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## ANALYSIS OF TEXTILE MATERIALS USED IN THE PRINTING INDUSTRY

VASILIEV Nicoleta, CAZAC Viorica

Technical University of Moldova, Chişinău, Republic of Moldova

[nicoleta.vasiliev@dip.utm.md](mailto:nicoleta.vasiliev@dip.utm.md)

*The textile industry offers a wide range of materials for various fields of application, each with specific properties that influence the durability, comfort, and sustainability of products. The printing industry is one of the applicable fields for textiles, both as a material for finished products and as materials involved in printing manufacturing processes, although they are not directly present in the final product. In this context, both natural and synthetic textiles are used in the printing sector.*

*This paper analyzes textiles with implications in the printing industry, considering their sustainability aspects. Natural materials (cotton, wool, linen, silk) are biodegradable but require significant resources for production. Synthetic fibers (polyester, polyamide) are durable and allow efficient pigment fixation through printing technologies, such as sublimation.*

*In the printing industry, materials such as paper, cardboard, plastic films, and specialized textiles (Tyvek, Balacron) are used depending on their compatibility with printing technologies. Finishing techniques, such as lamination or embossing, enhance the aesthetics and durability of the final product.*

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**Key words:** textile material, sublimation, digital, screen printing.

### INTRODUCTION

The printing industry is a field where textiles have extensive applications, both as a printing substrate and as essential elements in the manufacturing process itself.

Textiles used in the printing industry [11] can be of primary natural origin, synthetic, or recycled and are selected based on manufacturing objectives, considering their physical and chemical properties. Often, mechanical properties such as durability, flexibility, ink absorption, and resistance to external factors are the most sought-after in the context of their involvement in manufacturing technologies.

To determine the identity of textiles used in the printing industry, the following analysis will focus on textiles that are directly found in final products, serving as print substrates and interacting with printing technology. These include textiles for clothing, lingerie, special-purpose garments, technical products, interior and exterior decor textiles, medical textiles, geotextiles, agrotexiles, sports



products, filtration products, packaging, sports equipment, scenographic props, artistic creations, visual arts, advertising banners, etc.

Similarly, an analysis will be conducted on textiles involved in the manufacturing process but not present in the final products. These include textiles used as screen meshes in screen printing, textiles for offset rubber blankets in offset printing, and more.

### 1. TEXTILE IDENTIFY

The textile and printing industries play a crucial role in economic and social development, being closely linked to technological progress and sustainability requirements. The diversity of materials used in these fields necessitates a rigorous classification and a comparative analysis of each material's characteristics, considering both technical performance and environmental impact.

From the perspective of textile applications in the printing industry, particularly regarding sustainability, materials are categorized into natural fibers, synthetic fibers, and recycled fibers (Fig. 1), each with specific properties that influence product comfort, durability, and sustainability. Natural fibers such as cotton, wool, silk, linen, and hemp are valued for their biodegradability and comfort; however, they raise concerns regarding the resources required for production.

