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# Optimizing the Functional Properties of Air Slide Fabrics Used in Cement Industry

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**ABSTRACT**

Technical textiles are defined as textile materials and products manufactured primarily for their technical and performance properties according to the end use. High tensile strength air slide fabric is one of the technical textile which named as air slide belt, conveyor belt or air slide canvas. The air slide belt is placed between material (above) and air -flow box (below). Air flow cross the material and make the powder or particle Fluidized under gas pressure to achieve the purpose of conveying. This is research aims to produce Fabrics suitable for using as an air slide fabrics in cement plant.

Woven and non woven technique was used to produce 12 samples; the nonwoven fabrics made of 100% Polyester fibers with; weight of ( 2500 gm/m2 contains 3 layers of woven fabric), (2200 gm/m2 contains 2 layers of woven fabric) having 3,6 den. The nonwoven blending between(85% Polyester/15% Nomex) with; weight of ( 2500gm/m2 contains 3 layers of woven fabrics), (2200gm/m2 contains 2 layers of woven fabric) having 4, 8 den. for Nomex. Needle punching technique is using 600 beats/min, depth penetration (10, 12 and 14mm).

The woven layer (inner) was produced from 100% polyester yarns, warp and weft count was (900 den.) and (15 ends/cm, 9 picks/cm) with weaving structure (twill weave 1/2).

Tests are carried out to evaluate the products samples. the obtained test results are presented and discussed.

**KEYWORDS**: air slide conveyor - air slide fabric - breathable layer - pneumatic conveying - powdery materials - technical textile.

## 1. INTRODUCTION

Technical textiles are defined as textile materials and products manufactured primarily for their technical and performance properties according to the end use and it is a textile product manufactured for non-aesthetic purposes. (1)

High tensile strength air slide fabric is one of the technical textile which named as aero cloth, air slide canvas , air slide conveyor, air slide belt or aeration pads.

Air slide is a semi-permeable textile cloth which allows air to pass through but not the products.

Air slide belt is placed between material (above) And air-flow box (below), air flow cross the material and make the powder or particle fluidized under gas pressure, to achieve the purpose of conveying.

It is used for pneumatic transmission of cement, bauxite, carbon, black, gypsum, etc, and also equipped to fluid bed and powder mixing tank, which with a special and controllable air permeability can help to improve the convey efficiency. (2)

### 1.1. Pneumatic conveying

Is the movement of solids through pipe using gas (usually air) as the motive force. the flow regime in the pipe depends greatly on the ratio of solids to gas and the particle characteristics. (3)

Pneumatic conveying systems do have their limitations, such as material size and temperature. Pneumatic conveying is the perfect way to convey dry bulk solid such as cement raw mix, kiln dust, powdered coal and fly ash, and for this reason along with pneumatic silo aeration has played a major role in the conversion of the cement industry from wet to dry process. pneumatic conveying systems are called the arteries of a cement plant. (4)

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### 1.1.1. Advantages of pneumatic conveying

- Environmental (no dust due to total containment).
- prevents contamination (containment goes both ways).
- low capital cost (a pipe is the primary transport element).
- reliability & minimal maintenance (few moving parts).
- Simple operation and design.

The only disadvantage of pneumatic conveying compared to mechanical conveying is power consumption. (4)

### 1.1.2. Methods of pneumatic conveyance

"dilute phase" and "dense phase" in dilute phase, relatively high volumes of air moving at high speeds are used to transfer materials entrained in the air (or other gas) stream. In dense phase, low volume of air at high pressures are used to transfer nearly solid masses of materials. Dilute phase systems can be further divided into " pull " system that operate below atmospheric pressure, " push " system that operate above atmospheric pressure, and hybrid " push-pull" system, which are frequently used when materials need to be unloaded and then conveyed over long distance. (5)

### 1.2. Air Gravity conveyors

The air slide air-activated gravity conveyor is the ultimate of all pneumatic conveying system applications. Here is a system that uses the forces of gravity to do most of the work without any moving parts. Material is fluidized through a porous media with low pressure air. Material flow is achieved by sloping the air slide to match the fluidized angle of repose of the powdered material. (6)

### 1.3. Air slide fabric

Woven and nonwoven fabrics are used in a variety of industries and applications. Air slide fabric is also named as air slide belt, conveyor belt and air permeable fabric. Aeration fabrics are made of natural or synthetic fibers in accordance to their specific temperature resistance. (7)

Air slide fabric is a belt fabric used for pneumatic transmission of cement, equipped to fluid bed and powder mixing tank, which is special and controllable. Air permeability can help to improve the convey efficiency. This air slide fabric requires a special loom, the fabric is sufficiently heavy and strong. (8)

Air slide woven fabrics are normally woven from more than one set of warps, while other blinder warps are used to interlace through the fabric and thereby hold the entire construction together.

