ПЛАТФОРМА 2
**ТЕНДЕНЦІЇ РОЗВИТКУ АРТ І ФЕШН-ДИЗАЙНУ**

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# TECHNOLOGICAL ASPECTS OF CUSTOMIZING GARMENTS AND TEXTILE ACCESSORIES THROUGH HEAT TRANSFER PRINTING

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*The present study aims to conduct a comparative analysis of the two widely used thermal printing methods in the textile industry: DTF (Direct-to-Film) heat transfer and vinyl heat transfer. These techniques are essential for the customization and production of textile articles, each possessing specific characteristics and advantages that influence the production process, the final product quality, and its durability. Another important aspect addressed in this paper is the classification of textile materials used in these two types of heat transfer, as the correct selection of materials plays a crucial role in achieving optimal, durable, and high-quality results. Additionally, recent innovations in heat transfer printing are explored, contributing to improvements in efficiency and process quality, as well as expanding the possibilities for textile material customization.*

***Keywords:*** *heat transfer, textiles, printing, technological characteristics, innovation.*

## INTRODUCTION

Currently, for fast and high-quality customization of a limited number of garments or textile accessories, the heat transfer printing method is frequently used. This method can be classified into Vinyl Heat Transfer and Direct-to-Film (DTF) Heat Transfer. These heat transfer printing techniques are applicable to a wide range of textile materials, providing advantages for manufacturers of T-shirts, hoodies, tote bags, umbrellas, backpacks, caps, sportswear, workwear, ties, scarves, windbreakers, jackets, raincoats, vests, ponchos, polo shirts, sweatshirts, bags, eco-bags, tents, and flags, enabling them to offer products to customers or partners in a timely manner.

In the preliminary phase of analyzing the technological characteristics of heat transfer methods, the authors conducted a study on the diversity of textile

materials suitable for these printing techniques (fig. 1) to assess their technological compatibility and ensure a broad variety of finished products.

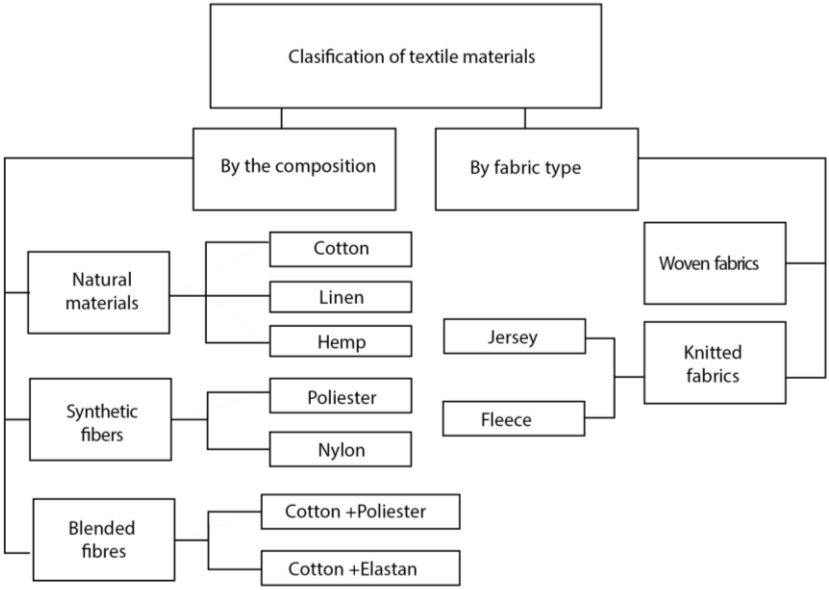


**Fig. 1.** Classification scheme of textile substrates for customization using the Heat Transfer Printing method [1,2]

**COMPARATIVE ANALYSIS OF THE TECHNOLOGICAL CAPABILITIES OF THE TWO TYPES OF HEAT TRANSFER**

To gain a better understanding of the technological characteristics of the two types of heat transfer (Vinyl Heat Transfer and Direct-to-Film Heat Transfer), the case study method was employed. Tests were conducted on natural fiber fabric, specifically used for T-shirt production. The following presents the results of the printing process analysis carried out at the ARTPOLIGRAF printing company, which allowed for the identification of comparative aspects, as shown in Figures 2.1 and 2.2, and Table 1.

