
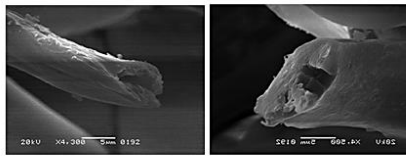
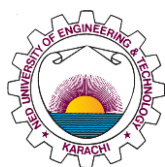
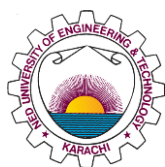


**Final Year Project Showcase Batch-2020
Year 2024**

Department: Textile Engineering Programme: Textile Sciences	
1	Project Title Fabrication And Characterization Of Hollow Yarn.
2	Project Idea The Fabrication and Characterization of Hollow Yarn project stands as a innovative project in textile industry and technology, which aims to overcome limitations present in conventional yarn, such as weight, insulation, and breathability. This project not only aims to fabricate hollow yarn but also represents an understanding and providing the unique characteristics of hollow yarn structures. These properties provide a various benefit, including a hollow structure that contributes to reduced weight, also enhancing overall comfort and the sound insulation properties of hollow yarn make it suitable for applications in textiles industries designed for noise reduction. Moreover, this project's industrial collaboration with Artistic Milliners Pvt Ltd enhances its practical applicability.
3	Process Through the research and availability, project opted to made core-spun yarn on ring frame. The choice of materials for hollow yarn involves cotton fibers as the sheath and PVA filament as the core because of environmental friendliness and the easily soluble nature of PVA in boiling water facilitates the fabrication of hollow yarn. Various yarn counts with different percentages of Cotton: PVA which are 16/s (contains Cotton: PVA, 80:20), 20/s (contains Cotton: PVA, 75:25) and 24/s (contains Cotton: PVA, 70:30) opted in order to achieve required results. The fabrication starts from the blow room till roving frame, then on ring frame, PVA filament as core incorporated with cotton as sheath in order to made core-spun yarn. Then yarn testing performed to characterize its attributes such as strength, count, elongation and IPI values. At the fabric stage, knitted fabric is developed with three different structures single jersey, rib and interlock, also the PVA is dissolved through washing at 60°C. After that, fabric characterization occurs for before and after wash samples in order to differentiate the results of properties, characterization includes tensile strength, water absorbency, vertical wicking, SEM image, and Sound insulation test. Therefore, this project has various innovative applications in textile industry in future.
	Outcome Fabrication of Various yarn counts with different percentages of Cotton: PVA which are 16/s (contains Cotton: PVA, 80:20), 20/s (contains Cotton: PVA, 75:25) and 24/s (contains Cotton: PVA, 70:30). At the fabric stage, knitted fabric is developed with three different structures single jersey, rib and interlock, also the PVA is dissolved through washing at 60°C.
	 <p>Figure 6. 34: SEM Test of before washing sample of 24s Single Jersey Fabric</p>  <p>Figure 6. 35: SEM Test of after washing samples of 24s Single Jersey Fabric</p>



