Quality Characteristics of Slub Yarns

دراسة جودة خيوط السلب

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ملخص البحث:

يهدف هذا البحث الى دراسة جودة خيوط السلب المنتجة من الاقطان المصرية على ماكينات الغزل الحلقي المعدلة . تناولت الدراسة العملية تأثير المتغيرات الاساسية لخيط السلب باستخدام خيوط بنمرتين مختلفتين "رفيعة ومتوسطة" ومستويات مختلفة من اس البرم و تصميمات مختلفة لخيوط السلب وتم استخدام المعادلات والتحليل النظري للتقييم الرقمي للتصميم والنمر ة ومقدار البرمات لخيوط السلب في المقارنة بين النتائج النظرية والعملية.

Abstract

The main task of this research is to study the quality characteristics of slub yarn produced from Egyptian cotton fibers on modified ring spinning machines . Experimental investigation was carried out considering the main parameters of slubs. The experimental verification was done with two different counts " medium and fine " , different twist multiplier and different yarn effects . The formula and theoretical analysis of numeric evaluation of slub yarn profile, count and twist are used to compare the theoretical and experimental results.

1- Introduction

Fancy yarn is a textile yarn with virtually unlimited pattern designs. Fancy yarns present deliberate decorative continuous or programmed effect of colors and are used to create some variations in the aesthetic appearance of a fabric or garment. Fancy yarn differs from the normal construction of single and folded yarns by way of deliberately produced irregularities in its construction. These irregularities relate to the inclusion of periodic effects such as knop, loops, curls, slubs or the like some of the effects which could be produced using the ring spinning system : slub , loop, gimp, boucle, spiral, corkscrew, eccentric , button, ect. The fundamental features of all these effects are used on modern fabric to produce a natural, rustic and attractive character of the product.

There are numerous technologies that can be used to create fancy yarns. Some of these technologies include machinery such as: hollow spindle machinery, chenille machines, ring spinning, rotor spinning frame, friction spinning, air jet texturized machines, folding / cabling machinery and specialized machines.

Slub yarn is a kind of fancy yarn whose slub appearance is gained by the variation of the yarn linear density during the spinning process and because of its special appearance, has been widely used in a variety of garments. Ring spinning is still regarded as the standard spinning methods against which all other yarn production systems. There are several ways of producing slub yarn on the

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ring spinning frame (1). Slub effect yarn may be divided into different classes (2, 3, 4): spun slub, very long slub yarns, ground slub yarn, inserted slub yarn, bound slub yarn, single and two ply slub yarn. Also, slub yarns definitions have been group logically (5, 3, 6 and 7) with respect to yarn structure, slub specifications, count and twist, method of manufacture, and uses of yarns. In this concern the present research study was planned to examine how multiple process variables such as slub length, slub distance, slub thickness, slub per meter, yarn count and twist affect the quality characteristics of slub yarn produced on modified ring spinning machines.

2- Experimental Work:

The present work carried out at Misr Mehalla/ Spinning and weaving company Ltd. The complete description of material used, yarn production and the methods applied to test the quality characteristics of slub spun yarns and comparing the results with the calculated values are described in the following sections.

2.1 Material Used :

Egyptian cotton fibers : "Giza 86" were collected from the runing stock of the mills for producing slub yarn.

2.2 Slub yarn production:

The basic principle of producing slub yarn is based on roller drafting system. The drafting process is deliberately interrupted to produce thick places at random intervals in the final yarn. The design of yarn pattern obtained by CAPIO device system (8). The present work was planned to examine how selected variables such as min. and max. Values of slub length, inter slub distance, slub thickness affect on the final pattern. Thus the experiment was constructed for producing Ne 36 carded slub yarn at two level of twist (αe3.6 and 4.2) and Ne 59 combed slub yarn at two level of twist (αe 3.8 and 4.2) Both yarns produced with four level of yarn effect as shown in table (1).

2.3 Yarn Measurements:

Yarn count: The yarn count was estimated through skein method. The tested length "30, 60 and 120 yd" used for testing with the help of autosorter.

Yarn twist: The most direct method has been used to measure the twist of the base yarns and slub respectively. The untwist method used to determine the twist of the slub yarn. The tests carried out using sample tested lengths of 2, 4, 10 and 20 inch

Yarn strength characteristics: was carried for slub by using schlafhorst hand tester. Also, USTER Tensojet used for measuring breaking force (B.F: gf), tenacity (gf/tex), elongation (%) and B. work (gf. Cm) at speed of test 400 m/min .

Yarn evenness, Imperfection 1000m and hairiness: yarn evenness "c.v % ", thick, thin places and neps / 1000m, were determined by USTER Evenness Tester (UT3). The procedure for testing was derived from ASTM standard.

Yarn faults : was determined using classimat at speed 800 m/min and R. H%=7.5% The tests carried out to determine total short thick places, disturbing short thick fault, long thick fault and long thin fault for 100 km of yarn.

Table (1)

Program Code number	Slub yarn parameters						Spinning parameters				
	Slub distance (cm)		Slub length (cm)		Slub Thickness ratio		Yarn cout Ne	36		59	
							Processing phase	carded		combed	
	min	Max	min	max	min	max	Twist M. α e	3.6	4.2	3.8	4.2
VII	15	97	3	4	2.2	3.8		×	×	×	×
IX	30	70	3	6	3	4		×	×	×	×
X	20	28	3	3	1.3	2		×	×	×	×
XI	12	26	4	6	2.3	2.8		×	×	×	×

Egyptian cotton fibers Giza86, Roving count Ne 1.5 For yarn Ne 36 and 2 Ne for yarn count 59 Ne.

3. Results and Discussion

3.1 Analysis of slub yarns referring to the basic terms of slub

The models and expressions we rebuild up or modified (1) is for analyzing :

- Relation between overall total length of program and slub yarn parameters .
- Relation between slub per meter and count of "slub, base yarn", yarn width ratio. Also, relation of slub per meter and twist distribution in slub yarn comparing with design twist .
- Relationship of slub parameters "slub length, slub distance, slub thickness, slub length / base length ratio and slub/ base count ratio" and twist distribution in slub yarn .

These items has been discussed in the earlier study(9). In this work, we try to verify these relations. The experiments were constructed for producing slub yarn "Ne36 and Ne59".

For slub yarns (Ne36 and Ne59), the selected programs shown in table (1), is used for determine numeric evaluation, table (2.1) and calculation of count; twist of slub yarn table (2.2).

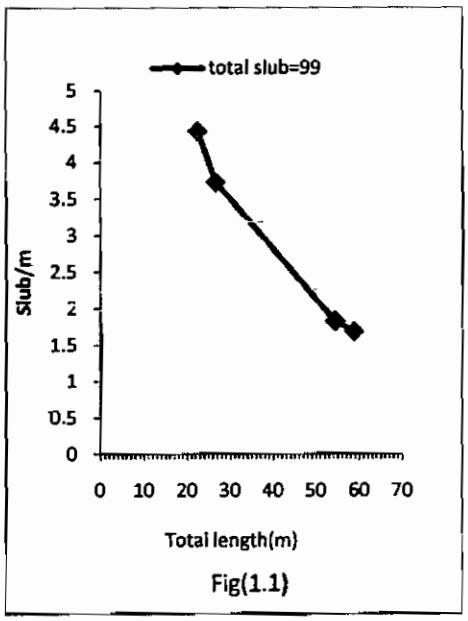
The calculated values of slub parameters represented graphically in figures (1.1) to (1.6) and show the same trend as for yarn count Ne20 (9).