We use high tenacity polyester Filament Yarn and follow established process weaving to impart the suitable properties to Air slides Fabric. (7)

In air slide woven fabric polyester yarns are produced in different blends and qualities (filament polyester in warp, spun polyester in weft). Therefore it is important to use only high quality and thoroughly Selected Multifilament polyester yarns. These yarns are pre-shrunk and highly Strengthened.

Air slide belt are semi-permeable (allow air to pass through, but not products) and are manufactured to meet specific permeation ranges ensuring that uniform volumes of air are allowed to pass through given standard air pressure .(8)

### 1.4. required Properties for air slide fabrics

Air slide fabrics are exposed to substantial stresses from temperature, contact pressure, friction, tensile stress and moisture so the essential required properties for air slide fabrics are:

1- constant air permeability.
2- High abrasion resistance.
3- High tensile strength in both directions.
4- High resistance to wear & degradation.
5- Resistance to decay and rot prevents the formation of bacteria and fungus.
6- Temperature resistance up to 150 $^{o}$C. (9)

### 1.5. Applications of air slide fabric

Air slide fabrics are used in various industries:

- cement industry.
- aluminum, lime and gypsum industry.
- power plants (coal fired).
- pharmaceutical industry.

- chemical industry.(10)

**1.6. Air slide conveying system**

When the air slide belt is in the middle of a chute, the Powder material will come into the chute above it , then the material will flow to the chute lower side as pneumatic blower down slide belt. air slide fabric can move powder material because of the wind power and then the rest wind will go out from the top of the chute. Through the moving, no parts moved except powder material. So that it can spare more energy and maintain cost.

For surface aeration of the material in storage tanks of smaller dimensions, fluidization bottoms are used. These are either flat or conical with aeration air supplied below an aeration partition in the shape of a circular board or a cone. Surface aeration elements fluidize the material across its Surface. The functioning members of an aeration elements is aeration fabric. Air flows through the pores in the aeration fabric to the surface and enters the powder material. Hereby, its internal friction is reduced and the material is put in a fluid state thus obtaining properties resembling a liquid. (8)

## 2. Experimental work:

### 2.1. Materials and Methods:

#### 2.1.1. Specification of samples under study:

The present research is concerned with the non woven fabrics which are suitable for using as air slide fabrics .

Twelve samples were produced with cross laid non woven technique and bonded using needle punching method, using two types of textile materials, polyester and Nomex.

Table (1) shows the specification of nonwoven fabrics under test.

The woven layer (inner) was produced from polyester continuous filament yarn of weft and warp by using weave structure (twill weave 1/2). table (2) shows the specification of woven fabric.

Whereas the nonwoven fabrics that weight 2500gm/m2 contain three layers of woven fabrics, and the nonwoven fabrics that weight 2200 gm/m2 contain two layers of woven fabrics.

**Table (1): Nonwoven fabrics specification (under test)**

| No. | Property | Specification | | | |
|---|---|---|---|---|---|
| | | Nonwoven polyester fabric | | **Nonwoven(85% polyester + 15% nomex) fabric** | |
| **1** | Fiber type | 100% Polyester | | **85% polyester + 15% Nomex** | |
| **2** | Fiber length | 64,80mm | | **64,80 mm polyester+80mm Nomex** | |
| **3** | Fiber count | 3,6 den. | | **3,6 den. Polyester +4,8 den. Nomex** | |
| **4** | Fabric weight | 2500 gm/m² With 3 layers of woven fabric | 2200 gm/m² With 2 layers of woven fabric | 2500 gm/m² With 3 layers of woven fabric | 2200 gm/m² With 2 layers of woven fabric |
| **5** | Web bonding | Needle punching | | **Needle punching** | |
| **6** | Number of beats/min | 600 | | **600** | |
| **7** | Puncture depth | 10,12.and14 mm | | **10 ,12,and 14 mm** | |
| **8** | Web formation | c.l. (cross- laid) | | **c.l. (cross- laid)** | |

**Table (2): Woven fabrics specification (inner layer)**

| No. | Property | Specification |
|---|---|---|
| **1** | Warp type | Polyester filament yarn |
| **2** | Weft type | Polyester filament yarn |
| **3** | Warp set | 15 ends/cm |
| **4** | Weft set | 9 picks/cm |
| **5** | Warp count | 900 den. |
| **6** | Weft count | 900 den. |
| **7** | Weave structure | Twill weave 1/2 |

#### 2.1.2. Tests applied to samples under study:

Several tests we carried out in order to evaluate the produced fabrics, these tests are:

1- Tensile strength and elongation at break in both direction .(11)
2- Fabric abrasion resistance was determined in accordance with their lost of weight at 2000cycle.(12)
3- Air permeability test.(13)

4- Fabric thickness test.(14)
5- Dimensional stability (shrinkage of fabric ratio in both direction after a 12 hours exposure at up to ($160^{o}$C) .

