Problem of Adherence in Highly Strained PET Fibers for Tyre Reinforcement

KORDSA

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ABSTRACT

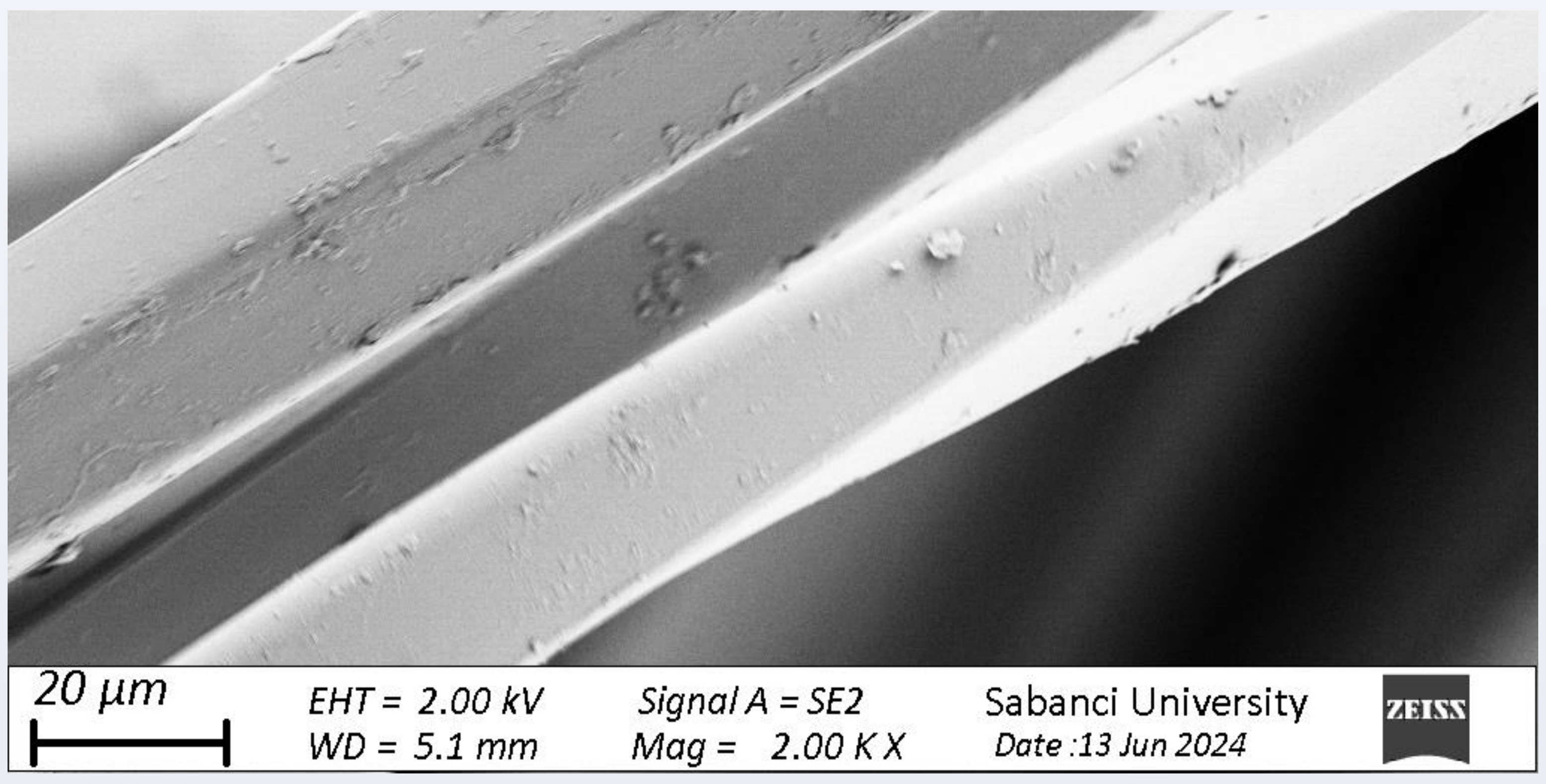

Figure 1: SEM image of A showing details about surface of the material.

This project focuses on the critical issue of adhesion between various amounts of stretched PET (polyethylene terephthalate) fibers and the rubber matrix in tires. PET fibers can crystallize during manufacturing. Partially crystalline fibers have a much higher tensile strength than amorphous fibers. However, as PET strands crystallize, they attach less to rubber tires. The fundamental cause is the different surface shapes of crystalline fibers versus amorphous fibers.

Our project aim is to investigate the relationship between PET fibers exposed to different stress levels morphology and adhesion properties. We will use different characterization techniques to solve the problem.

The findings of this study will help in the development of PET fibers that strike an optimal balance between strain-induced strength and adhesion for improved tire performance. This research has the potential to inspire innovation in tire production processes and contribute to the progress of automotive technology, which will benefit both manufacturers and customers.

OBJECTIVES

Objective 1: Obtain Various Strengths of PET Fiber from Kordsa.

