

Study on Water-Resistant Finish on Mattress Protector

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Abstract: A mattress protector is a piece of detachable bedding that lies on top of the mattress and encase the mattress to protect it from micro-organisms, water and dirt particles. In the home-textile market, we have many types of mattress protectors, but the water-resistant property is not imparted on the whole. Ordinary mattress protectors cover and avoid penetration of foreign particles such as stains, dust, and insects. For mattress protectors, to impart a water-resistant feature, the chemical base poly coating lamination technique has been adopted. These laminated mattress protectors provide a higher level of comfort with water-resistant property, as well as high-quality yarns provide a good night's sleep and prevents irritation to the skin. This product fabricated with blended yarns to provide extra benefits based on the application.

Keywords: Knitting, dyeing, lamination, water-resistant, mattress protectors.

1. Introduction

Mattress protectors play a major role in encasing the mattress material for different requirements. In the market base, we have different types of protectors. Mattress covers give protection from allergens and irritants such as dust mites, bed bugs, mildew, and dead skin like dandruff. Mattress toppers are also playing the same role comparatively, but they're made particularly for comfort function. A softly quilted contour sheet is the most basic type of mattress cover. It offers very minimum protection against liquids and offers little or no protection against dust mite allergies. Waterproof mattress coverings keep the mattress clean by preventing it from collecting bodily excretions such as sweating or spilt liquids, particularly breathable fitted covers are examples of these. Mattress protector with water-resistant property has been developed by adopting poly coating lamination technique. The composition of the laminating chemical varied to identify the best quality fixation and performance. Polyester/cotton blends are very fashionable clothing, stronger, more customizable, and possess easy drying property compared to 100% cotton. And it an equivalent time, it doesn't naturally stick with the skin like 100% polyester. Blended material of polyester with cotton produces stronger material, which is durable and affordable. The top layer of the mattress product is knitted terry fabric, the bottom layer is a TPU (Thermoplastic polyurethane) coating for waterproof purpose. These types of protectors perform better in protecting the mattress from dirt particles, stains and also water

which in turn prevents microbial growth over the mattress material. These sorts of protectors provide a higher level of comfort as the cotton and polyester fibres occupy the top layers of the product. Thermoplastic polyurethane coating gives water resist property, this coating will work like film or layer on the fabric. Fall fabric and elastic is attached sidewise to the product for giving fitness to the mattress protector.

2. Work Methodology

1) Knitting

Yarn of cotton/polyester blend procured at 80:20 proportion and the count is 40Ne. Cotton is a natural fibre, cotton may be a natural resource and is biodegradable. Cotton fibre is spun to form a thread or yarn to make a breathable and soft textile or fabric. Cotton clothes aren't only soft, but durable and comfortable and high price. In this blend proportion, the cost can be reduced without compromising the softness quality of the cotton material. Moreover, cotton is hypoallergenic and does not irritate sensitive skin and minimizes the possibility of causing allergies. Polyester is showing better strength and more lustre comparatively than cotton fibre. Cotton and polyester blends are less prone to pilling and static charge than 100% cotton material. When circular knitting machines are ready to produce these materials at a high speed and of sufficient quality, warp knitting circular technology will lead the textile industry in developing unique materials. Knitting terry textiles for towel and fitting linen has proven to be very successful with this process. The approach necessitates the use of a complex needle tricot machine incorporated with normal compound needles and alternating large-head needles within the needle bar. The guide bars are threaded so that the terry guide bar overlaps only the large-head needles and the bottom guide bar overlaps only the traditional compound needles. In the latter situation, this occurs only on alternate knitting cycles, causing the large-head needles to overturn the terry pile loops without obtaining a replacement overlap, resulting in pressing off their loops. Three guide bars are commonly used to knit single-sided terry. The bottom chain stitch is created by the front bar, the bottom is inlaid by the second bar, and the terry is alternately overlapped and inlaid by the third bar. The inlays of the even courses are kept within the structure by the bottom bars after the overlaps of the odd courses are pressed off. The terry loops on one side of the cloth

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protrude in this type of fabric. The material's opposing side remains flat. The pile loops are frequently fully on one side of the cloth or alternate between the face and back of the cloth. The required GSM was 140 in the stage of knitting. False twist textured polyester yarns are also used in circular knitting, where the inclusion of elastic improves the stretch qualities of the cloth. Sportswear and leisurewear are common end applications. Circular knitting is well-known and difficult to work with in terms of cloth appearance, since tiny crimp variation, yarn frictional qualities, intermingle uniformity, and crimp stability may harm dye color and fabric cover. It takes special care to achieve proper crimp stability on microfilament yarns to minimize the impact of any tension variations throughout the knitting process.