5	<p>Evidence (Theoretical Basis)</p> <p>In the published articles about hollow yarn focused on sound and comfort properties. It was found that they considered usually core spun yarn in ratio of 50/50 16/84, 20/80,28/72 and the count mostly produced are 11/s, 12/s and 15/s. Also, the material we study for sheath are mostly viscose, wool and cotton and PVA in core.</p> <p>For sound absorption by reading the papers we made the conclusion that amount of PVA also plays an important role. It was found that by increasing the hollow yarn diameter i.e., amount of core material in yarn the noise reduction coefficient decreases but it also led to surface porosity which supports noise dissipation because of porosity which means air and air is insulator which dissipates sound energy. The comfort properties include air permeability, wicking etc. It was suggested that we want less thermal conductivity, less water permeability and high air permeability, thermal absorptivity, thermal resistance for an efficient yarn with good mechanical properties, air permeability of fabrics is affected by inter-yarn porosity which depends on the yarn diameter and fabric thickness means thinner yarns create more gaps, enhancing breathability, while thicker yarns result in denser fabrics, reducing airflow. Whereas the thermal conductivity, thermal absorbency and thermal resistance are related to each other. It was found that by increasing ratio of core in core spun means after hollow yarn formation due to hollow core means air trap here and it gives less thermal conductivity as compare to less core content and thermal absorptivity also directly relates to thermal conductivity whereas, thermal resistance shows inverse relation with thermal conductivity means by increasing ore content Thermal resistance increase after dissolving core content and vice versa. Water absorbency and wicking depend on capillaries more capillaries more increase in these properties. So, by considering all the aspects, we made a conclusion that we make core spun in which PVA in core because of easily dissolving with not give bad impact to environment as easily dissolve in water at very normal temperature, Cotton in sheath as it is natural i.e. easily available, environmental friendly and also fit with PVA and we'll make 16/s, 20/s and 24/s count of core-spun and in a ratio of PVA/COTTON 20/80, 25/75 and 30/70 because each count yarn with 3 different ratios to compare the results after performing testing and get the best results for sound insulation with good comfort properties and also considerable mechanical properties.</p> <p>The purpose of selecting core spun count of 16/s, 20/s, 24/s in order to get sound insulation better to some extent and comfort properties some good and some not so good. Thus, selecting this count with the ratios mentioned above in order to get best results because in most papers the ratio used are 50:50 which gives very more hollowness which is not desirable (especially for sound insulation and mechanical properties). whereas if we go to not same ratio of core as sheath, we can achieve better comfort properties with best sound insulation as in more hollow sound dissipate but also in order to get required considerable thickness for sound absorption. And the purpose of choosing the ratios mentioned above is just because in one paper we found that similar ratios are comparing and giving good comfort properties so after analyzing that ratio we came up with these ratios 20/80, 25/75 and 30/70 of PVA/Cotton.</p>
6	<p>Competitive Advantage or Unique Selling Proposition (</p>
a	<p>Attainment of any SDG (e.g. How it is achieved and why it is necessary for the region)</p> <p>Choosing Responsible Consumption and Production criteria for the fabrication and characterization of hollow yarn is a strategic imperative rooted in the global commitment to sustainable development. As part of the United Nations' Sustainable Development Goals, Responsible Consumption and Production (SDG 12) underscores the need for industries, including textiles, to adopt practices that minimize environmental impact (SDG 8) and promote responsible resource use. By adhering to these criteria, the fabrication of hollow yarn can contribute to reducing the overall ecological footprint (SDG 11) of textile manufacturing.</p>
b	<p>Any Environmental Aspect (e.g. carbon reduction, energy-efficient, etc.)</p> <p>Sustainable process for the development of hollow yarn through washing process only.</p>
c	<p>Cost Reduction of Existing Product</p>



