.3
Crease recovery / length (º)	128	118	134
Crease recovery / width (º)	118	110	125
Air permeability (cm^3/cm^2.sec.)	0.15	0.13	0.14
Vapor permeability (L/m^2.sec.)	0.36	0.22	0.23
Abrasion (difference of lose in mass %)	8.3	9.2	6.6
Colorfastness to light (grade)	8	8	8

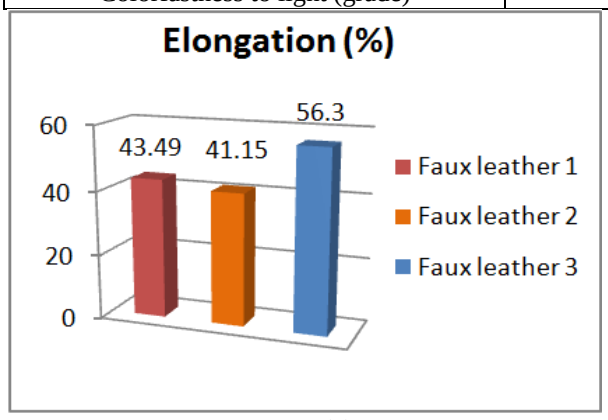

Fig.3 (a)

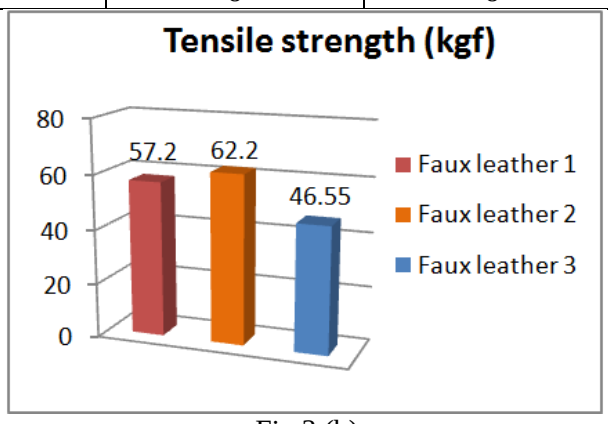

Fig.3 (b)

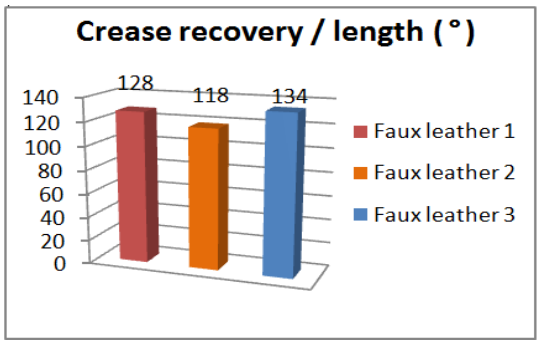

Fig.3 (c)

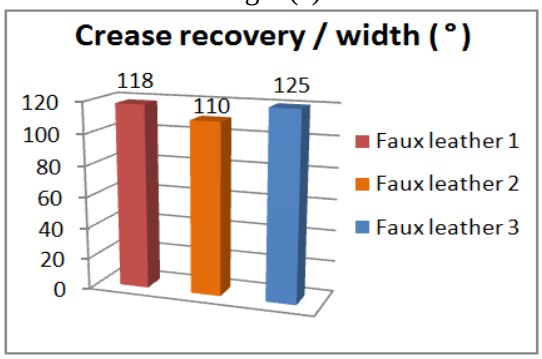

Fig.3 (d)

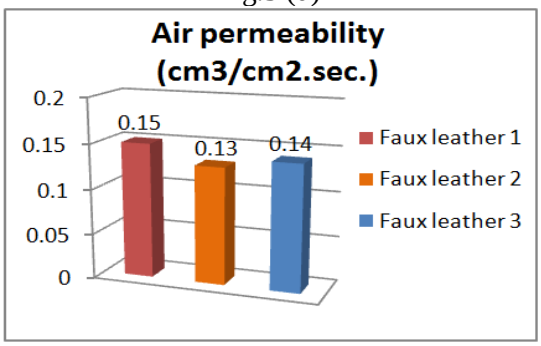

Fig.3 (e)

