PS FILM APPLICATION ON ARTIFICIAL FABRICS

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Abstract: The application of heat transfer vinyl onto synthetic materials represents a technology with significant application in the textile industry. Heat transfer vinyl is distinguished by its exceptional durability, abrasion resistance, and color saturation, making it a preferred material for various projects. The combination of multiple types of vinyl in a single project can provide limitless possibilities. Heat transfer vinyl can come in various colors and textures, including neon, matte, glitter and even velvet imitation. The versatility of heat transfer vinyl application on both artificial and natural materials is a key advantage of this technology, due to its flexibility in temperature requirements. Unlike other printing technologies that are typically geared towards either natural or synthetic materials, heat transfer vinyl breaks this limitation. It offers various combining possibilities, allowing for different effects depending on the type of material it is applied to. In this context, the article explores the application of heat transfer vinyl with PS film on synthetic materials, emphasizing the impact of optimal temperature limits during the fixing process. The selection of the right temperature, pressure, and transfer time is crucial for preserving the quality of the material and ensuring the durability of the vinyl. Temperature affects the structure of textile materials. Too low a temperature may result in insufficient adhesion, leading to poor vinyl attachment. Conversely, excessively high temperatures may cause problems such as whitening or deformation of the fabric. At elevated temperatures, heat transfer vinyl application can create a more resistant and durable effect, enhancing the longevity of the vinyl on textiles. Heat transfer vinyl finds extensive use in the textile industry, especially in the branding of clothing, including workwear subjected to intensive use. This application underscores the importance of choosing the correct parameters for heat transfer vinyl application with PS film to achieve high-quality and durable results in the textile industry. This research shows practical applications that hold considerable value for stakeholders within the textile industry. Manufacturers can leverage the reached experience into optimal temperature limits for heat transfer vinyl with PS film, contributing to improved production efficiency and cost-effectiveness. The knowledge gained empowers designers to explore diverse combinations of vinyl types, fostering creativity and expanding design possibilities in textiles. Stakeholders across the production and design spectrum can derive benefits from this research. Manufacturers can implement precise temperature control measures to achieve consistent and high-quality vinyl adhesion on synthetic materials, ensuring the creation of durable textiles.
Keywords: heat transfer vinyl, application of PS film, temperature affects

1. INTRODUCTION

Heat transfer vinyl applied to synthetic materials is widely used in the modern technological world (da Silva et. all 2019, Hufenus et. all, 2020, Islam et. all, 2023, Mondal, 2018, Park, 2020, Repon and Mikučionienė 2021, Sozcu, 2024). The application of heat transfer vinyl on synthetic materials represents a technology with significant relevance in the textile industry. This type of printing stands out for its exceptional durability, resistance to wear, and color saturation, making it a preferred choice for various projects. By combining different types of films in a single project, unlimited possibilities are revealed. The purpose of this article is to present heat transfer vinyl as a widely applicable technology, focusing on the transfer process and exploring the impact of temperature limits on various materials (Fig. 1). Amidst the dynamic evolution of Industry 4.0 and the transformative challenges posed by Industry 5.0, the application of heat transfer vinyl assumes a pivotal role in reshaping traditional paradigms within the textile sector. As industries embrace automation and data-driven methodologies, the integration of heat transfer vinyl underscores the importance of human factors and ergonomics in the production process. By prioritizing ergonomic design principles, manufacturers can optimize workflow efficiency and enhance worker well-being, fostering a synergy between human operators and technological advancements (Dovramadjiev et. all, 2023, Drăghici et. all 2022, Szabó et all. 2021). Within the context of Industry 4.0 and the emergent of Industry 5.0, the utilization of heat transfer vinyl fit to sustainable economic practices within the textile industry. As manufacturers navigate the complexities of global supply chains and market demands, the adoption of heat transfer vinyl offers a pathway towards enhanced economic resilience and competitiveness. By streamlining production processes and minimizing material waste, heat transfer vinyl contributes to cost-effectiveness and resource efficiency, driving sustainable

growth and economic prosperity. In connection with the modern dynamics, this interdisciplinarity seeks to explore the multifaceted implications of heat transfer vinyl application, delving into its transformative potential across human factors, Industry 4.0, Industry 5.0, and economic sustainability (Harsanto et. all 2023, Paraschiv et. all 2015, Wiegand and Wynn, 2023). As industries transition into the digital age, the integration of heat transfer vinyl embodies a convergence of traditional craftsmanship with cutting-edge technology, bridging the gap between human ingenuity and automated production processes.

