

## Development of Antibacterial and Thermal Storage Carbon/Silver Fabric by Using Thermoprint and Fitting Technique

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**Abstract:** This paper introduced an Antibacterial Carbon/silver film thermal fabric designed by using thermoprint and fitting technique, and introduced the base fabric selection, Product specifications, technological process, process parameters and key technologies detailedly, then tested antibacterial property, tear strength, the washing Appearance changes, abrasion resistance, warmth retention property according to the standard, Through the detection of the fabric we found that antibacterial rate of Staphylococcus aureus of the fabric up to 97.9%, the warp tear strength is 13.4N, and the weft tear strength is 12.9N, after washing the Carbon/silver film face has no significant Shedding, abrasion resistance > 5000 turns, thermal resistance is 0.013, water- vapor resistance is 25.1, test data shows that the designed functional fabric meet the technology requirement of the standards, meet the demand of the customer's use requirements.

### Introduction

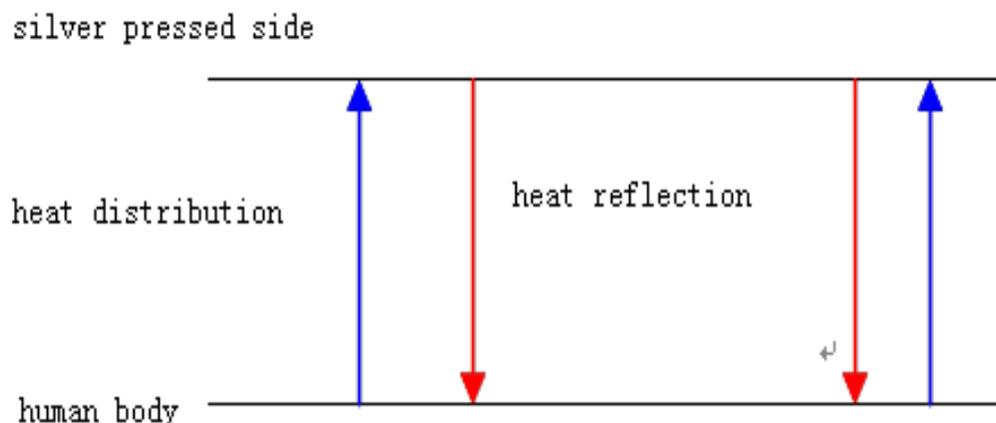


Fig.1. Heat preservation Mechanism diagram

Combination Gilding process of Printed matter we use the carbon silver film on 4-way Spandex woven fabric. It can make the fabric not only has the characteristics of heat preservation, antibacterial and deodorant, but also has the characteristics of fashion, smaller friction coefficient, wind proof and good elasticity. This product is woven fabric whose surface is coated with the activated carbon powder. Carbon powder materials is a kind of biological materials, which is non-toxic harmless. Carbon powder can be added into PU resin, which can make the fabric have the functions of moisture absorption, deodorant, antibacterial, negative ion, anti ultraviolet, heat preservation and so on. The product' PU resin was also added into silver powder. Silver powder is commonly known as the "Aluminum powder", which has the Light weight, high floating force, strong hiding power, and good reflection of light and heat. Also can made the derived textiles have the heat preservation and the metal appearance [1-3]. Fig.1 is the heat preservation Mechanism diagram of the silver pressed fabric.

## Experiment

### Materials and instruments

#### Fabric specifications

Fabric:4-way Spandex fabric;Linear density:75D+40D\*75D+40D;

Weight:105g/m<sup>2</sup>; Material:T(94% ),op(6%); Warp density: 480 roots/10cm;Weft density:430 roots /10cm;

Fabric weave:Plain weave

#### Selection of transfer film substrate

At present, the main heat transfer film substrate include OPP、PET、PVC、CP, This product used PU resin with carbon powder and silver powder to imprint with cloth through OPP transfer film, Select OPP film mainly because the materials have high smoothness and transparency, temperature resistance and Climate resistance.

#### Equipment

The production equipment of antibacterial fabric is provided by jiang su nanwei Yueda,The equipment consists of four parts:Glue table、oven、 tension control device of carbon silver film, winding device and stripping device.

### Technological process

#### Process flow chart

The process flow chart of the antibacterial carbon/silver film thermal Fabric is shown in Fig.2.