## 3. RESULTS AND DISCUSSIONS

Results of experimental test carried out on the produced samples were presented in the following tables and charts. Results were also statistically analyzed for the date listed and relationship between variables were obtained.

### 3.1. Tensile strength at break:

**Table (3): Tensile strength measurements results in both directions**

| Tensile strength kg/cm² | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Fabric type** | | **Polyester** | | | | **85% polyester + 15% nomex** | | | |
| **Weight** | | 2500 gm/m² | | 2200 gm/m² | | 2500 gm/m² | | 2200 gm/m² | |
| **Direction** | | Length | Width | Length | Width | Length | Width | Length | Width |
| **Puncture depth** | 10 | 571 | 475 | 502.5 | 418.6 | 608 | 507.8 | 535.4 | 446.5 |
| | 12 | 583 | 485.8 | 513 | 426.8 | 618.4 | 516.5 | 544.3 | 455.8 |
| | 14 | 595 | 495.3 | 523.8 | 435.2 | 629.3 | 523.7 | 553.7 | 465.2 |

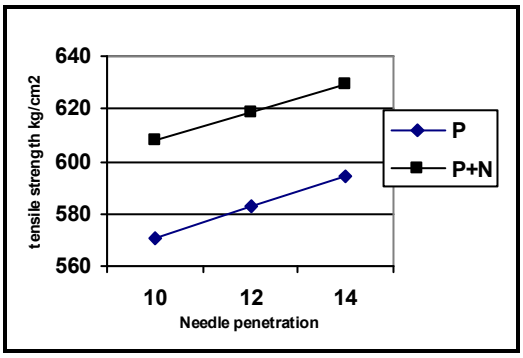


**Fig. (1)**
**Effect of fabric type and needles penetration depth mm on the tensile strength at break in the length direction at weight 2500 gm/m²**

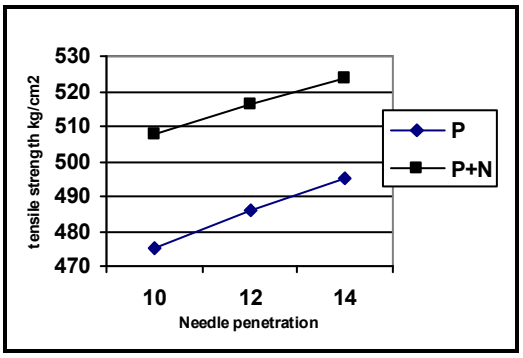


**Fig. (2)**
**Effect of fabric type and needles penetration depth mm on the tensile strength at break in the width direction at weight 2500 gm/m²**

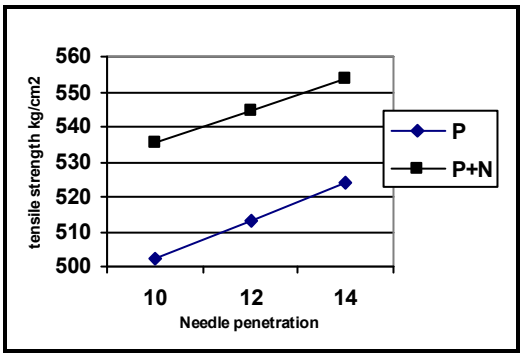


**Fig. (3)**
**Effect of fabric type and needles penetration depth mm on the tensile strength at break in the length direction at weight 2200 gm/m²**

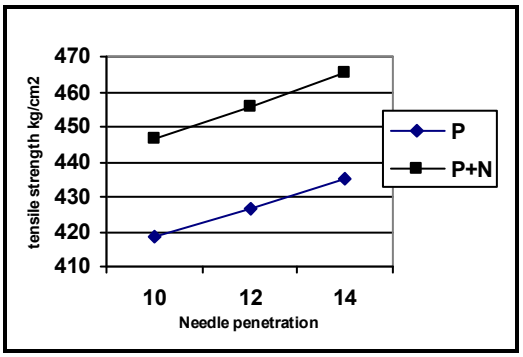


**Fig. (4)**
**Effect of fabric type and needles penetration depth mm on the tensile strength at break in the width direction at weight 2200 gm/m²**