Fig. 1. Various Colors from the Sparkle Series with Glitter Particles

2. MATERIALS AND METHODS

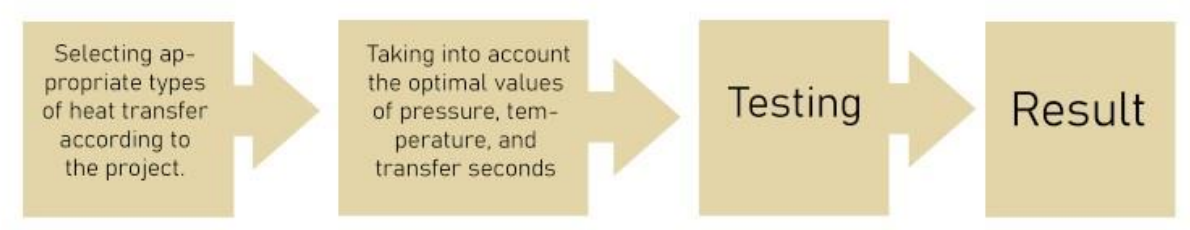
Thermal transfer films offer a variety of colors and textures, including neon, matte, with glitter particles, and velvet imitation. They can be combined to achieve various effects. For instance, combining embossed foil (Brick) with suede foil (Strip Flock) creates a unique visual effect (Fig. 2).

Fig. 2. Combination of embossed foil (Brick) with suede foil (Strip Flock)

Fig. 3. Sequential transfer of embossed vinyl (Brick)

In this case, there is an overlap of individual elements in both types of films, and it is necessary to place them sequentially, taking into account the optimal values of pressure, temperature, and transfer seconds, which differ between the two media. The respective settings are applied for each transfer separately, ensuring the durability and wear resistance of the print. It is crucial to consider the characteristics of both materials and arrange them logically so that one does not affect the other. In the specific example, it is necessary to place the suede foil first, as it is thinner (650 µm). The next step is to place the embossed foil with a thickness of (1000 µm). If the process is done in reverse, the thickness of the embossed foil would interfere with the optimal pressure for transfer onto the suede foil (Fig. 3-4).

Fig. 4. Methodology for applying heat transfer vinyl

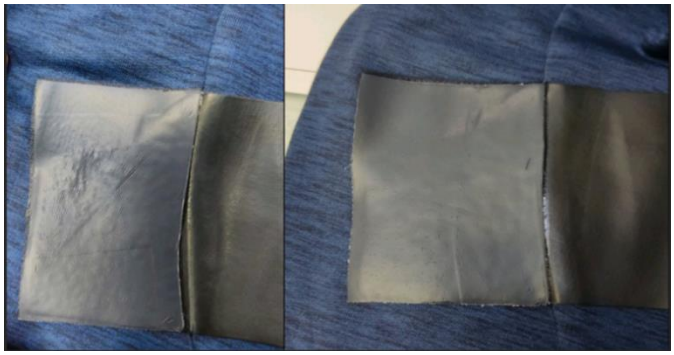


3. RESULTS

The ability to apply heat transfer vinyl on both artificial and natural materials is one of the key advantages of this technology, owing to its flexibility in temperature requirements. Typically, printing technologies are directed towards either natural or artificial materials, but in this case, heat transfer printing overcomes this limitation. The selection of the correct temperature, pressure, and transfer time is crucial for preserving the quality of the material on which the process is performed, as well as for the durability of the print itself. Temperature influences the structure of textile materials. If the temperature is too low, inadequate adhesion may occur, leading to poor film attachment. Conversely, at excessively high temperatures, issues such as bleaching or deformation of the fabric may arise.

In the following example, a process is examined where heat transfer printing is applied to an existing element of synthetic leather. The goal is to cover a worn-out part of the synthetic leather by adding a visually similar material - PS film onto a portion of it. In this case, the field to be transferred is not a standard textile but an artificial material that is not sufficiently responsive to temperature influences. To achieve the desired effect, a series of temperature tests are required to determine the optimal temperature at which the PS film will be well-transferred without damaging the synthetic leather. At higher temperatures, the synthetic leather contracts and affects the PS film, causing deformation. At a lower temperature, but one within the acceptable range for the film, the synthetic leather remains undistorted, allowing the PS film to adhere smoothly and achieve the desired result (Fig. 5).