*1. Heat Transfer Printing with Vinyl (Vinyl Heat Transfer)*

Materials used: heat transfer film (serving as the base layer for the foil), heat transfer foil (stored in rolls of various colors), and backing material.

Equipment: computer for design preparation, cutter plotter for cutting, and a heat press for printing.

*2. Heat Transfer Printing with DTF (Direct-to-Film Heat Transfer)*

Materials used: heat transfer film, adhesive powder (available in white or black – white is easier to use as it becomes transparent after melting and drying, while black is used for coverage due to its high opacity after drying), and backing material.

Equipment: computer for design preparation, DTF machine (comprising a printing and drying section), and a heat press.

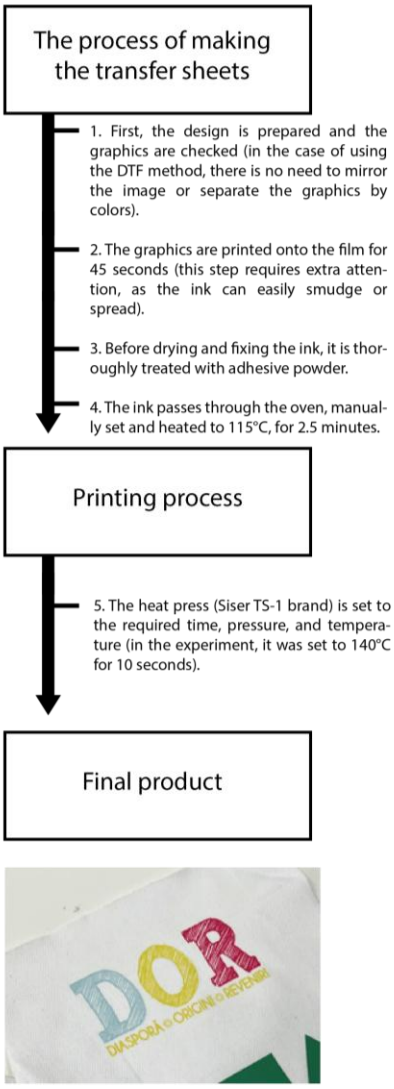


**Fig. 2.1.** Scheme of the technological stages specific to the DTF (Direct to Film heat transfer) process for T-shirt customization.

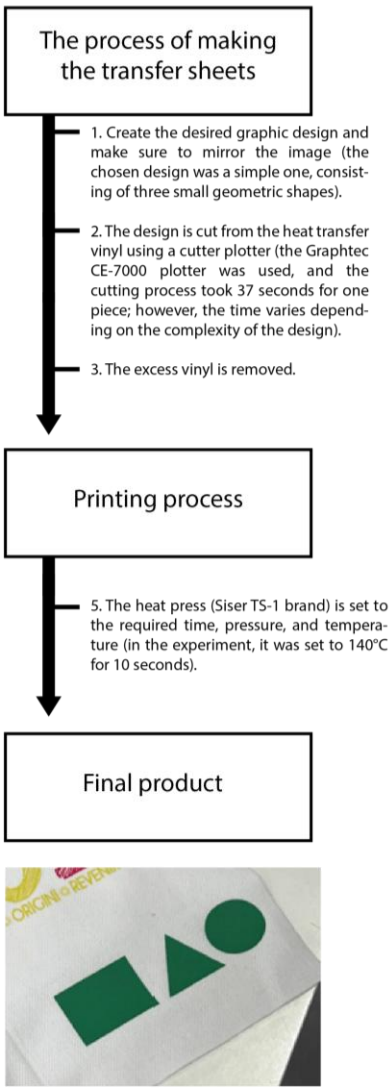


**Fig. 2.2.** Scheme of the technological stages specific to the Vinyl Heat Printing process for T-shirt customization.

**Table 1**

Comparative analysis of the characteristics of the two types of heat transfer printing