**Table (4)**
**Regression equation and correlation coefficient for the effect of the needle penetration depth (mm) and type of fabric on the tensile strength (kg/cm$^2$) in the two directions at different weights**

| Weight | Direction | Fabric type | Regression equation | Correlation coefficient |
|---|---|---|---|---|
| 2500 gm/m$^2$ | Length | Polyester | Y = 5.750 X + 513.667 | 0.99969 |
| | | Polyester + Nomex | Y = 5.325 X + 554.667 | 0.99991 |
| | Width | Polyester | Y = 5.075 X + 424.467 | 0.99932 |
| | | Polyester + Nomex | Y = 3.975 X + 468.3 | 0.99852 |
| 2200 gm/m$^2$ | Length | Polyester | Y = 5.325 X + 449.2 | 0.99997 |
| | | Polyester + Nomex | Y = 4.575 X + 489.567 | 0.99988 |
| | Width | Polyester | Y = 4.150 X + 377.067 | 0.99998 |
| | | Polyester + Nomex | Y = 4.675 X + 399.733 | 0.99999 |

### 3.1.1. Effect of the fabric type on the tensile strength at break in the both direction:

It is clear from table (3) and figs. (1,2.3.4) which is concerned with testing the fabric produced for the present study that the nonwoven (85 % polyester/15 % Nomex) Fabrics have higher tensile strength than the nonwoven polyester fabrics for all the weights and all needles penetration depth. this can be interpreted as the reason is the difference between properties of materials (Nomex has higher tensile strength than polyester).

### 3.1.2. Effect of fabric weight on the tensile strength at break in both direction:

It is clear from table (3) and figs. (1,2,3,4) that there is direct relationship between the fabric weight and samples tensile strength this is due to the increase in fabric weight means an increase in the number of fibers per unit area leading to the increase in contact area between fibers and woven layers, hence both fibers and layers contribute to the resistance against tensile for all the fabric type and all the needles penetration depth.

### 3.1.3. Effect of the needles penetration depth on the tensile strength at break in both direction:

It is clear from table (3) and figs. (1,2,3,4) that there is direct proportionality between the needles penetration depth and tensile strength of fabrics, this can be explained that the increase in needles penetration depth leads to increase the merging between the fibers and yarns hence, fabric to be more compacted to the resistance against tensile.

### 3.2. Elongation at break:

**Table (5): Fabric elongation at break measurements results in both directions**

| Elongation at break % | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Fabric type | | Polyester | | | | 85% polyester + 15% nomex | | | |
| Weight | | 2500 gm/m$^2$ | | 2200 gm/m$^2$ | | 2500 gm/m$^2$ | | 2200 gm/m$^2$ | |
| Direction | | Length | Width | Length | Width | Length | Width | Length | Width |
| Puncture depth | 10 | 14.7 | 10.5 | 18.6 | 12.4 | 9.9 | 7.9 | 12.8 | 9.1 |
| | 12 | 13.8 | 9.7 | 17.3 | 11.6 | 9.2 | 7.2 | 11.9 | 8.4 |
| | 14 | 12.7 | 8.9 | 15.8 | 10.7 | 8.6 | 6.5 | 10.8 | 7.7 |

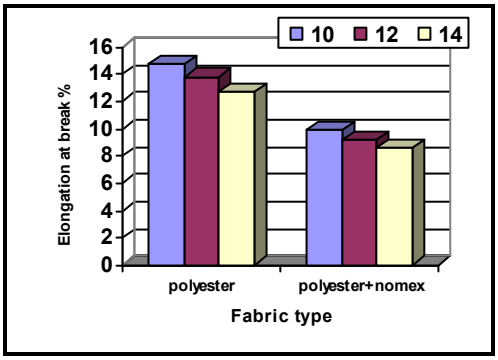


**Fig. (5)**
**Effect of fabric type and needles penetration depth mm on the elongation at break % in the length direction at weight 2500 gm/m$^2$**

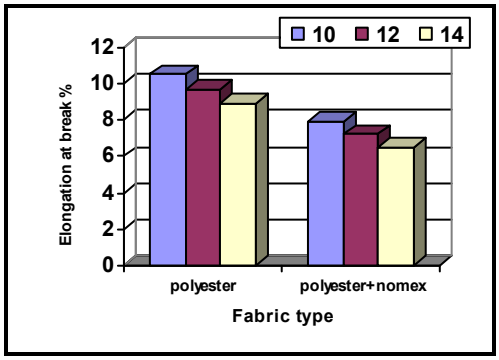


**Fig. (6)**
**Effect of fabric type and needles penetration depth mm on the elongation at break % in the width direction at weight 2500 gm/m$^2$**