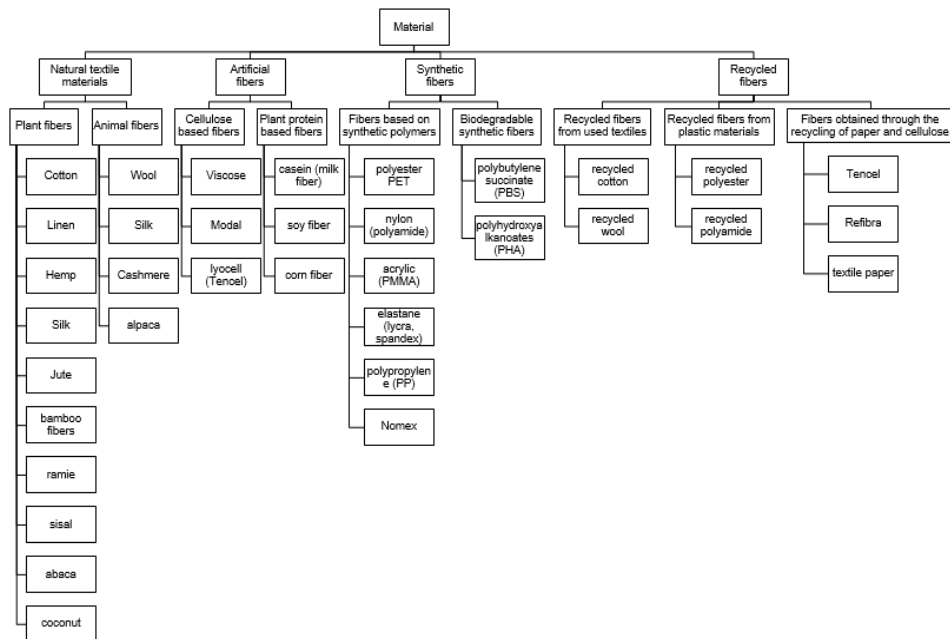
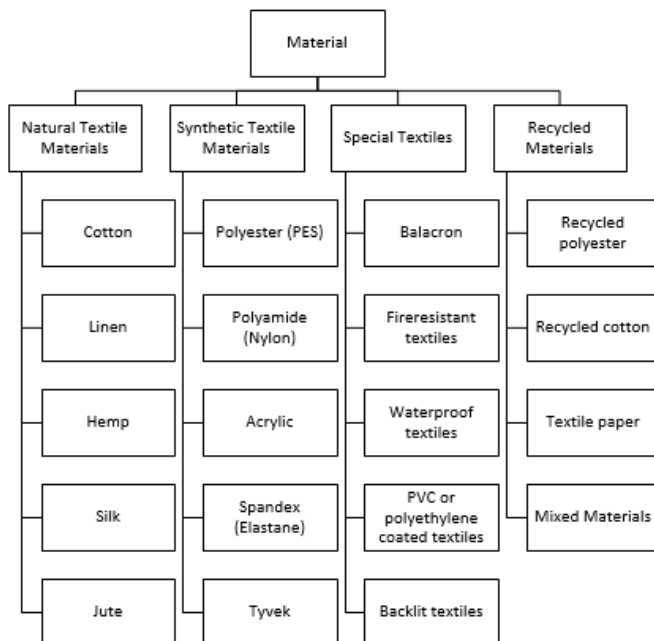


Fig. 1. Classification of Textile Materials [1, 2]



## 2. TEXTILES USED IN THE PRINTING INDUSTRY

The printing industry involves a wide range of materials, including paper (standard, recycled, art paper), cardboard, plastic films, and textile materials (Fig. 2). There is an increasing emphasis on using recycled materials and eco-friendly solutions to reduce environmental impact and meet current sustainability requirements.



**Fig. 2.** Textile Materials Used in the Printing Industry

Textile materials applied in the printing industry are obtained from:

- Cotton – Frequently used in screen printing and sublimation, ideal for t-shirts, fabric tote bags, artistic canvases, and customized drapes.
- Polyester (PES) – Primarily used for flags, textile banners, roll-ups, and printed sportswear.
- Polyamide (Nylon) – Utilized for textiles designed for outdoor activities, customized umbrellas, and durable banners.
- Tyvek – A highly durable and waterproof synthetic material used in the printing industry for book covers, packaging, and clothing labels [3].
- Balacron – A synthetic material used for book covers, planners, and customized menus, offering enhanced durability and compatibility with screen printing, embossing, or foil stamping.



- Fire-resistant (FR) textiles – Essential for exhibitions, indoor banners, and tents.
- Waterproof textiles – Used for customized umbrellas, outdoor textiles, and exterior banners.
- PVC- or polyurethane-coated textiles – Ideal for durable advertising banners and display materials.
- Backlit textiles – Specifically designed for banners and posters illuminated from behind (lightbox).

The relationship between textile characteristics and printing/finishing processes relies on the compatibility between fiber structures and applied technologies (Table 1). Natural fibers such as cotton and linen exhibit superior absorption of water-based inks, making them ideal for techniques like screen printing and sublimation, often requiring specific treatments [6]. In contrast, synthetic fibers such as polyester and polyamide enable more efficient pigment fixation through direct sublimation [5,6], ensuring vibrant colors and long-term durability.