Table (2.1) Numeric Evaluation of slub yarn parameters

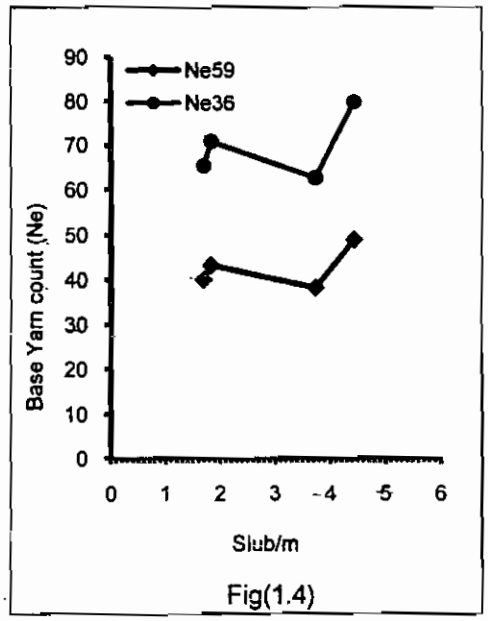
Program code No.	Program total length TL(m)	Percentage % of		Number of slub per meter(ns/m)	Slub length (mean) SLm (cm)	Slub dist. (Mean) Sdm (cm)	Slub thickness (mean) STm
		Slub dist Sd%	Slub length SL%				
VII	58.7	94.64	5.36	1.686	3.18	56.08	2.848
IX	54.3	93.84	6.16	1.822	3.38	51.43	3.525
X	26.6	88.83	11.17	3.723	3.0	23.86	1.540
XI	22.4	76.83	23.17	4.423	5.24	17.38	2.569

Table (2.2) Calculated "Twist and count" of slub and base yarn at different level of slub parameters (for Ne 36 & Ne 59)

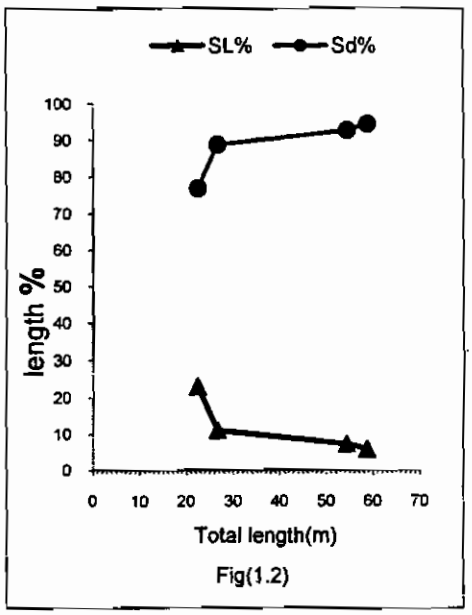
Program code No.	Nominal yarn count Ne	Input Roving count Ne	Actual draft	Calculated (Ne)		Calculated Twist (T/in)			
				Base Count (Nb)	Slub Count (Ns)	Base yarn Twist		Slub Twist	
						αe 3.6	αe 4.2	αe 3.6	αe 4.2
VII	36 carded yarn	1.5	24	40	19.3	17.68	26.57	15.82	18.42
IX				43.22	13.27	23.67	27.61	13.114	15.299
X				38.17	22.03	22.25	25.96	16.897	19.713
XI				48.79	31.81	25.75	29.34	20.304	23.69
			Nominal Twist (T/in)			21.6	25.2	21.6	25.2
						αe 3.8	αe 4.2	αe 3.8	αe 4.2
VII	59 combed yarn	2	29.5	64.84	35.11	30.60	33.82	22.52	24.84
IX				68.17	27.02	31.38	34.68	29.26	21.83
X				62.56	33.87	30.06	33.22	22.12	24.44
XI				79.97	52.15	33.98	37.56	27.44	30.33
			Nominal Twist (T/in)			29.188	32.261	29.188	32.261



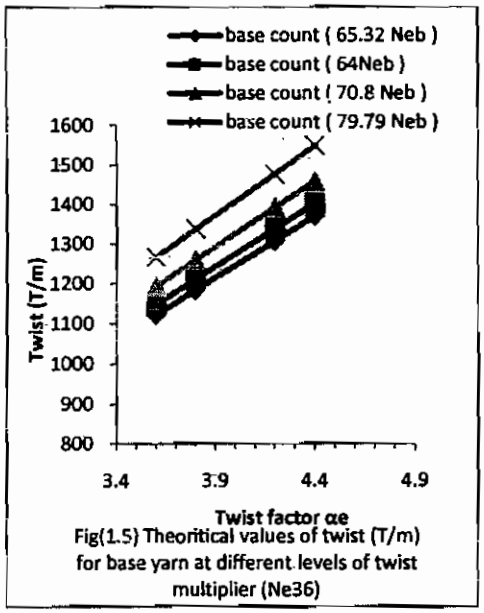
Fig(1.1)



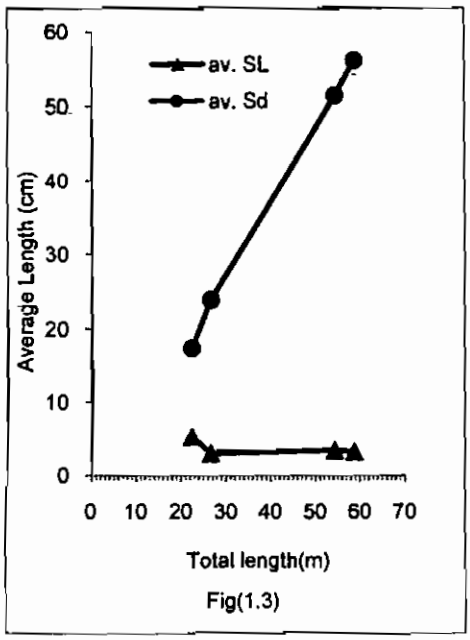
Fig(1.4)



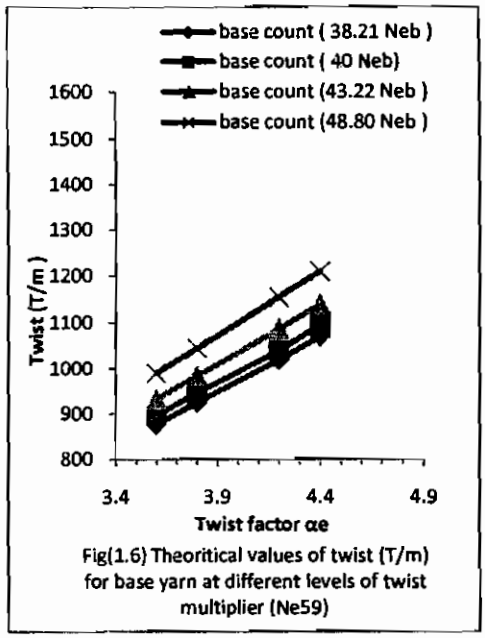
Fig(1.2)



Fig(1.5) Theoritical values of twist (T/m) for base yarn at different levels of twist multiplier (Ne36)



Fig(1.3)



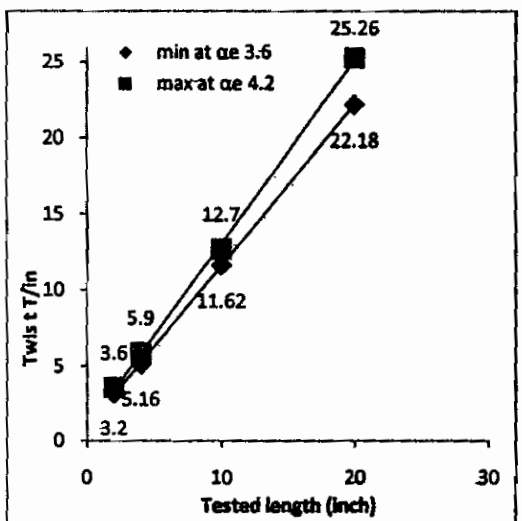
Fig(1.6) Theoritical values of twist (T/m) for base yarn at different levels of twist multiplier (Ne59)