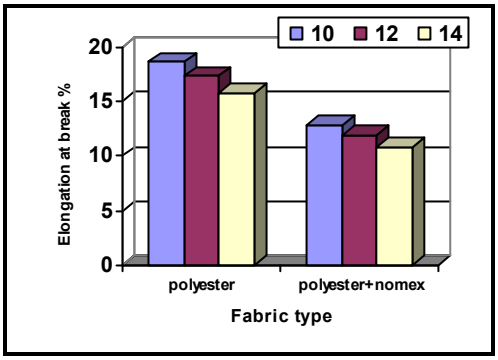


**Fig. (7)**
**Effect of fabric type and needles penetration depth mm on the elongation at break % in the length direction at weight 2200 gm/m$^2$**

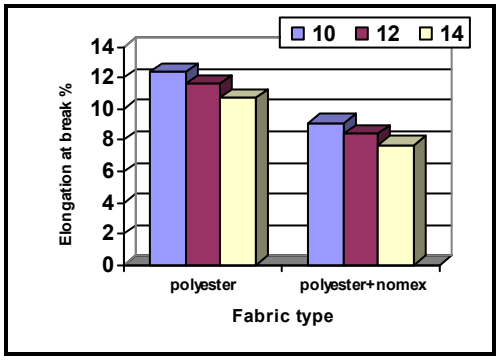


**Fig. (8)**
**Effect of fabric type and needles penetration depth mm on the elongation at break % in the width direction at weight 2200 gm/m$^2$**

### 3.2.1. Effect of the fabric type on the elongation at break in both direction:

It is clear from table (5) and figs. (5,6,7,8) that the nonwoven polyester fabrics have higher elongation at break than the nonwoven (85 % polyester/15 % Nomex) fabrics for all the weights and all the needles penetration depth this can be interpreted as the reason is difference between properties of materials. (polyester fibers have higher elongation than the Nomex fibers).whenever the elongation at break of air slide fabrics decreased the more it is suitable for usage.

### 3.2.2. Effect of fabric weight on the elongation at break in both direction:

It is obvious from table (5) and figs. (5,6,7,8) that there is an inversely proportional relation between the fabric weight and elongation at break. This happens mainly due to the increase in weight that leads to the increase in number of fibers and woven layers. Therefore, it results in increasing contact areas between fibers and yarns, so their resistance to slippage will increase leading to the decrease in elongation at break.

### 3.2.3. Effect of the needles penetration depth on the elongation at break:

It is obvious from table (5) and figs. (5,6,7,8) That there is an inversely proportional relation between the needles penetration depth and the Elongation at break. This can be attributed to increase in needles penetration depth causes increase the merging between the fibers and yarns and increase in number of fibers per unit area leading to decrease the space between the fibers and yarns so their resistance to slipping will increase causing decreases in elongation at break.

### 3.3. Fabric air permeability:

**Table (6) Fabric air permeability measurements results**

| Fabric air permeability cm$^3$/cm$^2$/sec | | | | | |
|---|---|---|---|---|---|
| Fabric type | | Polyester | | 85% polyester + 15% nomex | |
| Weight | | 2500 gm/m$^2$ | 2200 gm/m$^2$ | 2500 gm/m$^2$ | 2200 gm/m$^2$ |
| puncture depth (mm) | 10 | 3.64 | 4.11 | 3.98 | 4.57 |
| | 12 | 3.36 | 3.83 | 3.76 | 4.33 |
| | 14 | 3.12 | 3.58 | 3.48 | 4.06 |

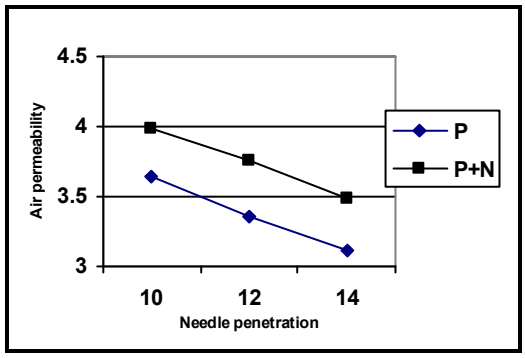


**Fig. (9)**
**Effect of fabric type and needles penetration depth mm on the air permeability $cm^3/cm^2/sec$ at weight 2500 $gm/m^2$**

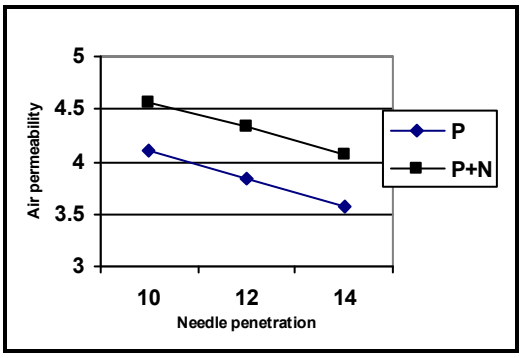


**Fig. (10)**
**Effect of fabric type and needles penetration depth mm on the air permeability $cm^3/cm^2/sec$ at weight 2200 $gm/m^2$**

