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SYRIAN ARAB REPUBLIC

Syria

Technical report: Assistance to cotton yarn spinning mills*

Prepared for the Government of the Syrian Arab Republic
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Laurence J. Gibson
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INTRODUCTION AND TERMS OF REFERENCE

This report forms part of the findings and recommendation of a UNIDO mission to provide practical assistance to selected companies in the public sector of the Syrian textile industry. The primary aim is to overcome the problems which inhibit the sales of knitted cotton underwear particularly to hard currency markets. The report deals specifically with questions of spinning and yarn supply and has been prepared in accordance with the duties specified below.

"As part of a team working in close co-operation with the Technical Director of the Ministry of Industry's General Organisation for the Textile Industry (GOTI), the spinning technologuist is to carry out the following duties at the Hama Spinning Company to:

- determine the yarn specifications of Ne32 knitting yarn used by the Orient Underwear Company;

- detect the causes for sub-standard yarn in the production process;

- demonstrate how to overcome the quality deficiencies;

- advise management on future action for maintaining a consistent quality level of the chosen yarn count and of all other yarns manufactured;

- prepare a technical report setting out the findings of the mission on all the duties mentioned above and recommendations to the Government on further action which might be taken".

CONTENTS

1. SUMMARY & CONCLUSIONS

Yarn Specification

The Ne 32 combed cotton hosiery yarn supplied by the Hama Cotton Yarns Company to the Orient Underwear Company in Damascus, and the Arab Underwear Company in Alleppo falls short of the standard normally specified for the manufacture of regular quality knitted underwear for sale in Western Europe. In general the Hama yarn has higher than average count variation and overall thickness variation, and a particularly high incidence of local imperfections; these shortcomings are quantified and compared with Western European standards in Section 2, 'Yarn Specification'.

Handling and Transport

Between the final process (cone winding) at the Hama mills, and the knitting rooms at Orient and Arab Underwear, the yarn is handled in a manner befitting a non-perishable root crop: the consequent damage impairs performance in knitting and creates unnecessary wastage. Aspects of handling, packing, transportation and storage, with recommendations for improved methods are treated in Section 3 'Handling'.

Mill Operation

The two spinning mills at Hama Cotton Yarns Company are well equipped and organised for the production of combed hosiery yarn, particularly in the range Ne24 to Ne36. The limitation of finer counts is imposed by the quality of cotton available rather than by the capability of the machinery. Although these mills came on stream in the 1970's; (the first '71 and the second in '76) the technology and equipment is that of the 1950's and 1960's. Production machinery of Chinese origin is of sound design and construction, sensibly augmented by more modern winding machines. There is no technical reason why they should not produce combed hosiery yarns up to the accepted Western European standard. The equipment and operation of the production machinery is dealt with in Section 4, 'Mill Operation'.

Quality Control

The mills have adequate facilities and numbers of staff for all testing operations required for effective quality control and assurance. At present, routine tests are made on batches of yarn for delivery and Quality

Certificates issued according to the terms of supply contracts; post maintenance checks are made when machines are returned to full production following maintenance or repair. In general, the 'control' function of this section needs to be strengthened and more effort directed to 'trouble shooting' i.e. to the detection and elimination of faults. The effectiveness of overall quality control, and the necessary improvement in yarn quality would be improved by simple but regular shop floor supervision carried out by knowledgeable and authoritative members of management. Detailed commentary and recommendations are in Section 5.

Carding

The operation and maintenance of the cards is a particularly weak spot, calling for urgent and intensive remiedial action. Most cards exhibit damage as a result of careless or improper usage; this condition is aggravated by an acute shortage of spare parts and particularly by an outdated approach to card maintenance combined with a lack of understanding of the essential requirements for keeping carding surfaces in good working condition. The use of the microscope for studying the condition of card wire to determine the need for, and to monitor the progress of grinding has been demonstrated.

This is one area where further help in the form of practical training in effective methods of grinding setting and card maintenance is urgently needed as an essential requirment for upgrading yarn quality. Section 6 gives details.

N.B. The mastery of the art of carding is fundamental to quality yarn production. The Hama Cotton Yarns Company is recognised in Syria as a well organised mill in the top rank of spinning establishments. Investment and effort directed to introducing modern first rate card maintenance methods at Hama would create there a centre of excellence from which the whole cotton spinning sector could benefit.