**Table 1**

**Textiles Applied and Compatible with Printing Technologies [4-10]**

| Textile material                     | Printing Technologies |                  |             |
|--------------------------------------|-----------------------|------------------|-------------|
|                                      | Screen printing       | Digital printing | Sublimation |
| <b>Cotton</b>                        | +                     | +                | +           |
| Wool                                 | +                     | +                |             |
| Linen & Hemp                         | +                     | +                |             |
| Silk                                 | +                     | +                |             |
| Jute                                 | +                     |                  |             |
| PES                                  | +                     | +                | +           |
| Nylon                                | +                     |                  | +           |
| Acrylic                              | +                     | +                |             |
| Elastan                              |                       | +                | +           |
| Tyvek                                | +                     | +                |             |
| <b>Balacron*</b>                     | +                     | +                |             |
| <b>Efalin*</b>                       | +                     | +                |             |
| <b>Surbalin*</b>                     | +                     | +                |             |
| <b>Fire-resistant textiles (FR)</b>  | +                     | +                |             |
| Waterproof textiles                  | +                     | +                |             |
| PVC- or polyurethane-coated textiles | +                     | +                |             |
| Photoluminescent textiles            | +                     | +                |             |
| Backlit textiles                     | +                     | +                | +           |
| Recycled polyester (rPET)            | +                     | +                | +           |
| Recycled cotton                      | +                     | +                |             |
| <b>Textile paper*</b>                | +                     | +                |             |
| Recycled mixed materials             | +                     | +                |             |

\* They can be printed using offset printing or flexography



Special materials like Tyvek [3] or Balacron [8] require specific printing techniques such as screen printing, UV printing, or foil stamping to ensure both durability and high-quality aesthetics.

Additionally, finishing techniques like lamination, protective coatings, or embossing enhance product lifespan and aesthetic effects, playing a key role in advertising, textile, and editorial fields. Thus, selecting the appropriate material and printing method must be aligned to achieve an optimal balance between visual quality, durability, and sustainability.

Analyzing the table, we observe that screen printing is the predominant printing method widely used for textiles, as it is compatible with all types of materials. This is due to its versatility and ability to print on various surfaces: flat or differently configured, including textiles, paper, and plastics.

Sublimation is mainly used for synthetic materials such as polyester, polyamide, and spandex, due to the ability of these fibers to retain pigments within their structure.

Digital printing is frequently combined with screen printing, being suitable for natural and recycled materials like cotton, wool, and textile paper. It offers increased flexibility and the possibility of quick customization.

Offset printing is mainly used for special materials, such as Balacron, Efallin, and Surbalin, due to the precision and fine details it can reproduce.

Flexography is found in materials with PVC or polyurethane coatings, being a technology adapted for smooth and flexible surfaces.

Thus, natural materials (cotton, wool, linen, hemp) are primarily compatible with screen printing and digital printing, synthetic materials (polyester, polyamide, acrylic) are ideal for sublimation and screen printing, while special materials (Balacron, Tyvek, Efallin) require UV printing, offset, or screen printing for optimal quality. Recycled materials can be printed using multiple methods, contributing to sustainability in the printing industry.

## **CONCLUSIONS**

Understanding the printing technologies applicable to various textile and printing materials provides multiple advantages in the industry, influencing both the quality of the final product and the efficiency of the production process. Choosing the correct printing method based on the material not only optimizes costs and resources but also contributes to the sustainability of the manufacturing process.

One of the main advantages of this knowledge is the correct selection of technology based on the material, thus avoiding the degradation of the printable substrate and ensuring optimal pigment adhesion. For example, polyester is best suited for sublimation as it allows the colors to penetrate the fibers, guaranteeing increased durability of the print. In contrast, cotton is more suitable for screen printing or direct digital printing to achieve quality results, as sublimation does not provide satisfactory results without a special coating layer.

Another quality printing objective is to maximize the durability and resistance of the print. By using the appropriate technologies for each material, prints become more resistant to washing, abrasion, and environmental factors. For instance, waterproof or fire-resistant materials require printing methods that preserve their



original properties, such as screen printing or UV printing.

Moreover, cost optimization and production efficiency depend on the correct application of the appropriate technology. Certain methods, such as digital printing, are better suited for custom productions and small batches, while screen printing is more advantageous for large-scale productions due to lower unit costs.

Finally, knowledge of printing technologies allows the identification of innovative elements and adaptation to market requirements, enabling the choice of ecological solutions, such as the use of water-based inks, inks derived from aquatic products (such as algae extracts), or recycled materials. In an ever-changing industry, this expertise becomes essential for optimizing processes and reducing environmental impact.

Therefore, understanding the printing methods applicable to each material type significantly contributes to producing quality, durable, and sustainable products that meet current market demands.

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