

STUDIES ON STRUCTURAL BLEMISHES IN AIR-JET TEXTURED YARNS WITH PARTICULAR REFERENCE TO NEPS IN THESE YARNS

by

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*Thesis submitted
in fulfilment of the requirements
for the degree of*
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**to the
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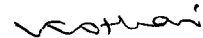
November, 1995

*Dedicated to
My Parents*

CERTIFICATE

This is to certify that the thesis entitled "**STUDIES ON STRUCTURAL BLEMISHES IN AIR-JET TEXTURED YARNS WITH PARTICULAR REFERENCE TO NEPS IN THESE YARNS**" being submitted by Mr. Jaydip Kumar Sensarma, to the Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy in the Department of Textile Technology, is a record of *bona fide* research work carried out by him. Mr. Jaydip Kumar Sensarma has worked under my guidance and supervision and fulfilled the requirements for the submission of the thesis.

The results contained in this thesis have not been submitted, in part or in full, to any other University or Institute for the award of any degree or diploma.



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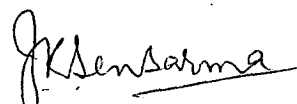
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ABSTRACT

Structural inhomogeneities, one of the main drawbacks associated with air-jet textured yarns, arise from improper and insufficient interaction between fluid forces and the filaments inside as well as outside the texturing jet. The manifestations are in the form of non-homogeneous loop distribution, occurrences of neps and thick places, higher yarn linear density CV%, higher yarn strength CV% and higher instability in the resulting air-jet textured yarn. It is important to check occurrence of these inhomogeneities so that air-jet textured yarns are acceptable in most of the applications they are used.

In order to examine extent of correlation among different inhomogeneity parameters listed above, values of correlation coefficients between them have been obtained through experiments. From the analysis of the experimental results, it has been observed that the inhomogeneity parameter, neps per unit length, has very high correlation with other inhomogeneity parameters, it is easy to assess and has high degree of sensitivity to changes in the process parameters. Hence, neps per unit length has been suggested as index of structural inhomogeneity of air-jet textured yarns to represent different forms of inhomogeneities. Extensive studies on effects of different jet parameters, process parameters and raw material characteristics on formation of neps have been carried out. Attempt has been made to understand the nature of neps in air-jet textured yarns and reason for their formation during the air-jet texturing process.

As a first step, effect of baffle geometry and baffle setting on nep formation has been investigated. Du Pont type XV nozzle with three baffles, viz., cylindrical baffle with small diameter, cylindrical baffle with large diameter and plate baffle with a flat surface have been used to study the effect of baffle geometry and to study the effect of baffle setting, both the Du Pont type XV jet and the HemaJet T100 core have been used. It has been found that use of flat surface baffle (zero curvature) reduces formation of neps significantly in relation to the neps formed while using cylindrical baffles. Use of lower baffle setting also reduces formation of neps during the air-jet texturing process.

Effect of important process parameters, viz., air pressure, overfeed, texturing speed and mechanical stretch on nep formation has been studied using a Central Composite Design. Polyester yarn has been textured at different factor level combinations called design points and nep frequency of these yarns have been measured. Statistical analysis of the results indicates that while increase in air pressure, overfeed and texturing speed cause increase in nep frequency, mechanical stretch has little or no effect on nep frequency in the resulting yarn. A second order response surface equation has been derived which gives empirical relationship between neps per 1000 m and different parameters. A combination of the levels of different factors has also been worked out through 'canonical analysis' which can be used as optimum setting to obtain minimum nep count in textured yarns.

Influence of raw material characteristics, viz., filament initial modulus, filament fineness, interfilament friction and filament cross-sectional shape on nep formation has been studied. To study effect of filament initial modulus, yarns have been drawn at three different draw ratios and at three different temperatures using three POY yarns with same number of filaments of different linear densities per filament. It has been observed that both an increase in initial modulus and an increase in filament fineness cause increase in nep frequency. Nep frequency also increases with an increase in interfilament friction. Use of trilobal filaments reduces nep frequency in the textured yarn.

While the above studies reveal effects of different parameters on nep levels in an air-jet textured yarn in general, a closer look at the neps under microscope reveals different structural patterns. Structure of these neps has been studied extensively using projection microscope and videophotographs. The study has revealed that, broadly, there are two types of neps formed during texturing. In one type of neps (type 1) the filaments divide into two groups where filaments of one group forms individual filament loops while filaments of the other group do not form any loop and either entwine the former group of filaments or form a big loop. The second type of neps (type 2) are formed due to heavy concentration of individual filament loops along a small length of the yarn. It has also been observed that these two types of neps behave differently under tensile load and demonstrate different load opening forces.

With the help of some additional experiments, a hypothesis on mechanism of nep formation has been proposed. The mechanism suggests insufficient opening of

filament bundle to be responsible for nep formation in air-jet texturing. While partial non-opening gives rise to formation of type 1 neps, complete non-opening of the filament bundle leads to formation of type 2 neps in the succeeding section of the non-opened section.