Combing

The method of making comber laps contains a basic error in process design in that the number of process steps between the card and the comber is technologically imperfect. An experiment has demonstrated significant improvement in yarn strength from a re-arrangement of pre-comber drawing and all combed qualities stand to benefit by a follow-up on the improved technique. The experiment is described, with results in Section 7.

Drawing, Roving and Ring Spinning

The general levels of yarn irregularity and count variation point to a need for more detailed attention to drafting. The systems used are adequate in design and construction, the control action required is essentially fault detection and elimination and the setting up of procedures which will minimise recurrent faults.

Although he company is well equipped, this particular aspect of 'fault hunting'. the detection of 'rogue' spindles and the tracing of instances of irregular roller movement is not practiced. [The USTER spectrogram in the physical testing labortory is neither used nor understood]. The potential of this particular device was demonstrated, and the general philosophy of exercising control over a large number of spindles was explained.

This is another area where more prolonged practical training, both in the use of sophisticated equipment and in the simpler methods of frequent observation and supervision, would be advantageous, not only for the quality of Ne32 combed hosiery yarn for Orient and Arab Underwear but also for other yarns produced at Hama, e.g. combed Ne26 for sewing threads, and carded Ne32 for export.

Winding

It has been established that there is little difference in the quality of the Ne32 combed hosiery yarn between the two mills of the Hama Cotton Yarns Company based on measurments after spinning. It is also apparent that the automatic winding process with electronic clearing, installed in No.1 mill delivers a better yarn, measured in terms of fabric appearance. Plans are already in hand to instal similar automatic/electronic equipment in the No.2 mill later this year. Rewinding experiments at Hama, complement and confirm the results of knitting trials at Orient. The details of these findings are in Section 8 and in Mr Elson's report.[3]

2. YARN SPECIFICATION

Table 2.1 compares, the Hama/Orient contract specification for the supply of Ne32 combed hosiery yarn with a typical W.European specification fo. the same yarn and also with the average measured yarn properties from twenty shipments of yarn, ten from each mill at Hama, recorded on Quality Certificates over the period February to June 1985.

It is evident that the local contract specification is very basic in character and does not define many parameters, particularly those dealing with variability and imperfections, which W.European users regard as important for this class of yarn.

The averaging of values relating to twenty shipments masks the variation which exists within and between batches; Table 2.2 shows the average and range of the ten deliveries from each mill and the number of occasions on which the recorded values were outside the contract specification.

Three main conclusions are apparent from a study of Tables 2.1 and 2.2

- the Hama/Orient Contract specification is far less stringent than the European equivalent, notably in count and strength variation,
- yarn deliveries tend to the lower quality limit of the contract specification and frequently fall below the required minima,
- the product of No.2 mill has failed to meet the contract requirement, significantly more often than that of No.1 mill. (This tends to support the subjective impression at Orient that yarn from No.2 mill is the poorer in quality and performance. Despite this impression, no yarn is returned as reject nor is any attempt made to segregate the fabric or garments according to yarn source with the result that the quality of all is reduced to that of the poorest input material).

The difference in yarn quality between No.1 and No.2 mills is readily attributed to the fact that No.1 has automatic winding with electronic clearing and modern replacement drafting systems in roving and ring spinning. There is no doubt that both these observations have some relevance, but neither account for the high level of count variation (CV%), particularly marked in No.2 mill, and the very high level of local Imperfection's which do not figure in the specifications or Quality Certificates, but which substantially reduce the acceptability of the knitted fabric and of the finished garments.

Table 2.3 summarises the results of a series of tests made on the spun yarn, before clearer winding, concentrating on variablity of count and imperfection levels. For comparison USTER experience values are also quoted: the meaning of the latter is that in the experience of the Zellweger Company of Uster in Switzerland (which extends worldwide over about three decades), 50% of all the yarns evaluated by them do not exceed the levels shown in the table. The 50% USTER experience value is often taken as the upper limit or acceptability in the quality yarn trade.[1]

Figures 2.1 to 2.4 display the results of these tests in graphical form showing the distribution of the measured values again with USTER experience levels superimposed for comparison. Table 2.4 indicates that so far as this series of tests is concerned there are no significant differences in average count, U%, and imperfection count between mills 1 and 2 and hence the results from both have been pooled in the frequency distribution of these properties (figs. 2.1 to 2.4).