**Table (7)**
**Regression equation and correlation coefficient for the effect of the needle penetration depth (mm) and type of fabric on the air permeability ($cm^3/cm^2/sec$) at different weights**

| Weight | Fabric type | Regression equation | Correlation coefficient |
|---|---|---|---|
| 2500 $gm/m^2$ | Polyester | Y = - 0.1300 X + 4.93333 | - 0.99902 |
| | Polyester + Nomex | Y = - 0.1250 X + 5.24 | - 0.99761 |
| 2200 $gm/m^2$ | Polyester | Y = - 0.1325 X + 5.43 | - 0.99947 |
| | **Polyester + Nomex** | **Y = - 0.1275 X + 5.85** | **- 0.99942** |

### 3.3.1. Effect of the fabric type on the air permeability:

It is clear from table (6) and figs. (9,10) that the nonwoven (85 % polyester/15 % Nomex) fabrics have higher air permeability than the nonwoven polyester fabrics for all the weights and all the puncture depth . This can be explained as the reason is difference between the properties of materials. (Nomex has higher air permeability than polyester).

### 3.3.2. Effect of fabric weight on the air permeability:

It is clear from table (6) and figs. (9,10) that there is an inversely proportional relation between the fabric weight and air permeability this can be explained that the increase in weight means increase in fibers per unit area and number of layers which leads to decrease in pores size between the fibers and layers, which delay the free passage of air through the fabric, causing decrease in fabric air permeability.

### 3.3.3. Effect of needles penetration depth on the air permeability:

From table (6) and figs. (9,10) it can be seen that there is an inverse relationship between puncture depth of fabric and its air permeability properties we can state that the increase in puncture depth cause increase the merging between the fibers and yarns leads to the increase of fabric compactness and decrease the space between the fibers so, the ability of air flow to be passed through the fabric will be decreased.

### 3.4. Fabric abrasion resistance:

**Table (8) Abrasion resistance measurements results**

| Abrasion resistance (lost of weight ratio % at 2000 cycle) | | | | | |
|---|---|---|---|---|---|
| **Fabric type** | | **Polyester** | | **85% polyester + 15% nomex** | |
| **Weight** | | **2500 $gm/m^2$** | **2200 $gm/m^2$** | **2500 $gm/m^2$** | **2200 $gm/m^2$** |
| **puncture depth (mm)** | 10 | 10.13 | 10.34 | 8.09 | 8.41 |
| | 12 | 9.86 | 10.05 | 7.84 | 8.13 |
| | 14 | 9.57 | 9.74 | 7.47 | 7.75 |

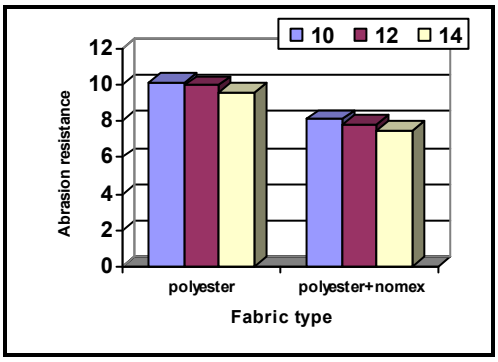


**Fig. (11)**
**Effect of fabric type and needles penetration depth mm on the abrasion resistance (lost weight ratio% at 2000 cycle) at weight 2500 gm/m$^2$**

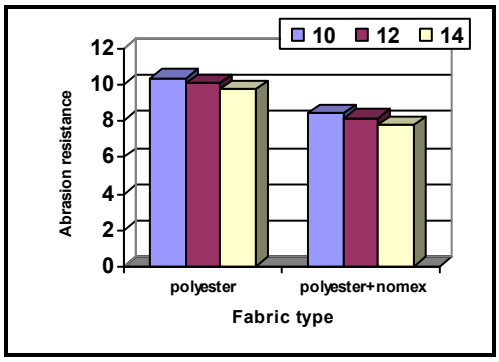


**Fig. (12)**
**Effect of fabric type and needles penetration depth mm on the abrasion resistance (lost weight ratio% at 2000 cycle) at weight 2200 gm/m$^2$**

### 3.4.1. Effect of the fabric type on the abrasion resistance:

It is clear from table (8) and figs. (11,12) that the nonwoven (85 % polyester/15 % nomex) Fabrics have higher abrasion resistance than the nonwoven polyester fabrics for all the weights and all the puncture depth .This can be explained as the reason is difference between the properties of materials. (nomex is higher abrasion resistance than the polyester)

### 3.4.2. Effect of fabric weight on the abrasion resistance:

It is clear from table (8) and figs. (11,12) that there is direct proportionality between the fabric weight and the abrasion resistance. which means the fabrics have the highest weight are more abrasion resistance than the fabrics have the lowest weight but the difference were insignificant.