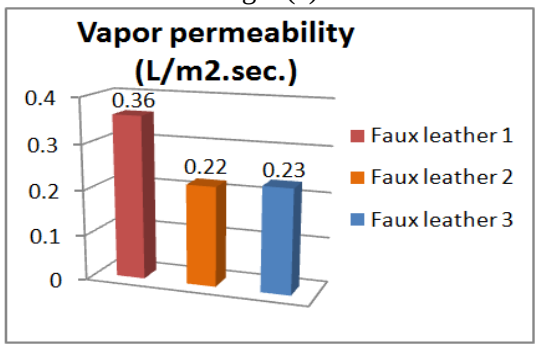

Fig.3 (f)

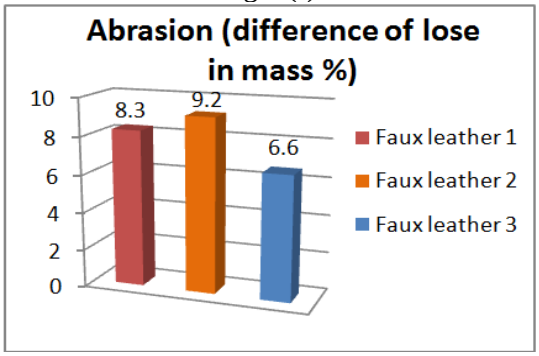

Fig.3 (g)

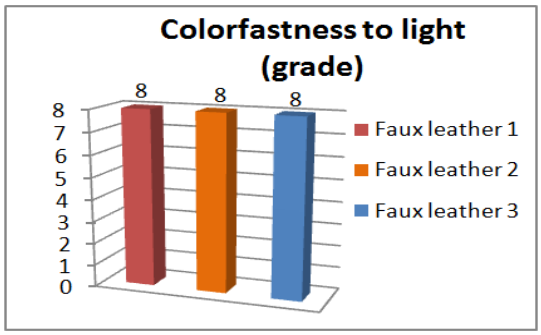

Fig.3 (h)

Fig.3. Functional properties of tested synthetic leather via natural

3.2.1. Tensile strength of tested synthetic leather via natural

Tensile strength ***is the ability of a material to withstand a longitudinal pulling force.*** *As shown in table4, fig.3 faux leather2 is more durable than faux leather1 while faux leather3 has the lowest value. (There is an inverse relation between tensile strength and elongation).* ***However*** *faux leather* ***is tenacious.***

3.2.2. Elongation of tested synthetic leather via natural

Extensibility is the ability of a material to extend when subjected to mechanical forces. While all kinds of leather however real or faux stretch more in width direction than in length, faux leather tend to stretch more than real leather. It can notice from table4, fig.3 that faux leather3 elongate more than faux leather1 while faux leather2 has the lowest elongation. (There is an inverse relation between elongation and stiffness). Extensibility is an important consideration in the shape retention of apparels. Materials with low elongation tend to be stiffer than those with more elongation and keep their original dimensions during use.

3.2.3. Crease recovery of tested synthetic leather via natural

The bending elasticity is the greatest importance in the phenomenon of creasing. Creases appear when the material is distorted in such a manner the ability of a material to regain its original shape after it has been wrinkled. ***As shown in*** *table4, fig.3 crease recovery in length direction is higher than in width direction. Faux leather3 has the highest crease recovery then faux leather1 while faux leather2 has the lowest value, which can be attributed to their stiffness (as stiffness increases crease recovery decreases). Crease recovery effects on the aesthetic appeal of apparel. (As crease recovery increases a better aesthetic appeal is given).*

3.2.4. Air permeability of tested synthetic leather via natural

Air permeability is the case with which air passes through material. It determines factors such as

wind resistance and breathability. To avoid the condensation of perspiration in a garment, breathable materials are required. It also influences the warmth or coolness of a garment. Table4, fig.3 shows that faux leather1 is more air permeable than faux leather3 while faux leather2 has the lowest value which can be attributed to their thickness (as thickness increases air permeability decreases and vice versa). Of course real leather is more breathable than faux leather whereas faux leather breathes more ***than*** *other windproof synthetic products.*

3.2.5. Vapor permeability of tested synthetic leather via natural

Vapor permeability which also referred to breathability, describes a material's ability to allow water in its gases form to pass through it. Table4, fig.3 shows that faux leather1 is more vapor permeable than faux leather3 while faux leather2 has the lowest value which can be attributed to the thickness (as thickness increases vapor permeability decreases and vice versa) like air permeability. In general vapor permeability of synthetic leather via natural is the most optima property among all the other synthetic leathers.

