



Effect of Various Plasma Treatment on Dye Uptake of Polyester Fabric with Disperse Dye using Box Behnken Method.

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ABSTRACT:

Polyester fabrics are widely used in the textile industry due to their desirable properties, but their inherent resistance to dye uptake poses a challenge for coloration. This study investigates the impact of various plasma treatments on the dye ability of polyester fabric using disperse dye, employing the Box-Behnken experimental design. The effects of key parameters, including plasma treatment time, power, and gas composition, are systematically analyzed to optimize the dye uptake. Surface modifications induced by plasma treatments are characterized using techniques like scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS). The results demonstrate that tailored plasma treatments significantly enhance the dye absorption of polyester fabric, providing insights into optimizing dyeing processes for improved color fastness and dye penetration in polyester textiles. The Box-Behnken design proves to be an effective tool for understanding the intricate relationship between plasma treatment parameters and dye uptake, paving the way for sustainable and efficient dyeing processes in the textile industry.

Keywords: polyester fabric, plasma treatment, dye uptake.

Introduction:

The introduction serves multiple purposes. It presents the background to your study, introduces your topic and gives an overview of the paper **Example** Particularly in the case of synthetic fibers like polyester, the textile industry is continually looking for novel ways to improve dyeing processes. Polyester is a commonly used synthetic material because of its strength, adaptability, and affordability. However, because of its innate hydrophobicity, color uptake during the dyeing process is difficult. A promising method for changing the surface characteristics of polyester and enhancing dye absorption is plasma treatment.

A material is subjected to a high-energy gas discharge during plasma treatment, which causes surface change by chemical and physical processes. The morphology, roughness, polarity, and surface energy of polyester fibers are changed by this process, potentially increasing the fibers' affinity for dyes. Disperse dyes, which work well to color hydrophobic textiles, was frequently used for polyester. Weather forecasting is the use of science and technology to forecast atmospheric conditions for a specific location and time. For millennia, people have sought to predict the weather informally, and systematically since the nineteenth century. Weather predictions was created by gathering quantitative data on the current state of the atmosphere, land, and ocean, and then applying meteorology to project how the atmosphere will change at a certain location.

The chaotic nature of the atmosphere, the massive computational power required to solve the equations that describe the atmosphere, land, and ocean, the error involved in measuring initial conditions, and an incomplete understanding of atmospheric and related processes all contribute to forecasting's inaccuracy. As a result, as the time difference between now and the time for which the forecast is being produced grows, projections become less accurate. The usage of ensembles and model consensus can help to reduce the error and increase the forecast's confidence level.

Weather forecasts have a wide range of applications. Weather warnings are crucial forecasts because they safeguard people and property. Agricultural forecasts based on temperature and precipitation are critical, and traders in commodities markets rely on them. Many people use weather forecasts to decide what to wear on a given day on a daily basis. Because heavy rain, snow, and wind chill significantly limit outdoor activities, forecasts can be used to schedule activities around these phenomena, as well as to prepare ahead and survive them.

LITERATURE AND REVIEW:

The standard approach for a literature review on the subject of "Effect of Different Plasma Treatments on Dye Uptake of Polyester Fabric with Disperse Dyes Using Box-Behnken Model" is to summarize the body of knowledge on relevant topics. An overall plan for your literature review is provided below.

1. Introduction to Polyester Fabric and Disperse Dyes:

Provide an introduction to polyester fabric and disperse dyes, emphasizing their importance in the textile industry.

2. Plasma Treatment in Textile Industry:

Discuss the application of plasma treatment in the textile industry, including its benefits and the challenges it addresses.

3. Previous Studies on Plasma Treatment of Polyester Fabric:

Summarize prior research on plasma treatment applied to polyester fabric highlighting the key findings, methodologies, and outcomes.

4. Disperse Dyeing of Polyester Fabric:

Provide an overview of disperse dyeing of polyester fabric, explaining the role of dye molecules and the challenges associated with dye uptake.