### 3.4.3. Effect of the needles penetration depth on the fabric abrasion resistance:

It is clear from table (8) and figs. (11,12) that there is direct proportionality between the needles penetration depth and the abrasion resistance this can be explained that the increase in needles penetration depth causes greatest fibers entanglement because needles penetration cause fibers to be reoriented so, increasing the contact areas between the fibers and yarns leading to the increase in fabric abrasion resistance.

### 3.5. Fabric Dimensional stability in both direction:

**Table (9) Dimensional stability measurements results**

| Dimensional stability (shrinkage of fabric ratio % in both direction) | | | | | |
|---|---|---|---|---|---|
| Fabric type | | Polyester | | 85% polyester + 15% nomex | |
| Weight | | 2500 gm/m$^2$ | 2200 gm/m$^2$ | 2500 gm/m$^2$ | 2200 gm/m$^2$ |
| puncture depth (mm) | 10 | 0.64 | 0.76 | 0.102 | 0.118 |
| | 12 | 0.60 | 0.72 | 0.098 | 0.112 |
| | 14 | 0.55 | 0.67 | 0.093 | 0.104 |

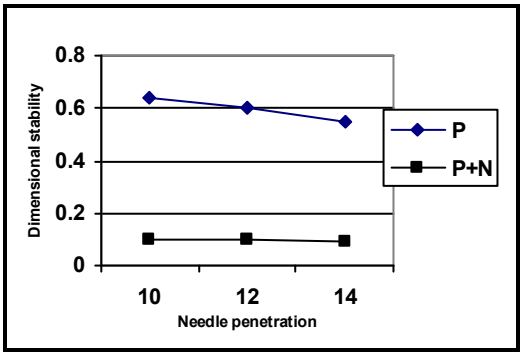


**Fig. (13)**
**Effect of fabric type and needles penetration depth mm on the dimensional stability at weight 2500 gm/m$^2$**

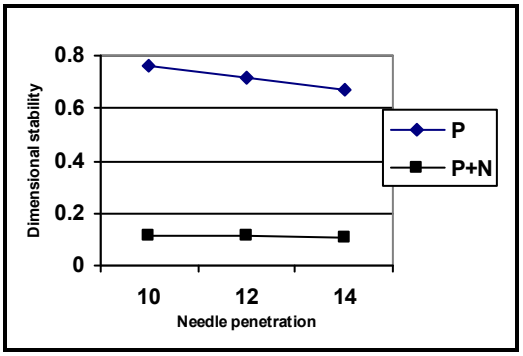


**Fig. (14)**
**Effect of fabric type and needles penetration depth mm on the dimensional stability at weight 2200 gm/m$^2$**

**Table (10)**
**Regression equation and correlation coefficient for the effect of the needle penetration depth (mm) and type of fabric on the dimensional stability at different weights**

| Weight | Fabric type | Regression equation | Correlation coefficient |
|---|---|---|---|
| **2500 gm/m²** | Polyester | Y = - 0.02250 X + 0.866667 | - 0.99795 |
| | Polyester + Nomex | Y = - 0.00225 X + 0.124667 | - 0.99795 |
| **2200 gm/m²** | Polyester | Y = - 0.02250 X + 0.986667 | - 0.99795 |
| | **Polyester + Nomex** | **Y = - 0.00350 X + 0.153333** | **- 0.99662** |

### 3.5.1. Effect of the fabric type on the fabric dimensional stability in both direction:

It is clear from table (9) and figs. (13,14) The nonwoven (85 % polyester/ 15 % nomex) Fabrics have higher dimensional stability in both direction than the nonwoven polyester fabric this can be explained as the reason is difference between the properties of materials (nomex fibers have higher heat resistant than polyester fibers).

### 3.5.2. Effect of fabric weight on the dimensional stability:

It is clear from table (9) and figs. (13,14) That there is directly proportional relation between the fabric weight and the dimensional stability this can be explained that the increase in weight leads to the increase in number of fibers and layers and as a result increase the contact areas between fibers and yarns and decreasing in prose size between the fibers so their resistance to shrinkage will increase leading to the increase in dimensional stability.

