

Research Article

# Coating Machine Developed for Technical and Smart Textile Applications

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## Abstract

*In today's textile industry, besides products that appeal to fashion, functional technical and smart textile products obtained by integrating many technologies into clothing are in demand. Many functional properties such as antibacterial, heat and electrical conductivity can be applied to yarns and fabrics by production methods such as impregnation, exhaust, etc. However, the current yarn coating technology has disadvantages such as inability to make homogeneous coating with different chemicals and low coating durability. In this study, the coating process was carried out in a yarn coating machine, which was developed to allow one-wire coating from bobbin to bobbin, which is the first in the sector, and the effect of the coating method on the yarn properties was evaluated by examining the performance characteristics.*

**Keywords:** Multifunctional Coating Machine, Yarn Coating, Technical Textiles

## 1. Introduction

Coating is a textile finishing process designed to obtain a value-added textile product by adding functional properties to yarns or fabrics. As technical textile applications become more diverse, the uses of this technique are increasing rapidly. Coatings also facilitate the development of entirely new products, leading to innovations in the field of smart textiles.<sup>1</sup> Coated products; it is used for various purposes such as protection from the harmful effects of electromagnetic fields, information transmission and storage, and reducing the static effect. Use of conductive textile materials instead of metal foil or wire mesh in applications; it provides advantages such as lightness, being able to be produced in a wide variety of forms, resistance to corrosion and low cost compared to metals [2].

Blending of synthetic and natural fibers with metals is carried out successfully especially in short staple spinning processes, but the obtained electrical properties are not at the desired level. In addition, mechanical properties, handle, drape etc. physical and appearance properties are adversely affected. In the coating process, yarns acquire a conductive structure by using various production techniques (eg impregnation, exhaust, spincoating, dip coating, electropolymerization, etc.). Today, coating systems do not allow coating on a single yarn for industrial purposes. In the current technology, three systems that can be used to coat the yarn; sizing, mechanical coating and bobbin dyeing machines. In sizing machines, it is not possible to coat the yarn from one bobbin to another over a single wire. For example; the bobbins are wound on an average of 500 wires on a beam in serial warp and approximately 10 beams are combined and 5000 wire coated with starch derivatives. Coating different chemicals in this system is not ergonomic for mass production. In the bobbin/hank dyeing technique, cylindrical yarn balls or bobbins with a weight of 500 gr to 1500 gr and a density of 300-400 dm<sup>3</sup> are dyed. In this technique, the penetration of the coating material to the yarn is not homogeneous. The last method that can be used in the coating process is mechanical coating machines and it is not possible to make chemical coating with this technique. In the coating machine developed for technical and smart textile applications, multifunctional yarns can be obtained by applying many environmentally friendly chemical coatings such as conductivity, antibacterial, flame retardancy, glitter coating homogeneously on a single wire yarn. In addition to coating on the filament in the developed coating machine, it is also possible to apply coating to yarns obtained from short fibers. Within the scope of the study, polyester/polyamide blended yarn; the effect of the coating method on the yarn performance properties was evaluated by making silver coating in the developed coating machine.

## **2. Materials and Methods**

### **2.1. Materials**

In this study, double-ply yarns were produced from Ne 20/1 Polyester/Polyamide 60/40% ring yarn for coating by the doubling-twisting method. In order to obtain a conductive yarn, it was subjected to coating, drying and winding processes with the silver coating solution prepared in the coating machine, which adopts the single-wire yarn coating technique. Features of the raw materials used; Polyester fiber fineness and length: 1.33 dtex, 38 mm, Polyamide fiber fineness and length: 1.4 dtex, 38 mm.

### **2.2. Method**

This study was carried out in the coating machine developed as a result of R&D studies in Karacasu Tekstil. (Figure 1) The yarn strength values of the yarns used in the study before and after the coating process were carried out in the Uster Tensojet-4 device in accordance with TS 245 EN ISO 2062 standards. Unevenness values such as hairiness, shape, yarn diameter were measured using the "TS 628" standard in the Uster Tester-6 device.