2) Dyeing

Knitted textiles are subjected to a variety of chemical treatments such as scrubbing, bleaching, dyeing, hydro-extractor dewatering, sewing, steering, compacting, softener padding and relax drying. These operations are used to impart a specific attribute to the material, like increasing absorbency, whiteness and adding colour to the material. And finishing is done to improve the material's suppleness and handling. The chosen process has an impact on the material's characteristics and overall performance. Internal tensions accumulated during the spinning and knitting processes are eliminated during the finishing process. A low-impact dye is used to dye the mattress fabric that has been certified as environmentally favourable by the Oeko-Tex Standard 100. Low impact dyes, in general, do not include hazardous chemicals or mordants (chemicals that help the dye adhere to the cloth), require less washing, and have a high absorption rate in the fabric (up to 70%). High absorption rates and less rinse water consumption result in reduced wastewater in the effluent. Reactive dye is a class of dye that makes a covalent bond with the fibre and becomes an integral part of the fibre. Circular knitted fabrics are opened width-wise before dyeing followed by the colouration process and at the end, the fabric is given a heat set to achieve dimensional stability and to reduce the tendency to twist at the sides. The fabric was coloured in rope form of open-width fabric using reactive dye at a pH level of 12-12.5 by addition of NaOH to the dye bath and with the presence of Ca and Mg in the hard water. However, these metal ions induced dyes to get hydrolyzed, resulting in insoluble complexes. The addition of anti-creasing agent, salt and soda in the range of 0.5-2.0G/L, 10-40 G/L, 2-20 G/L respectively, and fixing a higher liquor ratio improved the dyeing efficiency. All the active components were added and the process was carried out at a temperature around 60-80°C. The cloth washed in hot water (40 degrees Celsius) followed by in cold water. After the dyeing process, the cloth was rinsed in 13 G/L detergent soap solution for at least 10 minutes at 60°-80°C. The washing fluid drained and the coloured cloth washed in hot water and then cold water. Finally, the coloured textiles were subjected to hydro extraction followed by a dryer. Reactive dyes showed brilliant and bright colour shades along with permanency of the colour and covalent fixation of dye molecules with cotton fibre gave high wash fastness at various temperatures including low energy.

After dyeing the measured linear density of the polyester/cotton fabric showed 160 GSM.



Fig. 1. Face side of the fabric after dyeing



Fig. 2. Back the side of the fabric after dyeing

3) Lamination process

TPU (Thermoplastic polyurethane) film is a flexible substrate that may be tailored to a wide range of performance requirements. A range of basic chemical classes in TPU contributes to its adaptability. Polyester, polyether, or polycaprolactone in general utilized to extrude TPU film. The physical performance of the TPU substrate varied depending on the base chemical molecular structure and its function. Polyester based TPUs, possess greater chemical and oil resistance, whereas polyether-based TPUs shows good flexibility and rip resistance. Due to their high amount of hydrolysis-resistant, polycaprolactone based TPU substrates can be exposed to water for an extended period. The extruded TPU film applied over the fabric surface. Surface coatings, metallization, and lamination can improve the material's functioning after extrusion. The dimensional instability of TPU film caused more difficult processing. The high flexibility and elongation of TPU created a huge problem in handling the film material while processing the film in roll-to-roll form. The TPU coating was applied in the form of film to the bottom side of the mattress protector fabric. Thermoplastic polyurethane showed high elasticity, transparency, water resistance, abrasion resistance, low-temperature performance, high shear strength, and oil and grease resistance. TPU film is biodegradable which can be recycled. After the lamination process, the measured linear density of mattress protector fabric is 180 GSM.