3.2 Slub yarn characteristics "twist, linear density and tenacity".

The characteristics of slub spun yarns (Ne36 and Ne59) were investigated and factors affect on it can be discussed as follows :

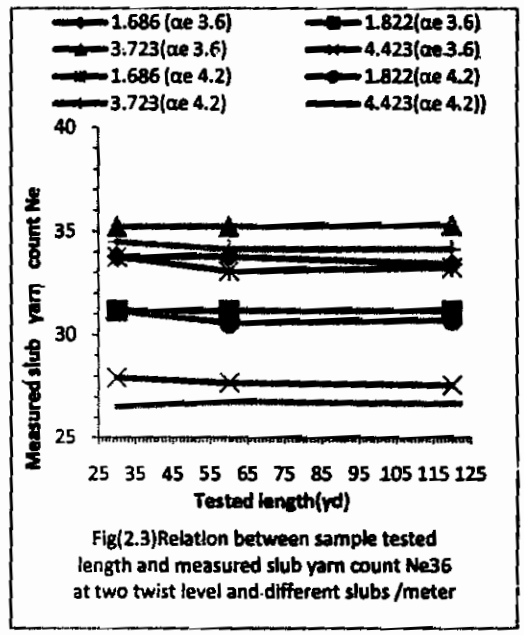
3.2.1 Effect of sample tested length :

For measuring slub yarn twist (T/in) either for low or high twist multiplier, the tests carried out at sample tested length 2, 4, 10 and 20 inch see Fig (2.1) .

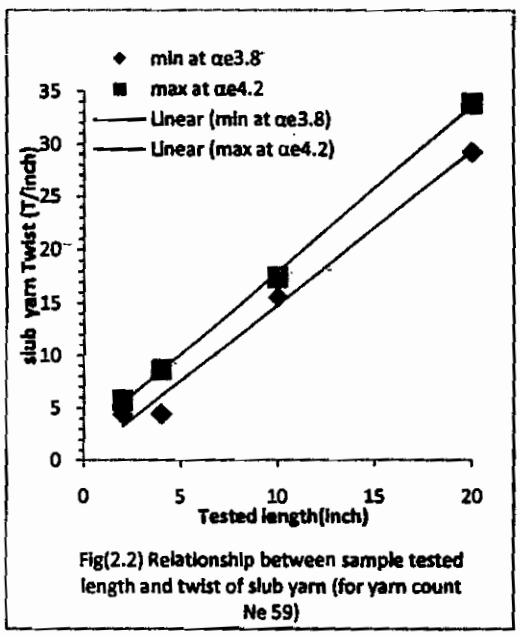


Fig(2.1) Relation between sample tested length and amount of turns per inch for slub yarn (36Ne)

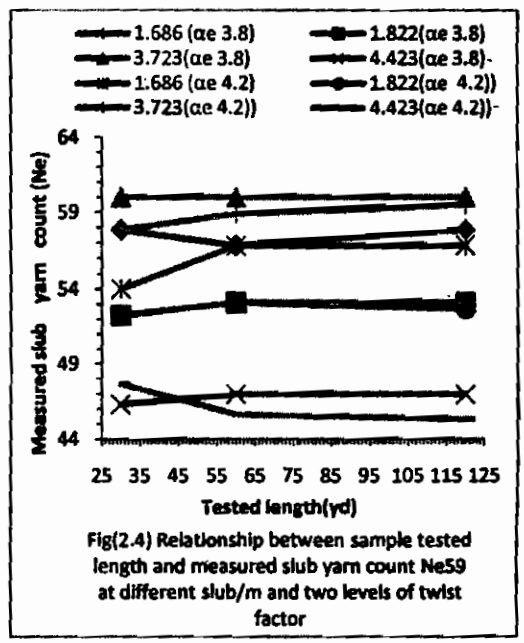
The increase in tested length show an increase of the final twist. While measured count of slub yarn not affected by varying sample tested length at 30, 60 and 120 yd, as shown in fig (2.3) for Ne 36. The same trend has been observed for yarn count Ne 59 as shown in fig (2.2) and fig (2.4). In addition for all test results, it is evident that, there is a significant effect of slub per meter on measured yarn count and causes a slight change in turns per inch.



Fig(2.3)Relation between sample tested length and measured slub yarn count Ne36 at two twist level and different slubs /meter



Fig(2.2) Relationship between sample tested length and twist of slub yarn (for yarn count Ne 59)



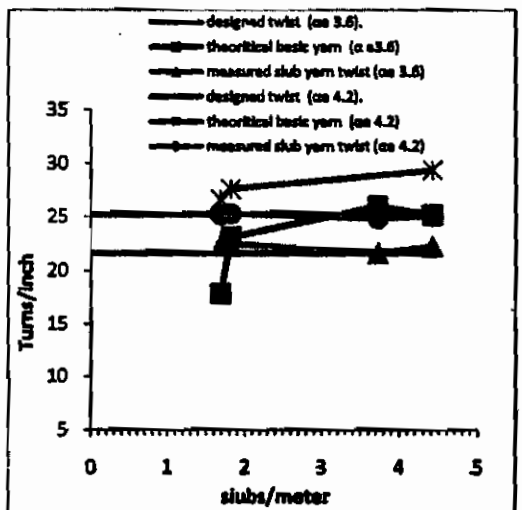
Fig(2.4) Relationship between sample tested length and measured slub yarn count Ne59 at different slub/m and two levels of twist factor

3.2.2 Effect of slubs per meter :

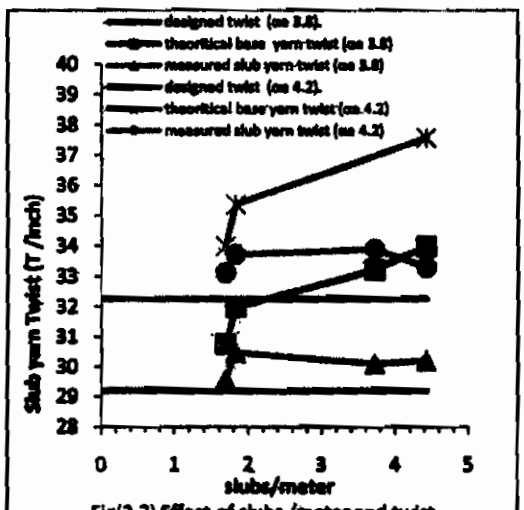
(i) Varying slubs per meter "from 1.686 to 4.423" causes a slight change in twist per inch for yarn count Ne36 as shown in fig (3.1) and fig (3.2) for Ne 59. On the other hand, theoretically twist increases as slubs per meter increased .

Both measured and theoretical values of twist is higher than design twist. Also, both values are very close at low slubs per meter while the differences is highly significant at high value of slubs per meter .

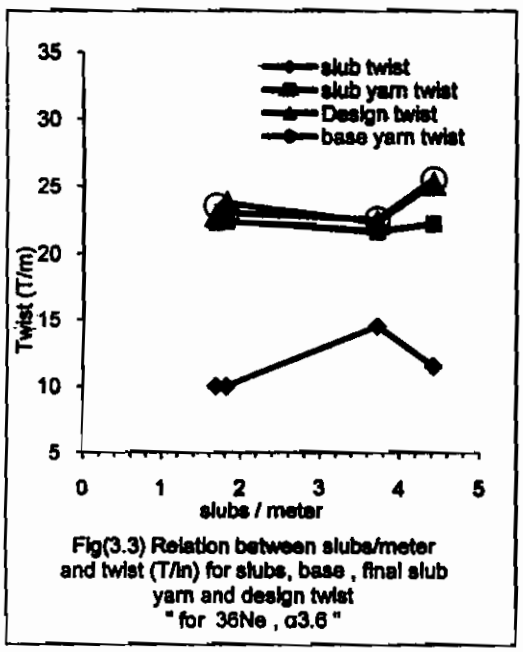
Also, the relationship between slubs per meter and twist (T/in) "for slub, base and final yarn", is shown in fig (3.3), (3.4) for Ne36 and fig (3.5), (3.6) for Ne 59. The results indicate that base twist (Tb) > final twist (Tf)> slub twist (Ts). The difference is about 1.8 t/in between (Tb) and (Tf), while it is about 18 t/in between (Tb) and (Ts) for Ne59. The some trend has been observed for Ne36, Tb > Tf by 1.5 t/in. and Tb> Ts by about 14 t/in.