3.2.6. Abrasion resistance of tested synthetic leather via natural

Abrasion resistance is the ability of a material to withstand rubbing (frictional force) applied to its surface (as smooth surface has higher abrasion resistance than rough one). Table4, fig.3 shows that faux leather2 ***has the highest*** *difference of lose in mass. This can be attributed to* ***its*** *velvet-like surface which is less abrasion resistance. On the other hand faux leather3* ***has the lowest*** *difference of lose in mass due to its smooth and soft surface which is high abrasion resistance. There is no doubt that real leather resist abrasion more than faux leather which consists of two components (polyamide fiber and polyurethane).*

3.2.7. Colorfastness to light of tested synthetic leather via natural

Colorfastness to light means resistance of the materials color to fade or run when they are exposed to light for 72 hours. To measure the colorfastness to light a blue scale is used, it is categorized from one to eight.

Table5 Colorfastness to light grades

Grade	Degree of Fading	Light Fastness Type
8	No fading	Outstanding
7	Very slight fading	Excellent
6	Slight fading	Very good
5	Moderate fading	Good
4	Appreciable fading	Moderate
3	Significant fading	Fair
2	Extensive fading	Poor
1	Very extensive fading	Very poor

Table5 shows the color fastness to light grades. As shown in table4, fig.3 all tested samples evaluated outstanding colorfastness to light. Generally synthetic leather has better colorfastness than real leather, because it's produced by coating colored polyurethane paste to textile materials, while real leather is colored during finishing after tanning. Therefore real leather is prone to fade when exposing to the sun for an extended period of time.

Table 6 Seam properties of tested synthetic leather via natural

Seam properties	Faux leather1	Faux leather2	Faux leather3
Seam thickness (mm)	1.29	1.85	1.74
Seam stiffness (mg.cm)	395.62	443.7	365.4
Seam tensile strength (N/mm)	5.99	6.88	4.94
Seam pucker (level)	4.8	3.8	4.4
Seam appearance (level)	9.6	7.2	8.8

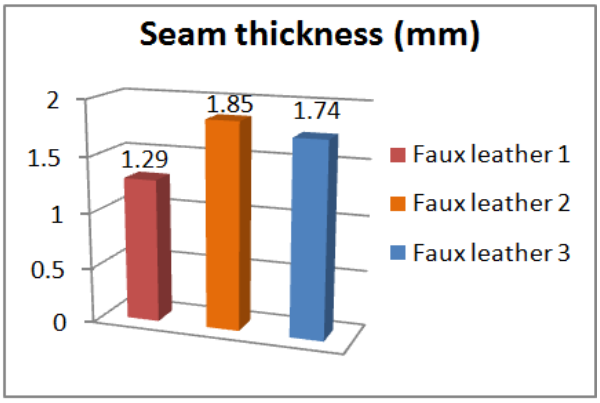

Fig.4 (a)

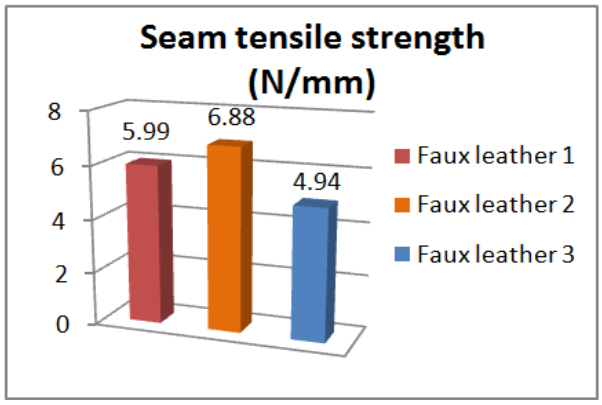

Fig.4 (b)

