A PRELIMINARY STUDY ON EFFECT OF APPLICATION NON-IONIC POLYACRYLAMIDE ON THE TENSILE STRENGTH OF MULBERRY SILK FILAMENT

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Abstract—**This study investigates the influence of non-ionic polyacrylamide (NPAM) on the tensile strength of mulberry silk filaments. Silk,a natural protein fiber known for its strength and elasticity, can be modified using polymer treatments to enhance its mechanical properties. The preliminary results indicate that treatment with NPAM improves tensile strength due to better fiber cohesion and surface modification. However, excessive concentration may lead to stiffness and reduced flexibility.**

I. Introduction

Mulberry silk, produced by the silkworm *Bombyx mori*, is widely valued for its high tensile strength, luster, and biocompatibility. Enhancing its mechanical properties is important for applications in textiles, biomedical materials, and composites. Non-ionic polyacrylamide (NPAM) is a water-soluble polymer commonly used in textile finishing, paper processing, and wastewater treatment. Due to its neutral charge, NPAM interacts with fibers primarily through hydrogen bonding and physical adsorption, potentially improving fiber strength. This study aims to evaluate the effect of NPAM treatment on the tensile strength of mulberry silk filament.

II. Materials and Methods

Raw mulberry silk filaments were used as the primary material for this study, along with non-ionic polyacrylamide (NPAM) as the modifying agent. NPAM solutions of varying concentrations (0.5%, 1%, 1.5%, and 2%) were prepared by dissolving the required quantity of polymer in normal tap water under continuous stirring until a homogeneous solution was obtained. The silk filaments were then immersed in these solutions for a fixed duration of 10–15 minutes to ensure adequate interaction between the polymer and the fiber surface. After treatment, the filaments were removed and dried under controlled ambient conditions. The tensile properties of both untreated and treated silk filaments were evaluated using a universal testing machine, where parameters such as breaking force, elongation at break, and tensile strength were recorded

Tensile Strength Testing

Tensile strength was measured using a universal testing machine. Parameters recorded:

- Breaking force
- Elongation at break

Fig.2.1 Application of polyacrylamide on silk filaments and testing of treated silk filaments

III. Results and Discussion

1. **Effect on Tensile Strength**
   A moderate increase in tensile strength was observed with increasing NPAM concentration up to an optimum level (around 1–1.5%).
   The improvement is attributed to:

   - Formation of a thin polymer coating
   - Enhanced intermolecular bonding
   - Reduction in surface defects

2. **Effect on Elongation**
   - Slight reduction in elongation at higher NPAM concentrations
   - Indicates increased stiffness of the fiber

3. **Optimal Concentration**
   Optimum NPAM concentration balances strength and flexibility
   Beyond optimum levels:

   - Fiber becomes brittle
   - Excess polymer causes rigidity

4. **Mechanism**
   NPAM interacts with silk fibroin via:

   - Hydrogen bonding with amino acid residues
   - Physical entanglement on fibre surface leads to improved load distribution along the filament.

IV. Conclusion

The preliminary study suggests that non-ionic polyacrylamide treatment enhances the tensile strength of mulberry silk filaments. An optimal concentration exists where strength is maximized without compromising flexibility. Further studies involving microscopic analysis and long-term durability are recommended.