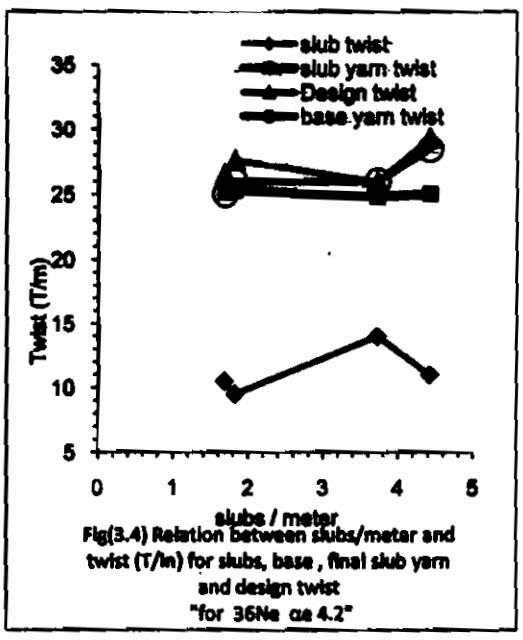
Fig(3.1) Relation between slubs/m and design twist, base yarn twist and slub twist(theoretical and measured for Ne 36



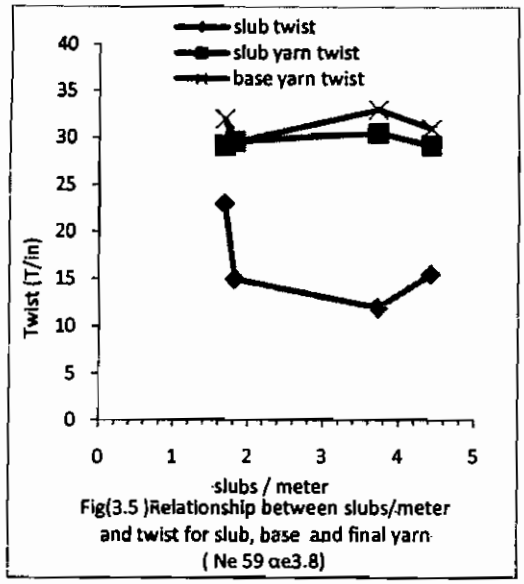
Fig(3.2) Effect of slubs /meter and twist multiplier on design twist-"Theoritical and measured twist of basic yarn and slub yarn for Ne 59"



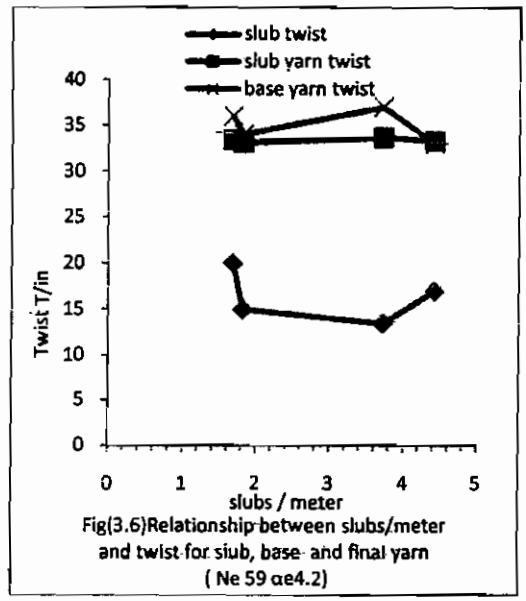
Fig(3.3) Relation between slubs/meter and twist (T/in) for slubs, base , final slub yarn and design twist
" for 36Ne , a3.6 "



Fig(3.4) Relation between slubs/meter and twist (T/in) for slubs, base , final slub yarn and design twist
"for 36Ne ae 4.2"



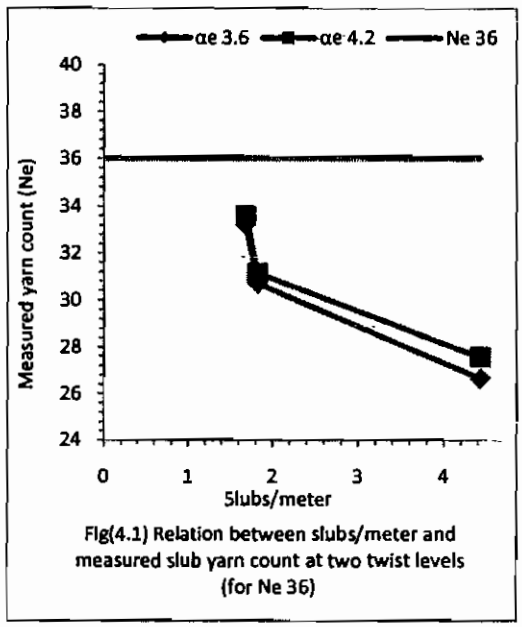
Fig(3.5)Relationship between slubs/meter and twist for slub, base and final yarn (Ne 59 αe3.8)



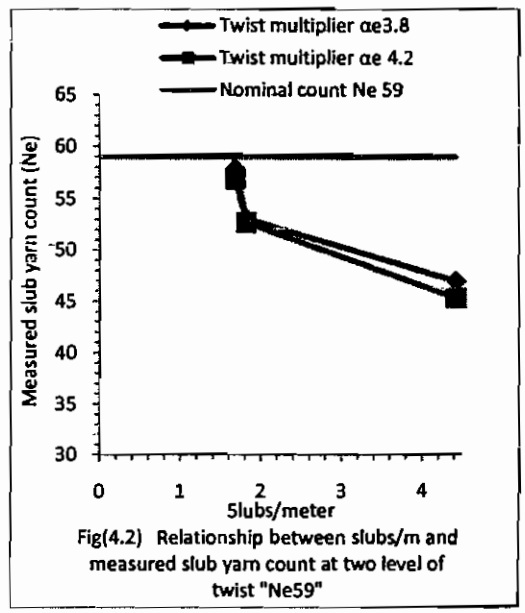
Fig(3.6)Relationship between slubs/meter and twist for siub, base and final yarn (Ne 59 αe4.2)

(ii) Count of slub yarn "measured and calculated" is shown in fig(4.1) for Ne36 and fig (4.2) for Ne59. The results show a decrease in yarn count as slub per meter increased. There is a small difference between measured and calculated at low slub per meter while a highly significant difference has been observed at high rate of slub per meter. Also, all values of measured count is lower than nominal count .

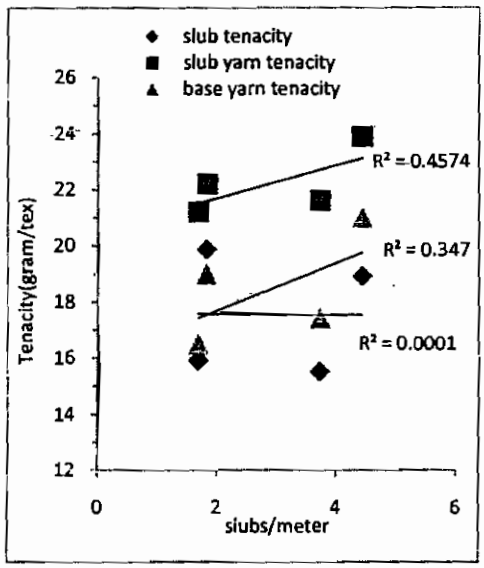
Also, slub per meter affect on count "of slub, base and finial yarn" as shown in fig (4.3), fig (4.4) for Ne36, and fig (4.5) and fig (4.6) for Ne59. As slub per meter increase an increase in average yarn thickness i.e coarse count produced .The experimental results indicate that at two level of twist multiplier, nominal count > count of base yarn > slub yarn count > count of slub .