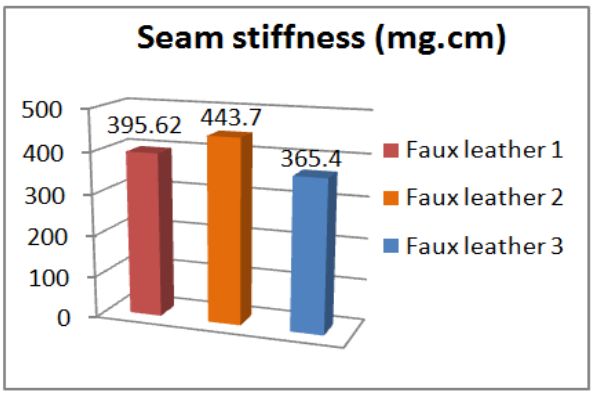

Fig.4 (c)

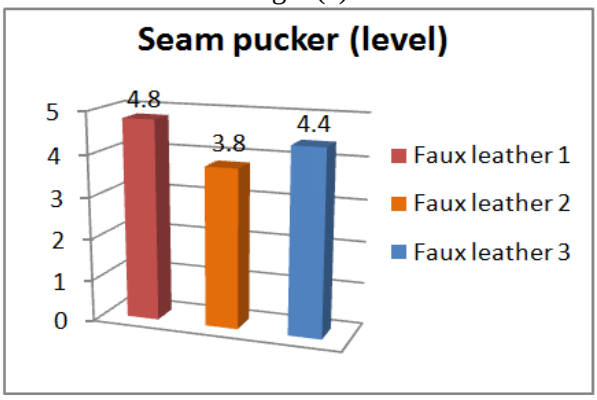

Fig.4 (d)

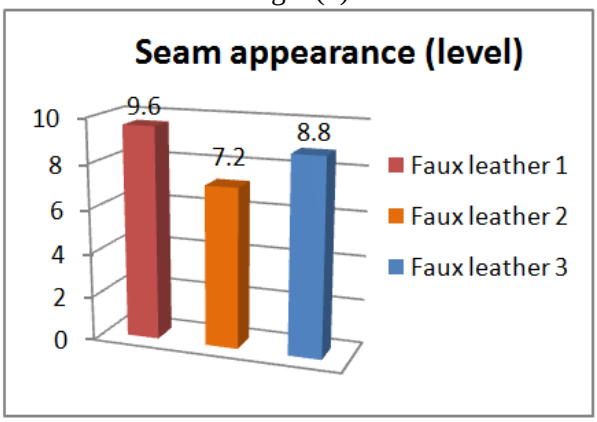

Fig.4 (e)

Fig.4. Seam properties of tested synthetic leather via natural

3.3.1. Seam thickness of tested synthetic leather via natural

As shown in table6, fig.4 faux leather2 gives the highest seam thickness then faux leather3 while faux leather1 gives the lowest value as thickness of tested samples and their seam thickness are directly proportional. Despite the difference between thicknesses of faux leather2 and3 was very small the difference between their seam thicknesses increases due to the occurred seam pucker which increases its seam thickness.

3.3.2. Seam stiffness of tested synthetic leather via natural

Seam stiffness of tested faux leathers goes in the same manner like their stiffness. As shown in table6, fig.4 faux leather2 gives the highest seam stiffness then faux leather1 while faux leather3 gives the lowest value.

3.3.3. Seam tensile strength of tested synthetic leather via natural

Seam tensile strength of tested faux leathers goes in the same manner like their tensile strength. As shown in table6, fig.4 faux leather2 is more durable than faux leather1 while faux leather3 has the lowest value.

3.3.4. Seam pucker of tested synthetic leather via natural

Seam pucker is a wrinkled appearance along the seam, which influences the appearance to a considerable degree. This procedure is objective and is focused on the aesthetic property of the seam assembly. Seam pucker evaluated (from 1 to 5) where 5 means no pucker and 1 means severely pucker. As shown in table6, fig.4 faux leather1 gives the lowest seam pucker (highest level) then faux leather3 while faux leather2 gives the highest value (lowest level).

3.3.5. Seam appearance of tested synthetic leather via natural

The visual appeal of the garment is a principal factor deciding its value.

Appearance evaluated (from2 to10) where 10 means best appearance and 2 means worst appearance. As shown in table6, fig.4 faux leather1 gives the highest seam appearance then faux leather3 while faux leather2 gives the lowest value (As the seam pucker decreases, seam appearance increases).