- **Task 1.1:** Request PET fibers produced under different strain conditions from the project manager.
- **Intended Result 1.1:** Obtain PET fiber samples with controlled strain levels for analysis.

Objective 2: Analyze PET Fibers Using Accurate Characterization Techniques

- **Task 2.1:** Investigate causes using SEM, FTIR, TGA, and other techniques.
- **Intended Result 2.1:** Identify root causes and enable targeted solutions.

Objective 3: Present Optimal Suggestions for Improvement

- **Task 3.1:** Develop strategies to address issues and enhance fiber performance.
- **Intended Result 3.1:** Propose new production methods for improved PET fiber.

PROJECT DETAILS

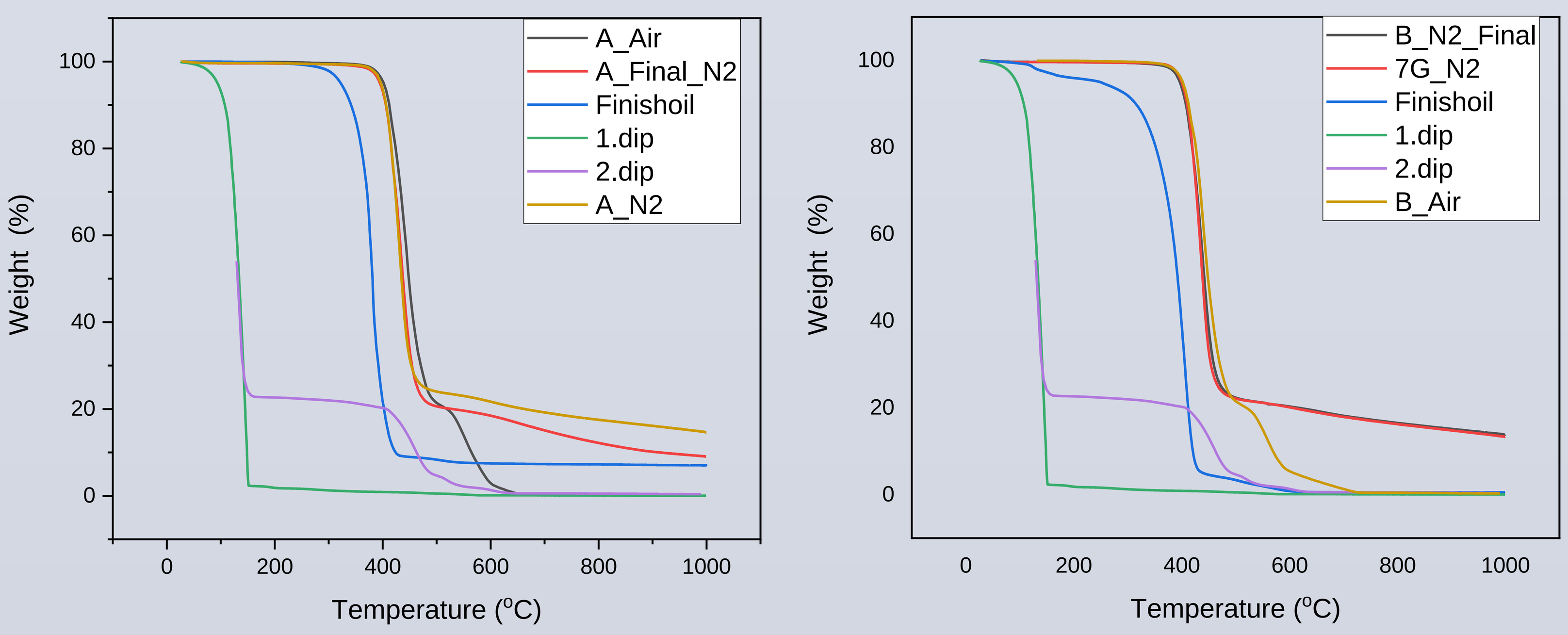

Figure 2: TGA analysis of fibers with different crystallinities (*A*: low crystallinity, *B*: high crystallinity).

Our goal is to understand the relationship between mechanical stress, fiber structure, and adhesion to rubber in PET fibers. Through FTIR and TGA analysis, we aim to identify the mechanisms behind adhesion degradation and develop strategies for improving the interfacial bond between fibers and rubber.

This research will pave the way for the development of PET fibers that are both strong and adhere well to rubber, leading to more robust and safer tire.