### 3.5.3. Effect of the needles penetration depth on the fabric dimension stability:

It is clear from table (9) and figs. (13,14) that there is a direct proportionality between the puncture depth and the dimensional stability in both direction. This can be explained that the increase in needles penetration depth causes greatest fibers entanglement because needles penetration depth causes fibers to be reoriented and so increase the contact areas between the fibers and yarns leading to the increasing in shrinkage resistance and as a result increase in dimensional stability of fabrics.

### 3.6. Fabric thickness:

**Table (11): Thickness measurements results**

| Thickness (mm) | | | | | |
|---|---|---|---|---|---|
| **Fabric type** | | **Polyester** | | **85% polyester + 15% nomex** | |
| **Weight** | | **2500 gm/m²** | **2200 gm/m²** | **2500 gm/m²** | **2200 gm/m²** |
| **puncture depth (mm)** | 10 | 7.16 | 6.24 | 7.76 | 6.84 |
| | 12 | 6.94 | 6.08 | 7.52 | 6.63 |
| | 14 | 6.74 | 5.88 | 7.31 | 6.45 |

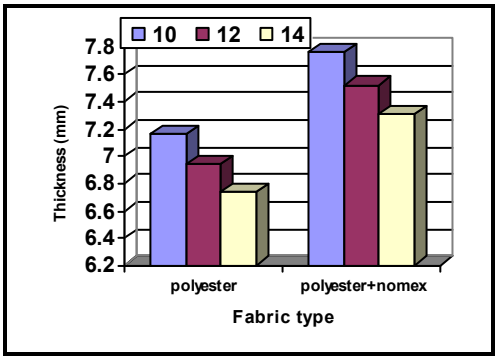


**Fig. (15)**
**Effect of fabric type and needles penetration depth mm on the thickness (mm) at weight 2500 gm/m²**

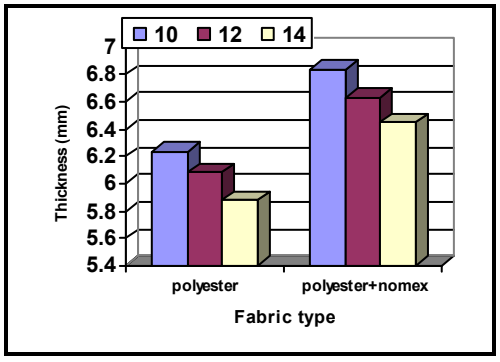


**Fig. (16)**
**Effect of fabric type and needles penetration depth mm on the thickness (mm) at weight 2200 gm/m²**

**3.6.1. Effect of the fabric type on the fabric thickness:**

It is clear from table (11) and figs. (15,16) That the nonwoven (85 % polyester/15 % nomex) Fabrics have higher thickness than the nonwoven polyester fabric for all the weights and all the needles puncture. This can be explained as the reason is difference between properties of materials.

**3.6.2. Effect of fabric weight on the thickness of fabrics:**

It is clear from table (11) and figs. (15,16) that there is a directly proportional relation between the fabric weight and the thickness this can be attributed to the increase in weight means increase in number of fibers per unit area and increase the layers number of fibers and layers number of woven fabric which leads to the increase in fabric thickness.

**3.6.3. Effect if needles penetration depth on the fabric thickness:**

It is clear from table (11) and figs. (15,16) that there is an inversely proportional relation between the needles penetration depth and the fabric thickness this can be attributed to the increase in needles penetration depth causes increase in merging between fibers and layers of fabric which increases fabric compactness and decrease pores size between fibers and layers, hence the fabric thickness will be decreased.

**4. Conclusion:**

The weight of fabrics and the type of materials have great impacts on the tensile strength, elongation, abrasion resistance, air permeability, Dimensional stability and thickness. Nevertheless the needles penetration depth has little impacts on the same properties.

- Increasing the fabric weight leads to increase the tensile strength, abrasion resistance, Dimensional stability and thickness.
- Increasing the fabric weight leads to decrease the air permeability and elongation.
- Increasing the needless penetration depth leads to increase the tensile strength, abrasion resistance and dimensional stability.
- Increasing the needles penetration depth decreasing the elongation, air permeability and thickness.
- The fabrics made of polyester and Nomex have higher tensile strength abrasion resistance air permeability dimensional stability and thickness than the Fabrics made of 100% polyester .
- The fabrics made of polyester have higher elongation at break than the fabrics made of polyester and Nomex. Whenever the elongation at break of air slide fabrics decreased the more it is suitable for usage.
- The fabrics in the length direction recorded higher tensile strength and elongation than the fabrics in the width direction.
- The fabrics made of (85%polyester+15%nomex) are better in the required properties as the air slide fabrics than the fabrics made of 100% polyester.

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