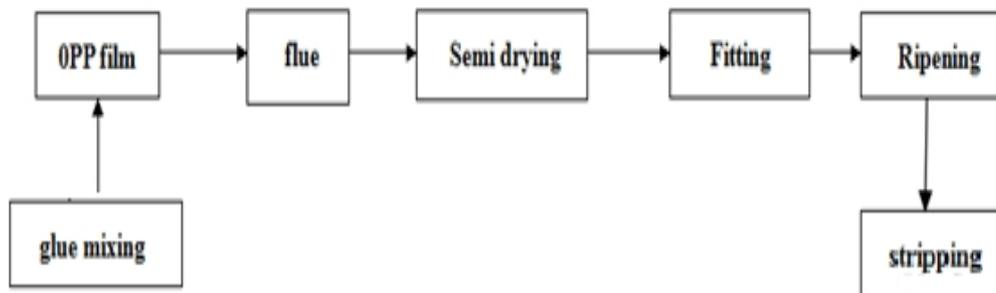


Fig.2. Process flow chart of the Antibacterial Carbon/Silver Film Thermal Fabric

#### Fitting Technological process

The technological process digram of the antibacterial carbon/silver film thermal Fabric is shown in Fig.3.

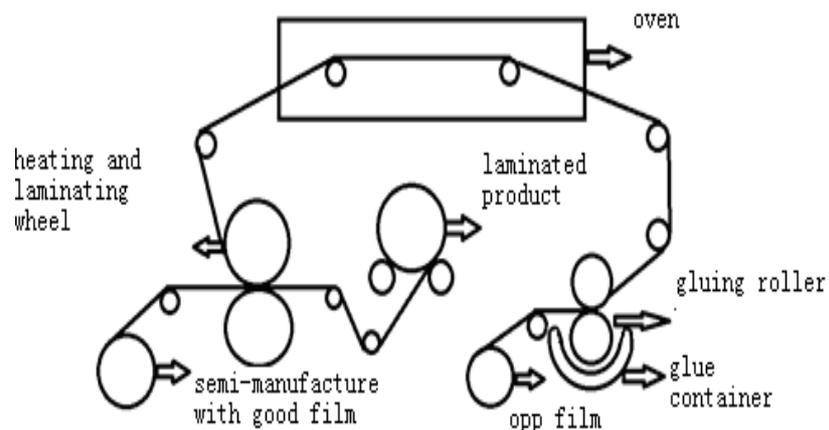


Fig.3. Technological process diagram

### stripping process diagram

The stripping process diagram of the antibacterial carbon/silver film thermal Fabric is shown in Fig.4.

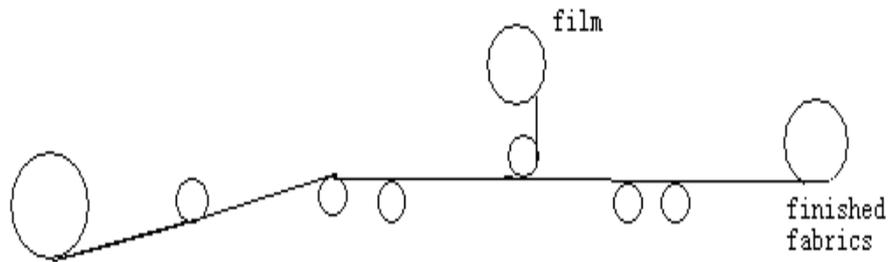


Fig.4. Stripping process diagram

**Place the finished fabrics in the ripening room to ripen**

### Process parameters and key technologies

#### Determination of hot stamping pattern

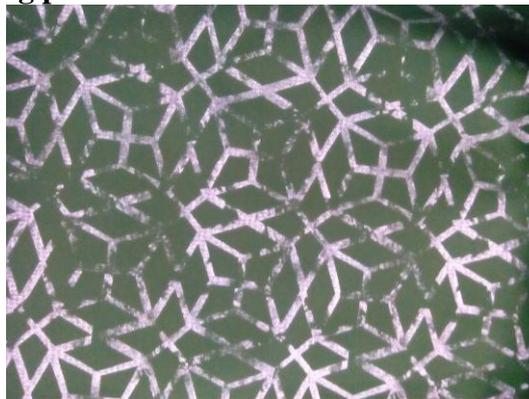


Fig.5. Face side silver pressed pattern

The pattern size determines the carbon and silver film coverage on the cloth, and also determines gluing quantity. Pattern density determines the product's insulation performance and fabric feel, Therefore, the pattern design is very important.

For this product, the face side of the woven fabric is silver pressed, the pattern is stereoscopic window grilles, the inner side of the fabric is laminated OPP film, on the film is carbon/silver pressed which with the pattern of honeycomblike. The specific pattern is shown in Fig.5 and Fig.6.