Fig. 3. The face side of the fabric after lamination

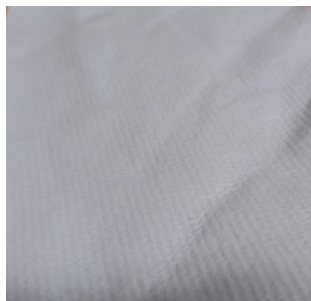


Fig. 4. The backside of the fabric after lamination

4) Cutting and stitching

An authorized sample was used to create a cut pattern for the finished fabric. The grainline pattern was referred to as laying and spreading the cloth longitudinally. A cloth shade guide was used to spread the fabric without curves, skew bends, narrow parts, non-uniform stress, and highlighting visual faults. Then the fabric was cut into the required size using a cutting machine. The required size of fabric pieces is 75 inches in length, 48 inches in width and 12 inches in polyester fall fabric in the side fitting.

5) Stitching

An overlock stitch type is used for edging, hemming, and seaming that sews over the edge of one or two pieces of cloth. In most cases, an overlock sewing machine will cut the edges of the cloth as it is fed through. With two needle threads, a 4-thread overlock stitch sews two rows of stitching on the fabric while the looped threads wrap around the edge. This stitch is appropriate for medium to heavyweight materials and seams that are subjected to stress. The 4-thread overlock is found as a good alternative to the fixed stitch when flexibility and durability are the major requirements in a seam. The 4-thread overlock stitch is used to join the top side of the fabric with the fall fabrics. And it attaches the elastic rope to the fall fabric for making fit comfortable while draping the protector.

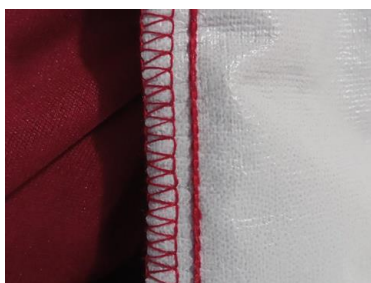


Fig. 5. Attaching fall fabric using overlock stitch

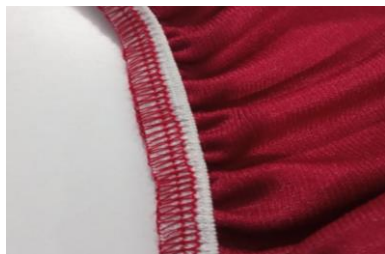


Fig. 6. Attaching Elastic with fall fabric using overlock stitch.



Fig. 7. The Finished mattress protector

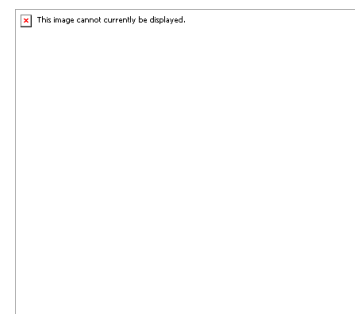


Fig. 8. The mattress protector with water-resistant in the application

3. Conclusion

A mattress is a big pad that is placed on a bed to provide support to a reclining body. As a result, a tailored mattress protector can help to increase the durability of mattresses. A high-quality mattress cover increases the life of a mattress by keeping germs and dirt mites at bay. Quilted mattress protectors and waterproof mattress protectors are the two most effective ways to make the sleeping pads more comfortable and healthy. Getting such protection comes with a slew of benefits. Even though it is waterproof, it prevents water and other substances from penetrating the mattress's wall. The waterproof bed protector keeps stains, allergies, and dust out of the bedding and fitted sheets. This keeps the mattress looking new, no matter how old it is. Since the mattress protector is detachable from the top, it takes very little effort for anybody to remove it and wash it as needed. The quilted mattress protectors are fine cotton with a touch of polyester. Quilted protectors, on the other hand, are constructed of 80% cotton and 20% polyester. These coverings are typically simply cleaned because they are 100% waterproof. Furthermore, a mattress protector makes a mattress more resilient and long-lasting, as well as protecting it from many types of damage and accidents.

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