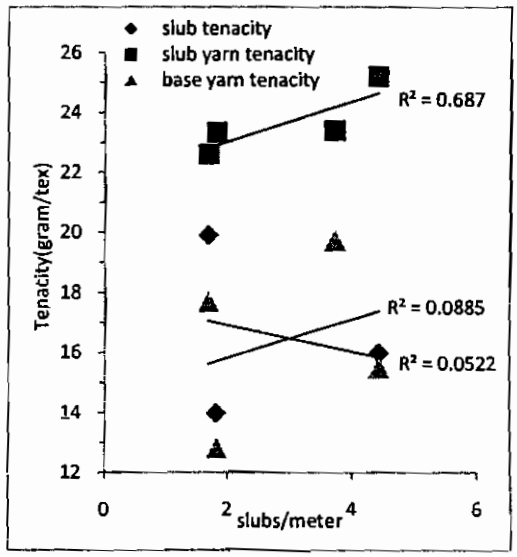
Fig(4.1) Relation between slubs/meter and measured slub yarn count at two twist levels (for Ne 36)



Fig(4.2) Relationship between slubs/m and measured slub yarn count at two level of twist "Ne59"



Fig(5.7) Relationship between slubs/m and tenacity of slubs,base yarn and final slub yarn Ne 59(αe3.8)

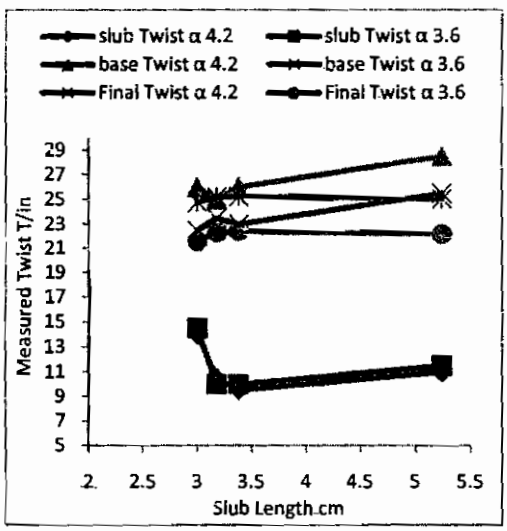


Fig(5.8) Relationship between slubs/m and tenacity of slubs,base yarn and final slub yarn Ne 59 (αe 4.2)

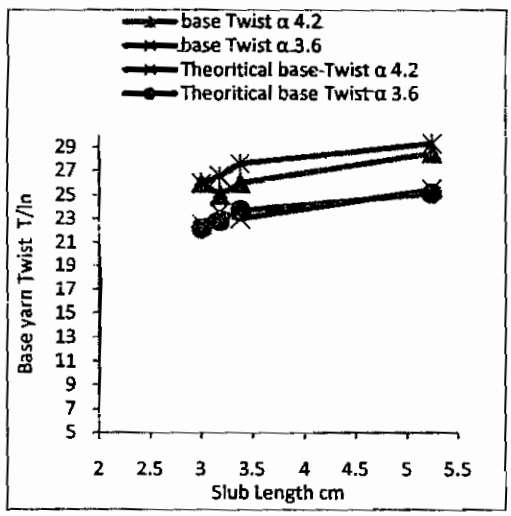
3.2.3Effect of slub length :

(i) Twist of slub, base and finial yarn due to the change of slub length is shown in fig (6-a), fig (6-b) for Ne36 and fig (7-a), fig (7-b) for Ne59 at two level of twist mutliplier. The test results indicate that the base twist is higher than these for final twist and slub twist respectively.

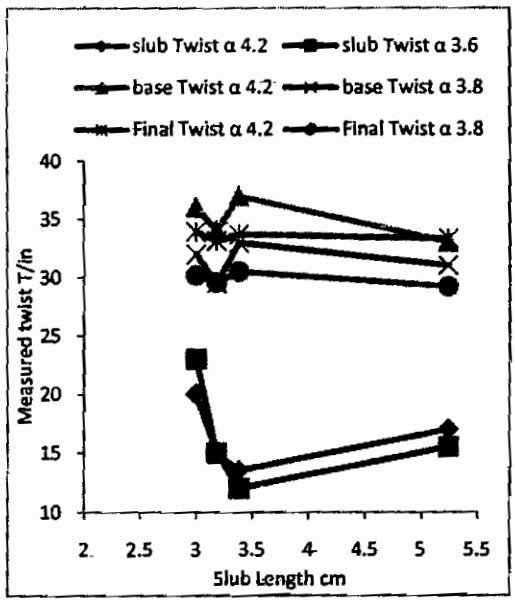
Refering the design twist, slub twist is lower while base and final twist is higher. Also, most of the results indicate that an increase of slub length causes an increase in the base twist. In addition, the calculated twist follow the same trend .



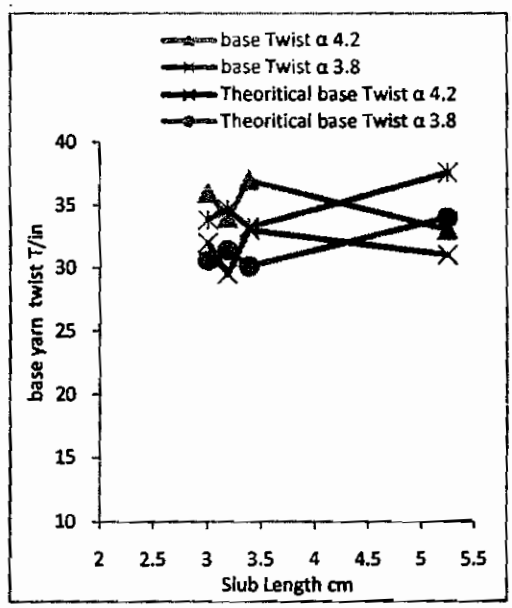
Fig(6-a)Effect of slub length on slub, base and final yarn twist(t/in For Ne36 at two level of twist



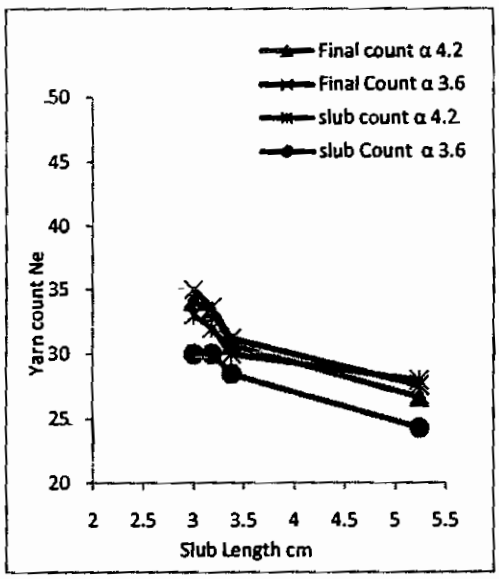
Fig(6-b) Effect of slub length on base twist (theoretical and measured For Ne36 at two level of twist