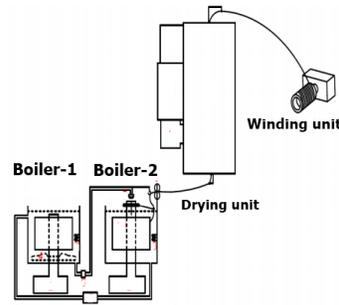


Figure 1: Coating Machine

### 3. Results

In the study, silver coating process was applied to the yarn obtained by using ring short fiber spinning and folding-twisting technologies from polyester and polyamide fiber blends, the technical characteristics of which are given above. The unevenness and strength values before and after the coating process are given in Table 1.

Yarns	Strength (RKm)	Elongation (%)	B.Work (N.cm)	Hairines	Shape	Yarn Diameter (mm)	D (gr/cm <sup>3</sup> )
Ne 20/2 Polyester/Polyamid %60/40 raw yarn	27.3	15.18	59.66	6.55	0.75	0.41	0.45
Ne 20/2 Polyester/Polyamid %60/40 after coating process	27.48	9.1	41.35	5.9	0.76	0.353	0.6

Table 1: Yarn Mechanic Analysis Results

The Strength value of Ne 20/2 Polyester/Polyamide 60/40% raw yarn is 27.3 RKm, Elongation is 15.18%, B.Work 59.66 N.cm, Hairiness 6.55, Shape 0.75, Yarn diameter 0.41 and Density (D) value 0.45 gr/cm<sup>3</sup>. The values after the coating process were measured as

Strength value 27.48 Rkm, Elongation 9.1%, B.Work 41.35 N.cm, Hairiness 5.9, Shape 0.76, Yarn diameter 0.353 and Density (D) value 0.6 gr/cm<sup>3</sup>.

As can be seen from Table 1, there was a slight increase in the yarn breaking strength value, a 6% decrease in the elongation value, and a decrease of 18.31 units in the breaking work value. Considering the yarn unevenness parameters, it was observed that there was a positive decrease in hairiness and yarn diameter values, while an increase in yarn shape and density values.

#### 4. Discussion and Conclusion

In this study, silver coating was applied to polyester/polyamide fiber blended double-ply yarns to obtain conductive yarn during transfer from coil to coil. In this study, the yarn unevenness and strength values after coating were examined, it was found that the silver coating applied to the yarn had a positive effect on the breaking strength and the yarn elasticity decreased due to the increase in yarn rigidity after coating, but B. Work values has shown that it will not be a problem for the weaving and knitting loom performances of the yarn. The reason for the improvement in hairiness and yarn diameter is the adhesion of the protruding fibers to the body with the coating material after the coating application. The reason for the increase in yarn shape and density values can be explained as a homogeneous coating and the yarn surface becoming a smoother, rounder and compact structure. In this study, conducted with an innovative perspective, it is seen that the single-wire yarn coating method with developed environmentally friendly materials has a positive effect on yarn unevenness and strength values and is suitable for industrial use.

This study, carried out in order to see the capability of the developed coating machine, continues with fabric performance tests.

In the machine, which can coat from coil to coil over a single wire, it can be coated homogeneously with different chemicals, as well as energy savings of 25-30% thanks to the feedback unit in the drying cabinet.

Thanks to the developed coating machine; many R&D studies will be carried out and many innovative products will be produced. Coating studies with different compounds for antibacterial properties, the possibility of working with different compounds that provide conductivity, breathability, heat conduction, thermo-photochromic etc. innovative products can be developed. It is predicted that the yarns with high added value can pave the way for R&D studies in the textile sector. Thanks to the products to be produced in the coating machine, it will be effective in bringing an innovative perspective to the textile and machinery manufacturing sector with high added value. In addition, it will create awareness in the textile sector that the transformation into the technical textile field is a factor that increases the competitiveness.

## **5. Acknowledge**

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