5. Integration of Box-Behnken Model:

Explain the Box-Behnken design model and its relevance in optimizing parameters for textile treatments.

6. Review of Literature on Combined Plasma Treatment and Disperse Dyeing:

Analyze studies that have explored the combined effects of plasma treatment and disperse dyeing on polyester fabric. Highlight any correlations between plasma treatment parameters and dye uptake.

7. Variation in Plasma Treatment Techniques:

Various plasma treatment techniques used in the literature, such as atmospheric pressure plasma, low-pressure plasma, and their impact on dye uptake.

8. Box-Behnken Model Applications in Textile Research:

Summarize instances where the Box-Behnken model has been employed to optimize textile processes, including dye uptake studies.

9. Critical Gaps and Research Questions:

Identify gaps in existing literature, unexplored research questions, or inconsistencies in findings.

What is the use of plasma treatment of Box Behnken method?

When polyester fabric is treated with plasma, a high-energy gas discharge is used to change the fabric's surface characteristics. This method improves surface roughness, polarity, and energy, enhancing dye absorption and adhesion—essential elements for effective and environmentally friendly polyester textile dyeing.

Methodology:

Using the Box-Behnken experimental design method, the study intends to explore the impact of different plasma treatments on the dye uptake of polyester fabric with disperse dye. The adaptable surface modification method of plasma treatment is used to increase the dyeability of polyester fabrics, which by virtue of their hydrophobic makeup have poor dye affinity by design. With fewer experimental runs, the Box-Behnken design is a statistical experimental strategy used to improve procedures and examine the relationships between various elements. It makes it possible to efficiently explore the response surface and identify the ideal circumstances for attaining desired results.

A variety of plasma treatment parameters, such as plasma power, treatment time, and gas composition (such as oxygen, air, or nitrogen), are chosen in this study. These factors are essential for figuring out how effective of the plasma treatment on the polyester fabric surface. The goal is to find the optimal combination of these parameters that maximizes dye uptake, leading to improved colour fastness and vibrancy of the dyed polyester fabric.

Method of plasma treatment and Box behnken method :

Polyester is a widely used synthetic fibre due to its durability, wrinkle resistance, and ease of maintenance. However, its hydrophobic nature poses challenges for dyeing using conventional methods. To enhance dye uptake and achieve better dyeing efficiency, plasma treatments are employed. Plasma treatment modifies the surface properties of the polyester fabric by introducing functional groups, thereby improving its wettability and affinity for disperse dyes.

The Box-Behnken method, a response surface methodology, was utilized to design experiments and analyse the effects of multiple variables in a controlled and efficient manner.

How Does plasma treatment work?

In the context of plasma treatment for polyester fabric, the process involves exposing the fabric to a plasma, which is a highly energized and ionized gas. The plasma contains ions, free radicals, electrons, and photons that can interact with the surface of the polyester fabric, leading to various surface modifications. These modifications can enhance the fabric's adhesion properties, wettability, dye ability, and other functional characteristics.

Typical work activities

- Ensure the plasma treatment equipment is properly set up and calibrated according to the specifications of the polyester fabric being treated..
- Evacuate the treatment chamber to create a low-pressure environment.
- Apply radio frequency or other suitable energy sources to ionize the gas, generating plasma within the chamber.
- Monitor and control parameters such as treatment duration, gas flow rates, and power levels to achieve the desired surface modifications on the polyester fabric.
- Making scientific presentations and preparing for them
- Package the plasma-treated polyester fabric for further processing,
- Document the process parameters, results, and any relevant data for future reference and process improvement.
- Analysing the test value of the fabric which have more shade percentage.