Fig. 5. Result of Temperature Influence on Synthetic Leather



Heat transfer vinyl finds extensive application in the textile industry, particularly in garment branding, including workwear subjected to intense use. This type of application underscores the importance of selecting the right parameters for heat transfer vinyl with PS film to achieve high-quality and durable results in the textile sector (Fig.5)

4. DISCUSSIONS

This study presents practical applications that hold significant value for stakeholders in the textile industry. Manufacturers can leverage the gained expertise in optimizing temperature limits for heat transfer vinyl with PS film, contributing to improved production efficiency and cost-effectiveness. The acquired knowledge empowers designers to explore various combinations of vinyl types, fostering creativity and expanding design possibilities in textiles. Stakeholders across the spectrum of production and design can benefit from this research. Manufacturers can implement precise temperature control measures to achieve consistent and high-quality adhesion of the vinyl onto synthetic materials, ensuring the creation of durable textile products.

5. CONCLUSIONS

Heat transfer vinyl on synthetic materials represents an innovative technology with broad applications in the textile industry. Its features, including exceptional durability, strength, and color saturation, make it a preferred method for various creative projects in the textile manufacturing sphere. The present study presents accumulated experience in the field of textile design, where the application of modern technologies is an asset. The attached information in the article would be a valuable resource for all stakeholders involved and working in the textile field.

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REFERENCES

da Silva Barbosa Ferreira, R.; Florindo Salviano, A.; Sonaly Lima Oliveira, S.; Maria Araújo, E.; da Nóbrega Medeiros, V.; de Lucena Lira, H. (2019). Treatment of Effluents from the Textile Industry through Polyethersulfone Membranes. Water, 11, 2540. https://doi.org/10.3390/w11122540

Dovramadjiev, T.; Dobreva, D.; Zlateva, R. (2023). Advanced application of ergonomics and human factors in academic and scientific activities. IETI Transactions on Ergonomics and Safety (TES), ISSN 2520-5439, USA, 2023, Volume 7, Issue 1, 49-56, DOI: 10.6722/TES.202304_7(1).0005. https://www.ieti.net/TES/2023V7I1/IETI%20TES%20V7%20I1%2049-56.pdf

Drăghici, A.; Szabo, G.; Gajšek, B.; Mrugalska, B.; Dovramadjiev, T.; Zunjic, A. (2022). Ergonomics and human factors in the Cyber Age. The case of Ergonomics and Human Factors Regional Educational CEEPUS Network. Timişoara: Editura Politehnica, https://doi.org/10.59168/RBWI1746

Harsanto, B.; Primiana, I.; Sarasi, V.; Satyakti, Y. (2023). Sustainability Innovation in the Textile Industry: A Systematic Review. Sustainability, 15, 1549. https://doi.org/10.3390/su15021549

Hufenus, R.; Yan, Y.; Dauner, M.; Kikutani, T. (2020). Melt-Spun Fibers for Textile Applications. Materials, 13, 4298. https://doi.org/10.3390/ma13194298

Islam, M.R.; Golovin, K.; Dolez, P.I. (2023). Clothing Thermophysiological Comfort: A Textile Science Perspective. Textiles, 3, 353-407. https://doi.org/10.3390/textiles3040024

Park, J. (2020). Functional Fibers, Composites and Textiles Utilizing Photothermal and Joule Heating. Polymers, 12, 189. https://doi.org/10.3390/polym12010189

Paraschiv, D.; Tudor, C.; Petrariu, R. (2015). The Textile Industry and Sustainable Development: A Holt–Winters Forecasting Investigation for the Eastern European Area. Sustainability, 7, 1280-1291. https://doi.org/10.3390/su702128

Repon, M.R.; Mikučionienė, D. (2021). Progress in Flexible Electronic Textile for Heating Application: A Critical Review. Materials, 14, 6540. https://doi.org/10.3390/ma14216540

Sozcu, S.; Venkataraman, M.; Wiener, J.; Tomkova, B.; Militky, J.; Mahmood, A. (2024). Incorporation of Cellulose-Based Aerogels into Textile Structures. Materials, 17, 27. https://doi.org/10.3390/ma17010027

Szabó, G.; Balogh, Z.; Dovramadjiev, T.; Draghici, A.; Gajšek, B.; Jurčević Lulić, T.; Reiner, M., Mrugalska, B.; Zunjic, A. (2021). Introducing the ergonomics and human factors regional educational CEEPUS Network. ACTA TECHNICA NAPOCENSIS Ser.: App. Math. Mech. Eng. 64(I), 201–212 (2021). ISSN/eISSN: 1221-5872

Mondal, K. (2018). Recent Advances in Soft E-Textiles. Inventions, 3, 23. https://doi.org/10.3390/inventions3020023

Wiegand, T.; Wynn, M. (2023) Sustainability, the Circular Economy and Digitalisation in the German Textile and Clothing Industry. Sustainability, 15, 9111. https://doi.org/10.3390/su15119111