d	<p>Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process (e.g. What is the issue in current process and what improvement you suggests)</p> <p>Hollow yarn manufacturing is expensive process due to expensive friction spinning machinery. However, present works open new window for the development of hollow yarn on existing ring frame without capital investment of expensive machinery for industrial demand.</p>
e	<p>Expanding of Market share (e.g. how it expand and what is the problem with the current market)</p> <p>Reduce cost to import sound absorber material</p>
f	<p>Capture New Market (e.g. Niche market or unaddressed segment)</p> <p>Telecommunication as a sound absorber soft material.</p>
g	<p>Any Other Aspect</p> <p>The project under the title fabrication and characterization of hollow yarn following can be done:</p> <ol style="list-style-type: none"> 1) Testing of air permeability will be done to determine the effect of air permeability in hollow yarn and solid yarn 2) Due to hollowness of yarn, it has potential ability to provide sound insulation. 3) The testings of impact resistance can be carried out in future to know the potential of hollow yarn. 4) Explore other core spun yarn manufacturing techniques in order to produce hollow yarn like friction spinning, rotor spinning, Electro-spinning technology when making hollow Nano fibers. 5) Hollow yarn has potential to be use in flame retardant textiles due to their high thermal resistance so testing related to flame retardant in future will result in use of hollow yarn in a flame retardant textile. 6) Testing for water vapor permeability can be carried out in future which gives future of hollow yarn in sportswear. 7) Explore other fabric manufacturing techniques like weaving, braiding etc. 8) Explore Different sound insulation testing methods. 9) Inspect the behavior of hollow yarn when fabric made up of core spun yarn by washing fabric at different HL and investigate the difference in behavior. <p>Therefore, it can be said that hollow yarn has a very high potential in different industries and give innovative solutions in different industries. Also by exploring different fabric manufacturing techniques and washing of fabric at different HL the behavior of hollow yarn can be inspected. So in future by doing testings' hollow yarn can serve in various industries.</p>
7	<p>Target Market (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service</p> <p>Industrial application in telecommunication as sound absorber, Medical textile for special patient</p>
8	<p>Team Members (Names along with email address)</p> <p>Maham Kamran kamran4305573@cloud.neduet.edu.pk Zainab Waqar waqar4303887@cloud.neduet.edu.pk Alvia Abdullah abdullah4304995@cloud.neduet.edu.pk Rafay Hassan siddiqui4305066@cloud.neduet.edu.pk</p>
	<p>Supervisor Name (along with email address)</p> <p>Engr.Dr. Muhammad Amir Qureshi , qureshi@neduet.edu.pk +923363685329</p>
11	<p>Video (If any) https://www.youtube.com/shorts/49x3 bjZto8</p>



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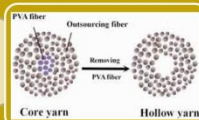
FABRICATION & CHARACTERIZATION OF HOLLOW YARN

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 Barch: 2020

Introduction

Hollow yarn is the result of dissolving the core & leaving behind the sheath, i.e hollow core running through its center.



Aims & Objective

- Understanding of hollow yarn and its fabrication
- To fabricate the hollow yarn on ring spinning frame
- To analyze the characteristics of hollow yarn by testing

Materials & Methodology

- Opted, hollow yarn contains cotton which is used as a sheath & PVA single filament used as a core
- The ring frame method was chosen for hollow yarn fabrication due to its feasibility, availability, and effective production.
- Cotton:PVA ratios for following yarn count chosen: 16/s = 20:80, 20/s = 25:75 and 24/s = 70:30

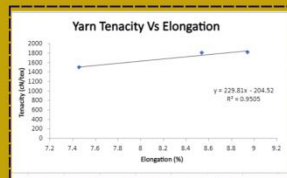
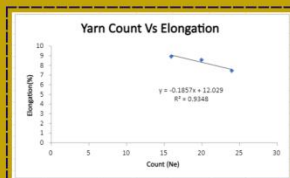
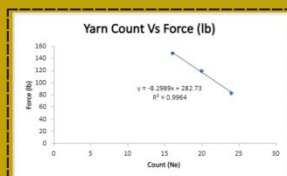
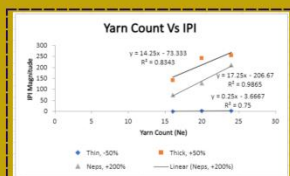
Ringframe Machine Parameters

- For 16/s
- Draft 32
 - Twist 19.20 twist/inch
 - Machine speed 12000 rpm
- For 20/s
- Draft 40
 - Twist 21.47 twist/inch
 - Machine speed 13000 rpm
- For 24/s
- Twist 24.32 twist/inch
 - Draft 48
 - Machine speed 15000 rpm



Experimentation

- Manufacturing of core spun on ring frame
- Yarn testing (evenness, tensile strength, count and CLSP) to evaluate mechanical property



Understandings

- Hollow yarn provides
- Light weight
- Sound insulation property
- Comfort property
- Mechanical property



Future Work

- Fabric development stage (knitted structured rib, single jersey, interlock) will be made.
- At fabric stage dissolving of core to convert core spun yarn to hollow yarn
- Further Fabric testing will be performed to evaluate properties