PROJECT DETAILS II

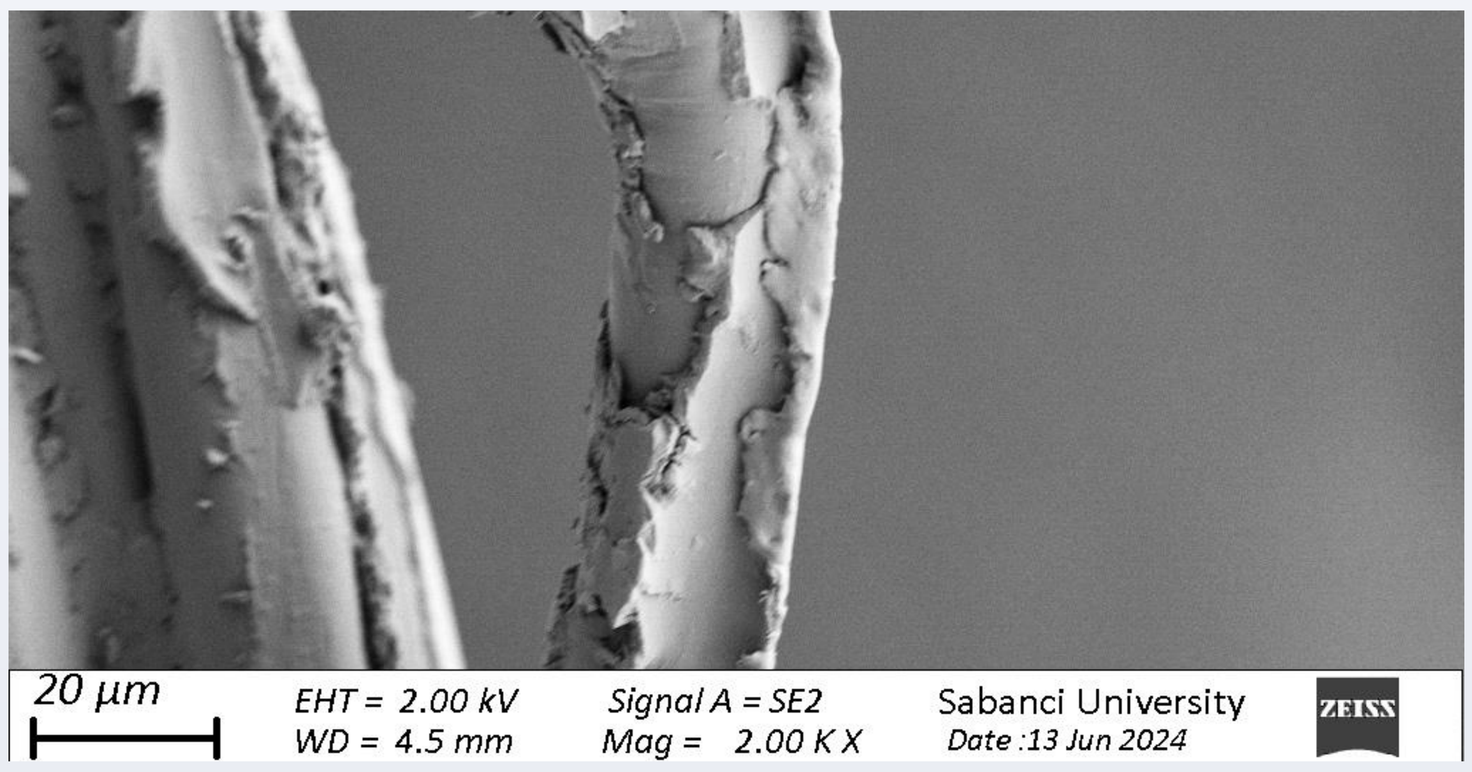

Figure 3: SEM image of B showing details about surface of the material.

This project investigates the adhesion challenges encountered when integrating highly strained PET fibers into rubber tire matrices. While these fibers offer exceptional strength, their limited adhesion to rubber can compromise tire performance and safety. To overcome this, the project utilizes a multi-faceted approach combining reverse engineering and advanced characterization techniques (TGA, DSC, NMR, SEM, surface tensiometer) to comprehensively analyze the chemical, surface, and interfacial properties of the fiber-rubber system.

This project seeks to optimize adhesion between fibers and rubber by systematically evaluating the effects of various chemical treatments and processing conditions. The project prioritizes sustainable solutions that enhance adhesion without compromising fiber properties and comply with environmental regulations.

By optimizing the interface between fibers and the rubber matrix, the findings have the potential to revolutionize tire reinforcement technologies, providing the tire industry with a competitive advantage in terms of durability and performance. This study not only supports innovation in material engineering but also contributes to global efforts to create sustainable and efficient industrial solutions.

CONCLUSION

While results are still pending, each completed analysis has provided valuable insights into the factors contributing to poor adhesion between PET fibers and the rubber matrix. The examination of finish oils, cleaning solutions, and adhesives (RFL) has revealed the complex nature of this issue, emphasizing the need for a thorough understanding of the interactions between individual chemicals. Despite challenges posed by time-consuming analyses and limited access to factory data, significant progress has been made in identifying key parameters that influence adhesion performance.

Future steps include conducting detailed factory visits to identify critical production stages contributing to the adhesion problem and performing in-depth analyses of the chemical interactions between the tire surface, RFL, PET fibers, and finish oils. Additionally, alternative surface treatments, adhesive formulations, or improved processing methods will be explored to enhance interfacial bonding.

By addressing the adhesion issue in PET fibers with varying crystallinity levels, this project could lead to the production of safer, more durable, and higher-performing tires, providing a competitive advantage for manufacturers.

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