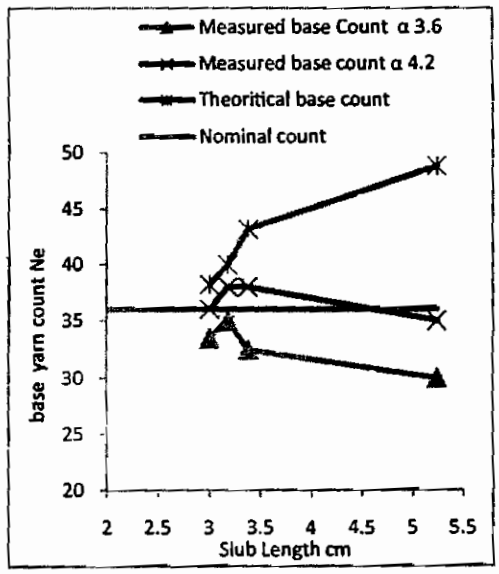
Fig(7-a)Effect of slub length on slub, base and final yarn twist(t/in For Ne59 at two level of twist



Fig(7- b)Effect of slub length on base twist (theoretical and measured For Ne59 at two level of twist

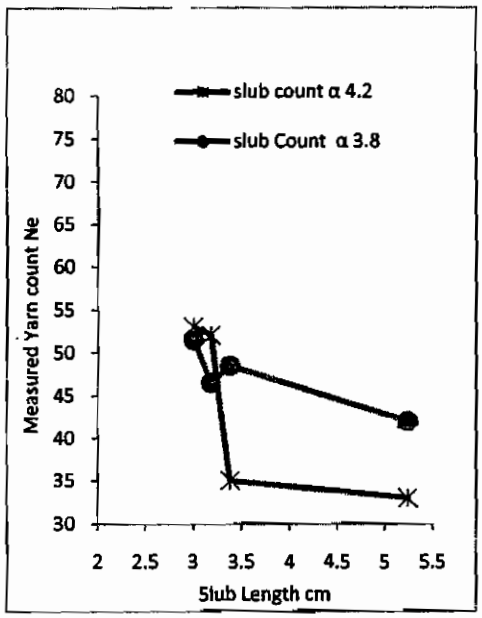


Fig(8-a)Relation between slub length and actual slub count for Ne36 at two level of twist base

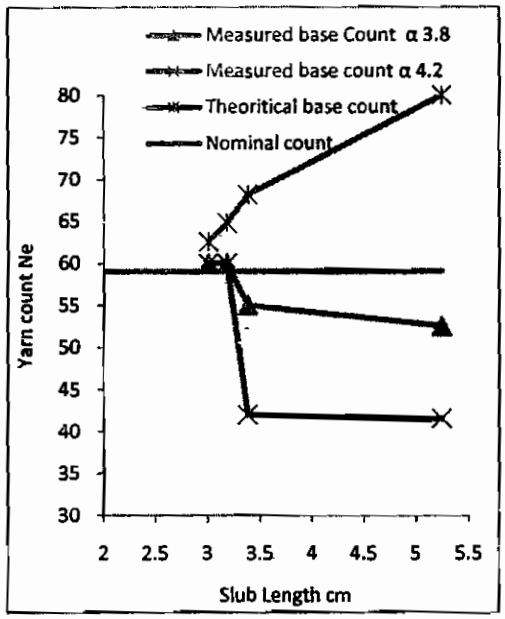


Fig(8-b) Relation between slub length and base count (Theoretical and measured) for Ne36 at two level of twist

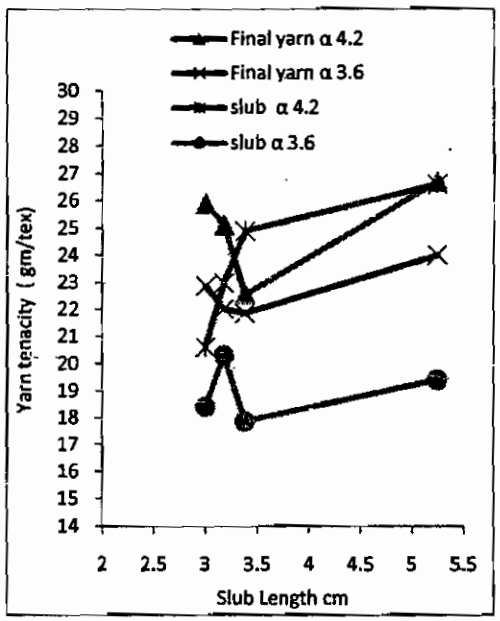
(ii) Slub yarn count. Test results for Ne36 is shown in fig (8-a), (8-b) and fig (9-a), (9-b)for Ne 59. The curves show an increase in slub length produce coarse yarn count than required for nominal yarn. Also, base count is higher than final yarn and slub respectively .



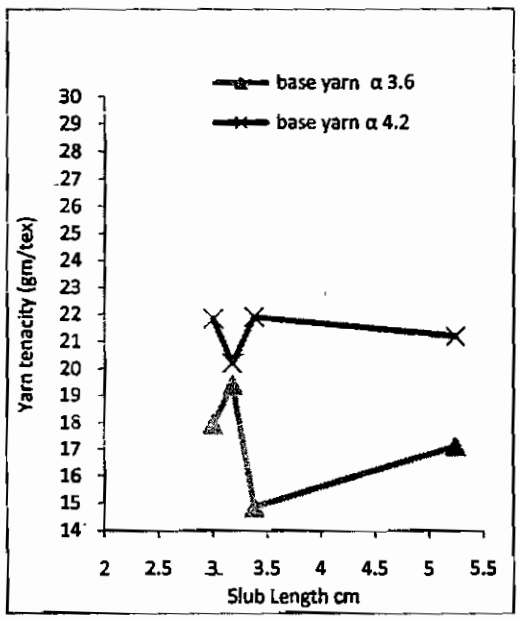
fig(9-a)Relation between slub length and actual slub count for Ne59 at two level of twist base



Fig(9-b) Relation between slub length and base count (Theoretical and measured) for Ne59 at two level of twist



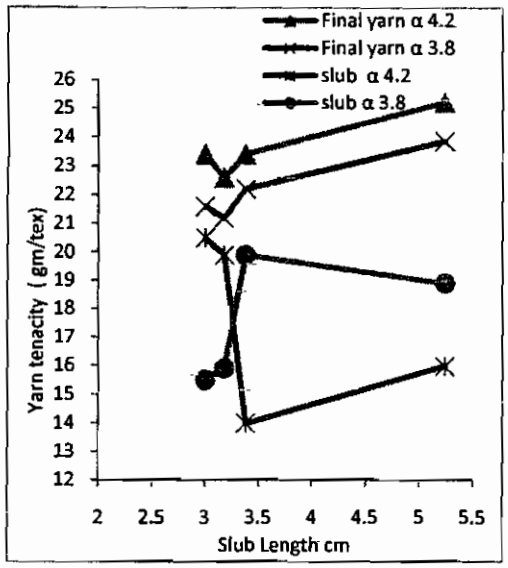
Fig(10-a) Relationship between slub length and tenacity of (slub, final yarn) for Ne 36 at two different level of twist



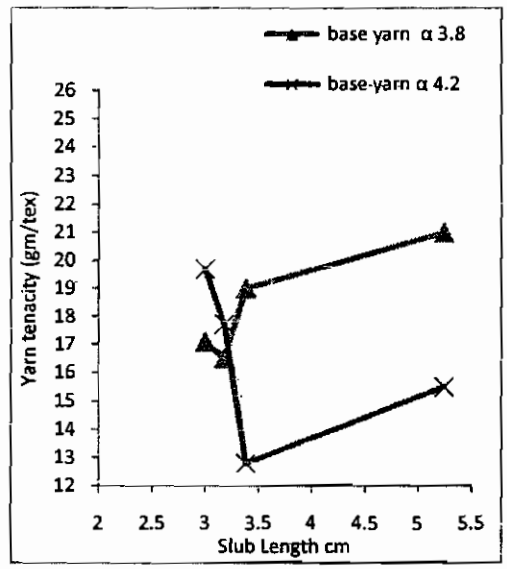
Fig(10-b) Relationship between slub length and tenacity of (base) for Ne 36 at two different level of twist

(iii) Slub yarn tenacity, varying slub length at four level show an effect on yarn tenacity (gf/tex) for slub, base and final yarn test results for Ne36 is shown in fig (10-a),(10-b) and fig (11-a),(11-b) for Ne59.