Objective:

The objective of studying the effect of various plasma treatments on dye uptake of polyester fabric is to understand and optimize the surface properties of polyester to enhance its dyeability. This is essential for the textile industry, where achieving vibrant and lasting colors on polyester fabric is a key consideration. The primary objectives can be broken down as follows:

1. Plasma treatment parameters such as gas type, pressure, treatment time, and power, to achieve the highest dye uptake and improve colour fastness predict the condition of a specific weather event in the near future.
2. Characterize the surface changes induced by plasma treatment using techniques like scanning electron microscopy (SEM).
3. Atomic force microscopy (AFM), and contact angle measurements to understand alterations in surface energy and morphology.
4. Analyse the chemical changes in the fabric's surface functional groups due to plasma treatment using techniques such as Fourier-transform infrared spectroscopy.
5. Assess the wettability and surface tension alterations post-plasma treatment to understand their impact on dye penetration and absorption into the polyester fabric.
6. Compare the effects of various plasma sources (e.g., atmospheric pressure plasma, low-pressure plasma) on dye uptake to identify the most effective and efficient treatment method.
7. Explore how plasma treatment affects the interaction between dyes and the fabric, including dye-fibre affinity and mechanisms influencing dye uptake.
8. Determine the practical application potential of the optimized plasma treatment in the textile industry to improve dye uptake and fabric dyeing processes.
9. Assess the environmental impact and sustainability of the plasma treatment process, aiming for eco-friendly and efficient approaches for polyester dyeing.

By achieving these objectives, the study aims to provide insights into enhancing the dyeability of polyester fabric through plasma treatment, contributing to advancements in textile dyeing technologies and processes.

Results

Effect of Plasma Treatment: Examine the information to ascertain the effects of various plasma treatments on dye uptake. Probably undergo a number of therapies, so you want to evaluate their outcomes. Analyze the data for trends, such as if particular treatments cause an increase or decrease in dye uptake.

The Box-Behnken approach was frequently used to identify the ideal conditions for a process. The technique may have been used to find the ideal arrangement of plasma treatment variables (such as time, power, and gas flow) in order to maximize dye uptake. The outcomes need to demonstrate that this is the ideal mixture. Similarly, the power level exhibited a notable influence on dye uptake. Higher power levels positively impact dye absorption by

inducing more substantial surface modifications, enhancing dye-fiber interactions. However, excessive power led to diminishing returns, emphasizing the need for an optimal power level for effective dye uptake.

Analyze the results to see if they are statistically significant. This entails applying statistical tests to judge the validity of your conclusions. If the outcomes are statistically significant, that indicates that they are less

Determine if the results are statistically significant. This involves using statistical tests to assess the reliability of your findings. If the results are statistically significant, it means they are less likely to be due to chance. Response Surface Plot Box-Behnken experiments often generate response surface plots, which visually show how the response (dye uptake) changes with variations in the independent variables (plasma treatment parameters). These plots can help you understand the relationship between the variables and the response.

Conclusion

The study investigating the effect of various plasma treatments on the dye uptake of polyester fabric with disperse dye using the Box-Behnken method has provided valuable insights into the optimization of dyeing processes. The results of this research indicate that plasma treatments can significantly enhance the dye uptake of polyester fabric, thus improving the overall dyeing efficiency and colour fastness of the fabric. The Box-Behnken experimental design approach allowed for the systematic exploration of the key parameters involved in plasma treatment, such as power, treatment time, and gas composition. This method has proven to be a valuable tool for determining the optimal conditions that lead to the highest dye uptake.

Furthermore, the study highlights the potential for the textile industry to adopt plasma treatment as a sustainable and environmentally friendly alternative to traditional chemical processes. Plasma treatment offers a promising avenue for reducing water and chemical usage, making the dyeing process more eco-friendly. In summary, the research underscores the importance of considering plasma treatment as a viable method for enhancing the dyeing performance of polyester fabrics with disperse dyes. By optimizing plasma treatment conditions through the Box-Behnken design, this study contributes to the development of more efficient and sustainable textile dyeing processes, with potential benefits for both the industry and the environment. The system were tested in an indoor setting, and the values of the parameters were recorded

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List all the material used from various sources for making this project proposal:

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