Finally, effect of different parameters on formation of these two types of neps has been studied extensively. It has been observed that while changes in some parameters favour formation of one type of neps, changes in other parameters favour formation of the other type of neps. However, both the types of neps increase or decrease together in absolute number whenever there is any increase or decrease in total nep count. An attempt has been made to explain these trends in the light of the proposed mechanism. The proposed mechanism is able to explain the observed results adequately.

This study has helped in identifying the factors responsible for occurrence of neps and in providing an insight into the mechanism of nep formation.

CONTENTS

	<i>Page</i>
ABSTRACT	<i>i</i>
LIST OF FIGURES	<i>x</i>
 CHAPTER 1	
INTRODUCTION	
1.1 GENERAL INTRODUCTION	1
1.2 DIFFERENT MEASURES OF STRUCTURAL INHOMOGENEITIES	1
1.2.1 Non-uniform Loop Frequency and Size	1
1.2.2 Variation in Yarn Linear Density	2
1.2.3 Thick Places	2
1.2.4 Neps	2
1.2.5 Variation in Yarn Strength	3
1.2.6 Instability	3
1.3 IMPORTANCE OF STUDYING THE SUBJECT	3
1.4 OBJECTIVES OF THE PRESENT STUDY	4
 CHAPTER 2	
LITERATURE REVIEW	
2.1 INTRODUCTION	6
2.2 THE AIR-JET TEXTURING PROCESS	6
2.3 DEVELOPMENTS OF JET DESIGNS	9
2.3.1 Converging-Diverging Nozzles	9
2.3.2 Cylindrical Nozzles	18
2.4 MECHANISM OF LOOP FORMATION IN AIR-JET TEXTURING	24
2.4.1 Hypotheses of Bulking for Pre-twisted Supply Yarns	24
2.4.2 Hypotheses of Bulking for No-twist Supply Yarns	25

2.5	CLASSIFICATION OF AIR-JET TEXTURED YARNS	30
2.6	STRUCTURE AND PROPERTIES OF AIR-JET TEXTURED YARNS	31
2.7	VARIABLES IN THE AIR-JET TEXTURING PROCESS	31
2.8	RANGE OF FEEDER YARNS AND END PRODUCTS	32
2.9	GENERAL METHODOLOGIES FOR TESTING AIR-JET TEXTURED YARN PROPERTIES	33
2.9.1	Methods of Analyzing Structure of Air-jet Textured Yarns	33
2.9.2	Methods of Measuring Bulk	34
2.9.3	Methods of Measuring Instability	37
2.9.3.1	Weight hanging methods	37
2.9.3.2	Extension measurements under static conditions	38
2.9.3.3	Methods based on measurement of thread tensile force during stretching of a yarn	39
2.9.3.4	Permanent extension as measure of instability in a tensile test	40
2.9.3.5	Method based on repeated loading (%Decay Method)	40
2.9.3.6	Comparison of different methods available for measurement of instability	41
2.10	FRICITIONAL BEHAVIOUR OF TEXTILE FIBRES	42
2.10.1	General Mechanism of Friction	42
2.10.2	Friction and Lubrication of Synthetic Fibres	43
2.10.3	Parameters Influencing Frictional Behaviour	45
2.11	ROLE OF WATER IN AIR-JET TEXTURING	45
2.11.1	Role of Water in Changing the Fluid Properties	46
2.11.2	Role of Water as a Lubricant for Fibres	46
2.11.3	Effect of Wetting on Textured Yarn Properties	48
2.11.4	Spin Finishes, Frictional Behaviour and Wetting	48
2.12	RAW MATERIAL AND JET PARAMETERS IN AIR-JET TEXTURING	49
2.12.1	Effect of Filament Cross-sectional Shape	50
2.12.2	Effect of Filament Linear Density and Number of Filaments	51
2.12.3	Effect of Jet Parameters	52
2.12.3.1	Converging-diverging nozzles	52
2.12.3.2	Cylindrical nozzles	54
2.12.4	Effect of Impact Element	55
2.13	BLEND INTIMACY IN AIR-JET TEXTURED YARNS	56
2.14	INHOMOGENEITIES IN AIR-JET TEXTURED YARNS	60
2.14.1	Non-uniform Loop Size and Distribution	60
2.14.2	Neps	60

CHAPTER 3

NEP LEVEL AS AN INDEX OF STRUCTURAL INHOMOGENEITIES OF AIR-JET TEXTURED YARNS

3.1	INTRODUCTION	62
3.2	EXPERIMENTAL DETAILS	62
3.2.1	The Air-jet Texturing Machine	62
3.2.2	Jets Used	64
3.2.3	Raw Materials	64
3.2.4	Texturing Conditions	64
3.2.5	Test Methods for Measuring Different Structural Inhomogeneity Parameters	65
3.2.5.1	Yarn CV %, Thick places and Neps	65
3.2.5.2	CV% of loop frequency and types of loops	66
3.2.5.3	Yarn strength CV%	67
3.2.5.4	Instability	68
3.3	RESULTS AND DISCUSSION	68
3.3.1	Relationships between Inhomogeneity Parameters	73
3.3.2	Neps Correlated with Other Parameters	82
3.3.3	Nep as an Index of Structural Inhomogeneity	85
3.4	SUMMARY	86