Conclusions

- Synthetic leather via natural has a significant effect on each of physical, functional and seam properties.
- There is a direct relationship between faux leathers mass and its thickness.
- There is an inverse relation between faux leathers elongation and each of stiffness and tensile strength.
- There is an inverse relation between faux leathers stiffness and crease recovery.
- There is an inverse relation between faux leathers thickness and each of air and vapor permeability.
- Seam properties of each thickness, stiffness and tensile strength of tested faux leathers go in the same manner like before sewing.
- There is an inverse relation between faux leathers seam pucker and its seam appearance.
- Faux leather1 (brown) is like **lamb nappa for its** soft and light-weight. It's distinguished than the other tested leathers for its smallest mass,

thickness and seam thickness, highest air and vapor permeability, in addition to its lowest seam pucker and its greatest seam appearance. Therefore authors recommend using it for making sportswear jackets.

- Faux leather3 (off white) is like **cow nappa** for its smooth and soft surface. When comparing it with the other tested leathers, results referred that it has the advantage of smallest stiffness and seam stiffness, highest elongation, crease recovery and abrasion resistance making it suitable for a host of fashion apparels.
- Faux leather2 (yellow) is like goat suede for **its** velvet-like surface. It's characterized only by tensile strength and seam tensile strength than the other tested leathers. Therefore the authors recommend using this type in apparel parts which are more subjected to high tensile strength.
- There is no doubt that real leather exceeds synthetic leather via natural by durability, abrasion resistance, breathability and vapor permeability but in general these properties are greater in synthetic leather via natural among all the other synthetic leathers.
- Synthetic leather via natural exceeds real leather by elongation, drape ability, crease recovery and color fastness which effects on its aesthetic appeal. In addition it is considerably cheaper.
- In the fashion world, authors' advice designers to use synthetic leather via natural since it can add value to their products, and customers to purchase it duo to its high-end image and performance.

References

1- Chung Wai Man, Cherry Ba Hons, PU Synthetic Leather Become the Alternative to Genuine Leather in the Apparel Industry, Institute of Textile & Clothing, The Hong Kong Polytechnic University, 2011.

2- Longfang Ren, Guohui Zhao, Xuechuan Wang, Taotao Qiang, PhD, Na Wang, Chao Han, Hygienic Property of Synthetic Leather Base Modified via a "Two-Step Method", Journal of Engineered Fibers and Fabrics, Volume 9, Issue 3 – 2014.

3- Stana Kovačević, Darko Ujević and Snježana Brnada, Coated Textile Materials, Woven Fabric Engineering, Polona Dobnik Dubrovski (Ed.), ISBN: 978-953-307, 2010.

4- Ren Longfang; Zhao Guohui; Wang Xuechuan, et al; Advances in the Microfiber Synthetic Materials Emulating Natural Leather; Leather Science and Engineering 2012.

5- Ma Xingyuan; Lv Lingyun and Li Xiao; Enzyme Hydrolyzation of Polyamide Hyperfine Fiber Synthetic Leather Base; China Leather, 2010.

6- Qiang Taotao; Wang Xuechuan; Ren Longfang; Synthesis of Hyperbranched Polymers and Its Effect on Sanitary Properties of Microfiber Synthetic Leather; Joumal of Donghua University(Eng.Ed.) 2010.

7- Hu Yuqin; Zhong Anhua; Moistuer Permeability of PU Film Modified By Silk Powder; Journal of Wuhan University of Science and Technology 2009.

8- Hao Wentao; Wang Xiaoming; Zhu Deqiang, et al; Application of Cyclodextrin in the Water Vapor Permeable PU Synthetic Leather; Plastics and Additives 2010.

9- B.S.-2544: Method for determination of thickness.

10- ASTM D 1388: Method for determination of stiffness.

11- EN ISO 13934-1: Method for determination of tensile strength and extensibility.

12- ASTM D3884: Method for determination of abrasion resistance.

13- ASTM D737: Method for determination of air permeability.

14- ASTM F2298: Method for determination of vapor permeability.

15- AATCC 16: Method for determination of colorfastness to light.

16- BS51-31: Method for determination of seam strength.

17- BS 11313: Method for determination of crease recovery.

18- AATCC 88B-1978: Method for determination of seam pucker.