Most of results for slub and final yarn indicate an increase of tenacity as slub length increases, while for base yarn it fluctuate decreases or increase. Also, tenacity of final yarn is higher than those for slub and base yarn .



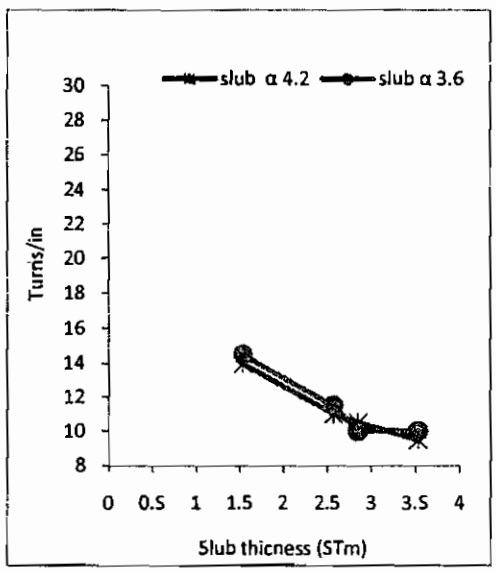
Fig(11-a) Relationship between slub length and tenacity of (slub, final yarn) for Ne 59 at two different level of twist



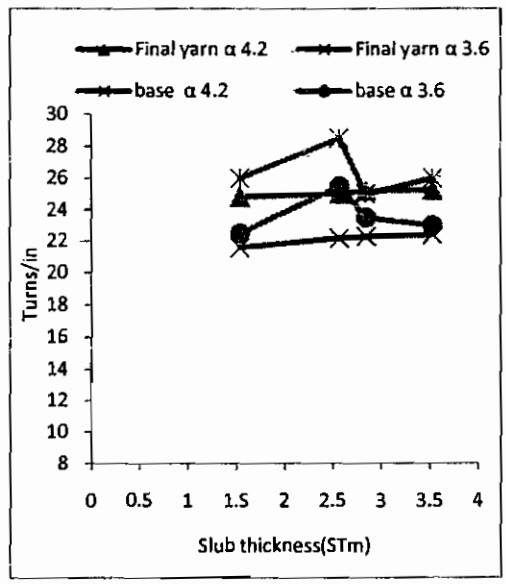
Fig(11-b) Relationship between slub length and tenacity of (base) for Ne 59 at two different level of twist

3.2.4 Effect of slub thickness :

(i) Relationship between slub thickness and twist "for slub, base and final yarn" is shown in fig (12-a),(12-b) for Ne36 and fig (13-a),(13-b) for Ne59. Measured slub twist decreased as slub thickness increased and the reduction is highly significant, while for final and base yarn, the curves show a slight decrease in twist or almost remain constant. Also, the twist value for base yarn is higher than those for final yarn and slub .



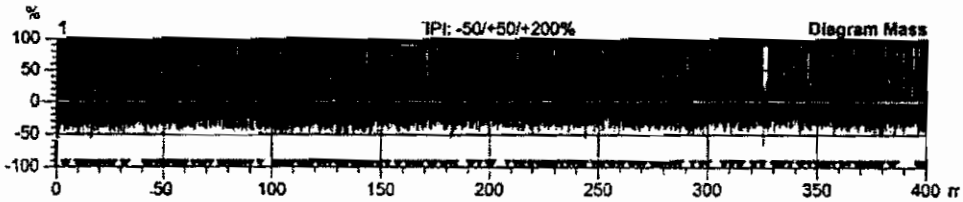
Fig(12-a) Relation between slub thickness and measured slub twist for Ne36 at two level of twist



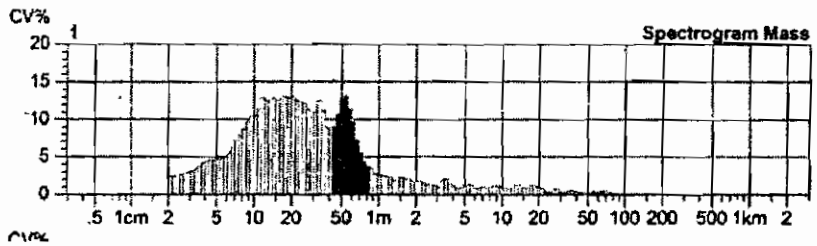
Fig(12-b) Relation between slub thickness and measured twist (base and final) for Ne36 at two level of twist

Nr	CVm %	Thin -50% /km	Thick +50% /km	Neps +200% /km	Neps +280% /km	Uster	Neps +400% /km	Rel. Cnt ± %
1	32.48	732.5	1818	1265	525.0		177.5	0.0
Mean	32.48	732.5	1818	1265	525.0		177.5	0.0
CV								
USP01	>95	>95	>95	>95				

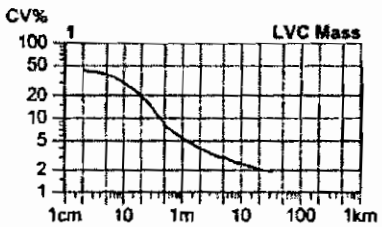
Fig(16-a)



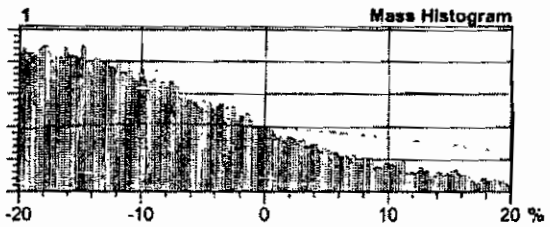
Fig(16-b)



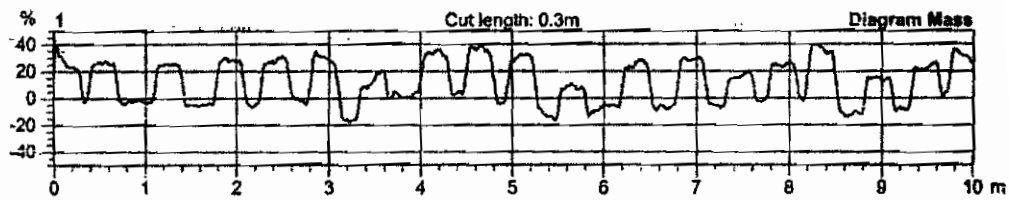
Fig(16-c)



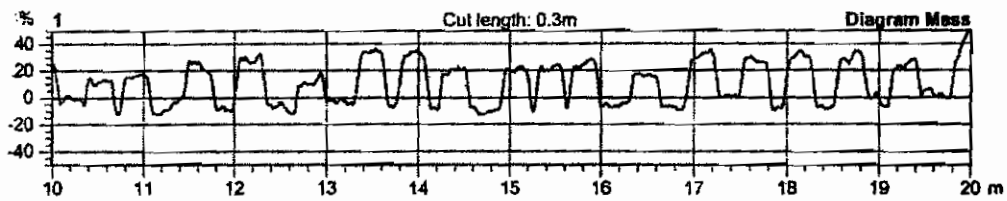
Fig(16-d)



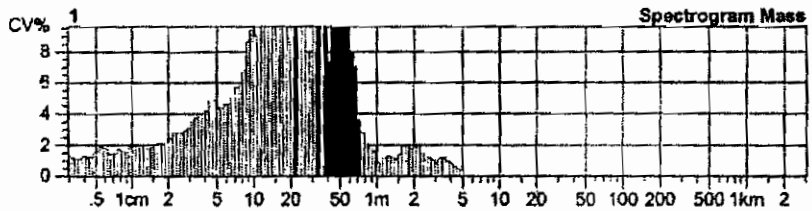
Fig(16-e)