CHAPTER 4

EFFECTS OF BAFFLE GEOMETRY AND BAFFLE SETTING ON NEP FORMATION, BULK AND INSTABILITY OF AIR-JET TEXTURED YARNS

4.1	INTRODUCTION	87
4.2	EXPERIMENTAL DETAILS	87
4.2.1	Raw Material	87
4.2.2	Jets and Baffles Used	87
4.2.3	Texturing Conditions	89
4.2.4	Test Methods for Measuring Different Textured Yarn Properties	89
4.3	RESULTS AND DISCUSSION	89
4.3.1	Effect of Baffle Geometry on Textured Yarn Properties	89
4.3.2	Effect of Baffle Setting on Textured Yarn Properties	95
4.4	SUMMARY	98

CHAPTER 5

EFFECTS OF SOME IMPORTANT PROCESS PARAMETERS ON NEP FORMATION IN AIR-JET TEXTURING

5.1	INTRODUCTION	99
5.2	EXPERIMENTAL DETAILS	99
5.3	RESULTS AND DISCUSSION	100
5.3.1	Solution for the Stationary Point	108
5.4	SUMMARY	109

CHAPTER 6

EFFECTS OF SOME RAW MATERIAL CHARACTERISTICS ON NEP FORMATION IN AIR-JET TEXTURING

6.1	INTRODUCTION	117
6.2	EXPERIMENTAL DETAILS	117
6.2.1	Raw Materials	117
6.2.2	Application of Spin Finish and Measurement of Interfilament Friction	118
6.2.3	Texturing Conditions	121
6.2.4	Test Methods	121
6.3	RESULTS AND DISCUSSION	122
6.3.1	Effect of Filament Initial Modulus on Nep Frequency	122
6.3.2	Effect of Filament Fineness on Nep Frequency	125
6.3.3	Effect of Filament Cross-sectional Shape on Nep Frequency	126
6.3.4	Effect of Interfilament Friction on Nep Frequency	128
6.4	SUMMARY	128

CHAPTER 7

CLASSIFICATION OF NEPS UNDER DIFFERENT CATEGORIES

7.1	INTRODUCTION	129
7.2	EXPERIMENTAL DETAILS	129
7.2.1	Raw Materials and Texturing Conditions	129
7.2.2	Test Methods	129

7.2.2.1	Evenness testing and collection of neps for classification	129
7.2.2.2	Examination of structural configurations of the neps	130
7.2.2.3	Testing of tensile behaviour of the neps	130
7.3	RESULTS AND DISCUSSION	131
7.3.1	Classification of the Neps under Different Categories	131
7.3.2	Behaviour of the Neps under Tensile Load	131
7.4	SUMMARY	141

CHAPTER 8

MECHANISM OF NEP FORMATION IN AIR-JET TEXTURING

8.1	INTRODUCTION	142
8.2	MATERIALS, TEXTURING CONDITIONS AND TEST METHODS	142
8.3	EXPERIMENTS, RESULTS AND DISCUSSION	142
8.4	HYPOTHESIS OF NEP FORMATION MECHANISM	164
8.5	SUMMARY	164

CHAPTER 9

EFFECTS OF DIFFERENT PARAMETERS ON FORMATION OF THE TWO TYPES OF NEPS

9.1	INTRODUCTION	165
9.2	EXPERIMENTAL DETAILS	165
9.2.1	Raw Materials	165
9.2.2	Texturing Conditions	165
9.2.3	Test Methods	166
9.3	RESULTS AND DISCUSSION	166
9.3.1	Effects of Process Parameters on Formation of the Two Types of Neps	166
9.3.1.1	Texturing speed	166
9.3.1.2	Air pressure	168
9.3.1.3	Overfeed	172
9.3.1.4	Dry/wet texturing	174
9.3.2	Effects of Baffle Geometry and Baffle Setting on Formation of the Two Types of Neps	174

9.3.2.1	Baffle geometry	174
9.3.2.2	Baffle setting	179
9.3.3	Effects of Some Raw Material Characteristics on Formation of the Two Types of Neps	182
9.3.3.1	Filament fineness	182
9.3.3.2	Filament cross-sectional shape	182
9.3.3.3	Interfilament friction	182
9.4	SUMMARY	184

CHAPTER 10

SUMMARY AND CONCLUSIONS

10.1	SUMMARY	185
10.2	CONCLUSIONS	188

REFERENCES	189
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APPENDICES

APPENDIX A

VALUES OF COEFFICIENTS OF THE BEST FIT LINES SHOWN IN DIFFERENT CHAPTERS	199
---	-----

APPENDIX B

A BRIEF LITERATURE REVIEW ON EXPERIMENTAL DESIGN AND SUBSEQUENT ANALYSIS OF RESULTS	202
--	-----

APPENDIX C

LISTING OF THE COMPUTER PROGRAMME	215
-----------------------------------	-----

APPENDIX D

TABLE SHOWING THE VALUES OF 'Z' AGAINST DIFFERENT VALUES OF d/L USED FOR CALCULATING FLEXURAL RIGIDITY	235
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LIST OF PUBLICATIONS	236
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BIODATA	237
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