Fig.6. OPP film silver pressed pattern

### Temperature determination

The temperature mainly includes hot stamping temperature, oven temperature and fitting wheel temperature, The temperature has a great influence on the quality of hot stamping. If the temperature is too low, the melting will be insufficient, which result in no hot stamping or weakly stamping , If the temperature is too high, it will make film to melt, And also lead to the oxidation between the surface of the dyed layer and carbon silver film, so that the hot stamping products lose the metallic luster, reduce the brightness, according to the performance of the carbon silver film, hot stamping stress , hot stamping speed, for this production the hot stamping temperature range is 70 to 150°C. Oven temperature: 40~45°C. Fitting wheel temperature: 100~120°C.

### Laminated pressure determination

The function of the Laminated pressure, The first is to ensure the TPU film can be adhered to the substrate, Laminated process itself is the process which use the temperature and pressure to glue the fabric to the substrate. If the pressure is small, it will not be able to make the fabric adhere the substrate ,which result in no laminating or weakly laminated , If the pressure is too big, the fabric and substrate 's compression deformation will increase. For this product the laminated pressure is 6 - 6.5Kg.

### Speed determination for hot stamping

The contacting time between carbon silver film and substrate be determined by the hot stamping speed, and the contacting time determines the stamping fastness, the speed must accommodate to the pressure and temperature , too fast and too slow won't be good. For this product the speed is about 15~20m/min.

### Determination of tension control

Degree of tightness for silver film tension should be appropriate , if the tension is bigger ,the lines will be lack or broken. If looser the film surface will be folded to death. The cloth tension control should be appropriate too, if the tension is bigger will produce shrinkage for the silver pattern, and the pattern will broken. If looser will produce dead fold and indentation. Therefore, the cloth and film feeding tension and winding tension are extremely important.

### Glue formula

The formula determines the silver pressed fastness, but the adjustment of the formula and the temperature, speed, pressure and pattern of the process are related, the choice of solvent determines the temperature and speed, choose the volatile solvents need to reduce the temperature , The ratio of the additive agent based on the pattern which determine the glue's viscosity and pressure. Therefore, it's need to determine the solvent ratio and solvent type in the glue according to the pattern. For this product , the glue formula is shown in Table.1.

Table.1 Glue formula

Reagent name	Proportion
Polyurethane adhesive	100
MEK	120
Bridging agent	8
Silver powder	20
Carbon powder	10
Promoters	3

## Ripening temperature and time determination

Ripening temperature and time determines the hot silver fastness so as to improve hot silver wash ability and soft feel. For this product the ripening temperature and time: 65 °C, 12h.

## Performance test

Table.2 Testing Results

Item	Standard	Index	Result	Judgement
Washing appearance	AATCC 124-2011	10 laundering	3.0 grade	up to standard
Colorfastness to laundering	AATCC 61	4 and over	Color fastness: 4.5 staining color fastness : 4.5	up to standard
Abrasion resistance	ASTMD4966-2010	OVER 5000	≥5000turns	up to standard
Tearing strength	ASTMD1424-2009	10 N	warp: 13.4 weft: 12.9	up to standard
Physiological effects	GB 11048	Thermal resistance≥0.01 Water vapor resistance≥23	0.013 25	up to standard
Antibacterial test	GBT20944.3-2008	antibacterial rate (Staphylococcus aureus )	97.9%	up to standard

The Products were produced by Jiangsu Nanwei Yueda Fiber Technology Co.Ltd and were sent to CNTAC Testing Center-Suzhou Zhongke Textile Technology Service Co.Ltd.The Test standards and the corresponding index and test results are shown in the Table.2[4-6].Testing data from Table.2 show hat the designed product's performance on antibacterial、washing appearance、color fastness、wear resistance and heat preservation、strength have all reached technical requirements of the standards, meet the requirements of the normal customers, fulfill the original intention of the design[7-8].

## Conclusions

Thermal storage carbon/silver fabric, use the 4-way Spandex fabric as the base cloth, using the hot stamping and fitting techniques, according to the self-designed pattern, and transferred carbon silver film to the woven fabrics.

The product Mainly were endowed with excellent antibacterial deodorant, heat preservation effect, and this product has the fashion and novel appearance、smooth、easy to put-on- and-off and other excellent performance too.

This functional fabric is preferred fabric used as lining of wind jacket, inside, Outdoor Jackets,golf shirt and so on .

## Acknowledgements

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