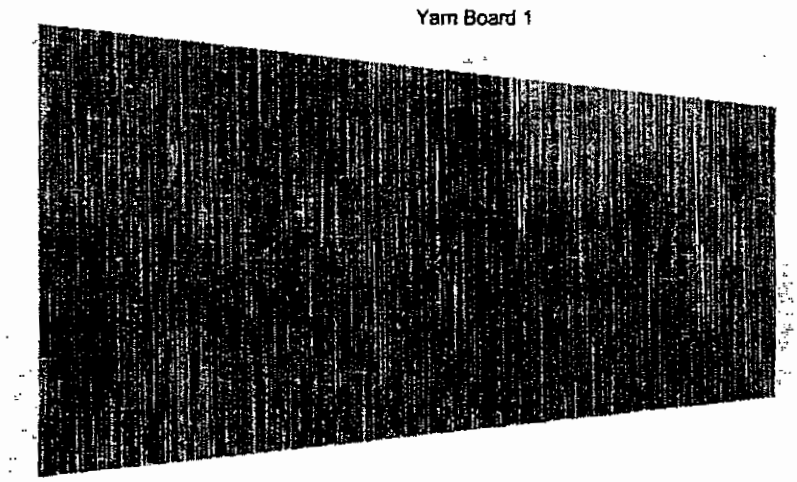
Fig(16-f)



Fig(16-g)



Fig(16-h)

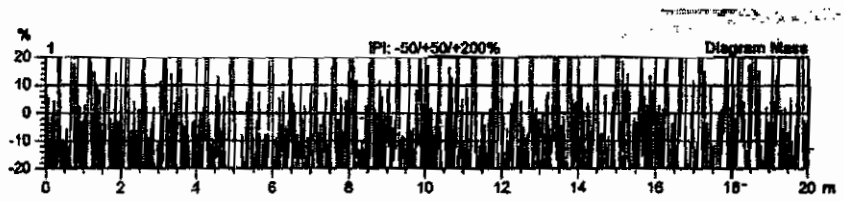


Fig(16-i)

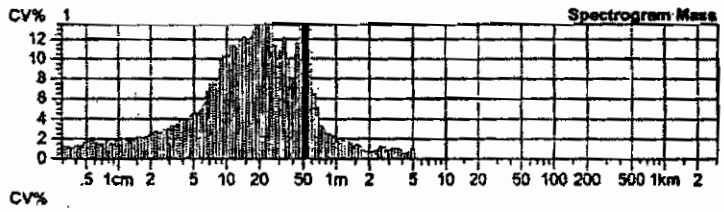
Fig(16) Mean yarn imperfection "thin, thick and thin places"/ 1000m, spectrogram mass, LVC mass, mass diagram, yarn appearance for 36Ne - α3.6

Nr	CVm %	Thin -50% /km	Thick +50% /km	Neps +200% /km	Neps +280% /km	Neps +400% /km	Rel. Cnt ± %
1	35.70						0.0
Mean	35.70						0.0
CV							
USP01	>95						

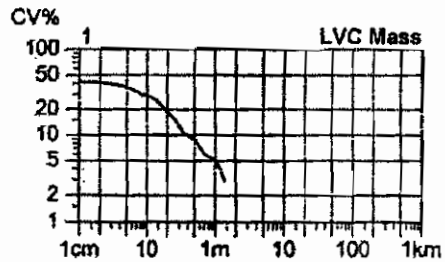
Fig(17-a)



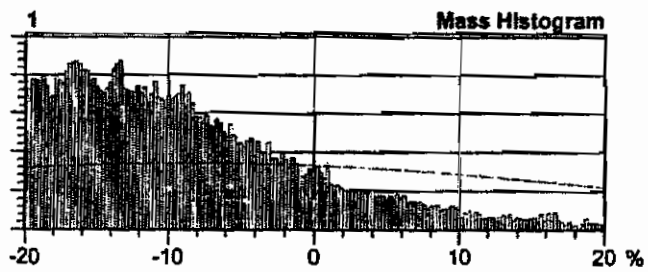
Fig(17-b)



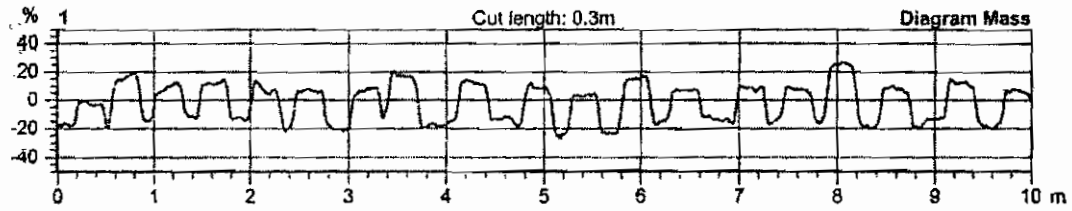
Fig(17-c)



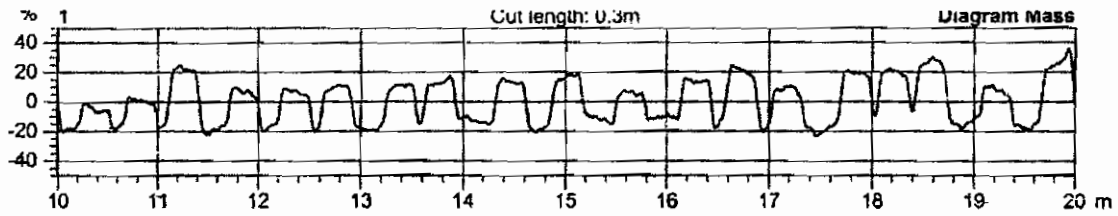
Fig(17-d)



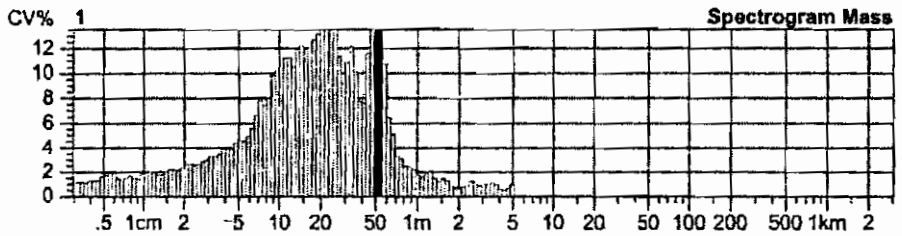
Fig(17-e)



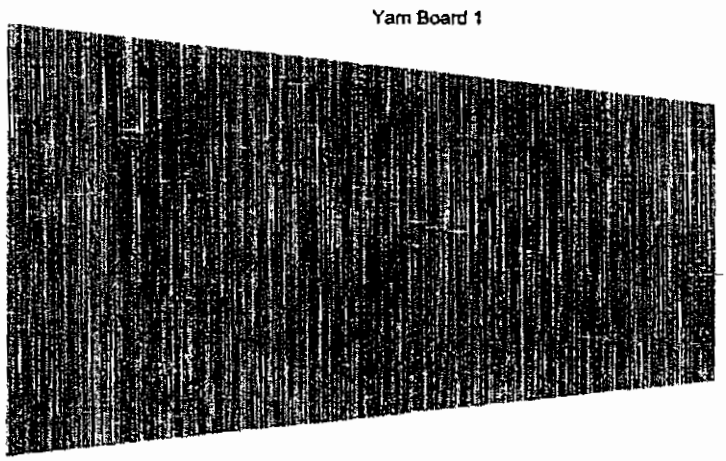
Fig(17-f)



Fig(17-g)



Fig(17-h)



Fig(17-i)

Fig(17) Mean yarn imperfection "thin, thick and thin places"/ 1000m, spectrogram mass, LVC mass, mass diagram, yarn appearance for 59 Ne α 3.8

5-References

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