| **Criteria\Printing method** | **Thermal transfer printing with vinyl** | **Thermal transfer printing using the DtF machine** |
|---|---|---|
| **Costs** | $500 (plotter) + $200 (hot press) = 700$ | 5000 (DtF machine) + 300 (hot press) = 5300**$** |
| **Productivity** | 30 t-shirts, scrap 2-5% | 100 t-shirts, scrap 1-3% |
| **Minimum number of workers required** | 1 | 1 |
| **Energy consumption (W\h)** | 500 W | 1000 W |
| **Disadvantages** | It is considered an outdated method that does not allow the creation of complex graphics with thin lines, gradients, or too many colors. It is suitable only for single-color printing. For multi-colored graphics, the design is prepared separately for each color, and then the cut pieces from the films are manually joined to form the final shape. | The DTF machine is expensive, requires maintenance, and is cost-effective only for larger print runs. |
| **Advantages** | It is an affordable method that does not require large investments in equipment. Method suitable for small runs and simple graphics. Low cost, applicable on many textiles, does not require special ink. | Rapidly obtaining high-quality, durable printing forms of any degree of complexity (the time to obtain the forms does not vary with the level of complexity of the graphics). |

**INNOVATIONS IN HEAT TRANSFER TECHNOLOGY.** In the context of 2025, thermal transfer ribbon (TTR) technology is making significant advancements, with a strong focus on sustainability and efficiency. TTR manufacturers are emphasizing the development of biodegradable ribbons and recyclable components, aligning with global ecological requirements.

At the same time, there is an increasing adoption of solvent-free inks, which replace harmful chemicals while ensuring high-quality prints with superior contrast. High-performance ribbons, resistant to heat, chemicals, and UV radiation, represent innovative solutions that not only meet the demands of the printing industry but also extend to aerospace and manufacturing sectors, guaranteeing long-term performance in application [3-5]. These innovations contribute significantly to both the sustainability and reliability of industrial products.

**CONCLUSIONS**

The results obtained have highlighted that both DTF (Direct-to-Film) and vinyl heat transfer are effective solutions for textile printing, each with its own advantages and limitations. DTF offers greater flexibility in terms of design complexity and the types of materials it can handle, and the technology has significantly evolved in recent years, improving production time and costs. On the

other hand, foil heat transfer remains a reliable method, providing exceptional print quality, particularly for textiles with smooth and uniform surfaces.

Technological innovations in heat transfer printing have led to significant advancements in durability and process efficiency, while the selection of appropriate materials remains a key factor in the success of each method. In conclusion, both thermal printing techniques are valuable, and the choice of the optimal method depends on the specific requirements of each textile production project.

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**АДАСКАЛІЦА Л., МУСТЕАЦА Д., ДУГАН А., НАСТАС М.**

**ТЕХНОЛОГІЧНІ АСПЕКТИ КАСТОМІЗУВАННЯ ОДЯГУ ТА ТЕКСТИЛЬНИХ АКСЕСУАРІВ МЕТОДОМ ТЕПЛОПЕРЕНОСНОГО ДРУКУ**

*Дане дослідження має на меті здійснити порівняльний аналіз двох широко використовуваних у текстильній промисловості методів термічного друку: термотрансферу за допомогою DTF (Direct-to-Film) та плівки. Ці технології відіграють ключову роль у персоналізації та виробництві текстильних виробів, кожна з них має свої специфічні характеристики та переваги, що впливають на виробничий процес, кінцеву якість продукції та її довговічність. Ще одним важливим аспектом, проаналізованим у дослідженні, є класифікація текстильних матеріалів, що використовуються для цих двох методів термотрансферу, оскільки правильний вибір матеріалу відіграє вирішальну роль у досягненні оптимальних, довговічних та високоякісних результатів. Також досліджуються останні інновації у сфері термотрансферного друку, які сприяють підвищенню ефективності та якості процесів, а також розширенню можливостей персоналізації текстильних матеріалів.*

***Keywords:*** *термотрансфер, текстиль, друк, технологічні характеристики, інновації.*