From these data it is clear that the Ne 32's yarn from Hama Cotton Yarns Company falls far short of the normal commerical standards which would be expected in the W.European market.

The difference in count variation (Ne CV%) shown in Table 2.3 is examined in Table 2.5 from which it must be concluded that there is evidence of a real difference between the two mills at Hama in yarn count variation based purely on this series of tests. This evidence is reinforced by the data collected from Quality Certificates summarised in table 2.2.

From the graphical representations, Figs. 2.1 to 2.4 it is apparent that:

- the sample means are high or very high in relation to the experience values, and

- all distributions have a 'tail' of extremely high values

These patterns suggest that in seeking remedial actions the aim must be two-fold; to identify and correct the cause of high average fault levels, and to hunt for those 'rogue' elements which are responsible for the relatively infrequent but extremely poor results.

In this context, the likely possible causes include:

- cotton quality, particularly, maturity ratio and short fibre content: these parameters are related to nep formation, and uneven drafting leading to high general yarn irregularity. The level of comber extraction is also obviously related to the short fibre content in the sliver which goes forward to roving and spinning,

- the quality of carding, always a vital element in preparation, particularly with reference to nep and the formation of short thick places in the yarn,

- the weight uniformity of slivers, which is specially relevant to yarn count variation,

- variations in the movement of drafting elements, due to eccentricity, ovality, slippage or vibration,

- inadequate cleaning which gives rise to 'spun-in' fly and various drafting faults.

Table 2.1 YARN SPECIFICATIONS. Ne 32 COMBED HOSIERY YARN

Cotton	Typical W.European specification	Hama/Orient contract spec.	Average of 20 deliveries Hama/Orient Feb.to June'85
Type	American white	ns	-
Length	1 3/32"	ns	-
Grade	strict midding	ns	-
Comber waste%	18	ns	-
Yarn Count	32	32	32.2
Tolerance %	ns	3	2.0
CV%	2.0-2.5	ns	3.5
Twist	T.F. Ne 3.5	775 t.p.m.	777 t.p.m.
Tolerance %	ns	3	0.4
CV%	ns	ns	4.7
Strength	13 g/tex	200-220 g	223
CV%	8.0	ns	12.3
Elongation %	7.0	ns	6.3
Evenness U%	12.5	12.0 to 14.0	14.0
Imperfections(USTER)			
Thin places/ Km(-50)	24	ns	-
Thick places/ Km (3)	60	ns	-
Nep/Km (3)	100	ns	-
Classimat(USTER)			
total imperfections per 100 Km.($A_1+B_1+C_1+D_1$) maximum	600	ns	-
average	300	ns	-
Cone angle	ns	9°15'	-
Cone weight	ns	1200-1400	1320
Clearer	electronic	ns	-
Lubrication	waxed	ns	-

ns = not specified - = not stated or not measured.

Table 2.2 SUMMARY OF DATA FROM 'QUALITY CERTIFICATES' Ne32 COMBED HOSIERY

Values from 10 deliveries from each mill Feb. to June '85

	Standard sample 10 cones tests per cone	Contract Standard	No.1 Mill		N	No.2 Mill		N
			mean	range		mean	range	
Yarn Count (Ne)	3	32.0	31.54	31.0 to 32.0		32.9	31.7 to 34.3	
Tolerance (%)	"	±3	0.92	0.0 to 3.2	1	3.15	0.31 to 7.2	6
C.V. (%)	"	ns	3.24	2.7 to 4.1		3.75	2.6 to 7.0	
Twist (tpm)	3	775	774	763 to 782		780	772 to 796	
Tolerance (%)	"	±3	0.23	0.0 to 0.6		0.59	0.0 to 2.7	
C.V. (%)	"	ns	2.90	2.0 to 4.1		6.47	2.8 to 13.5	
Strength (g)	10	200 tc 220	225	221 to 237		221	205 to 242	
CV (%)	"	ns	11.9	8.9 to 14.9		12.78	10.4 to 14.7	
R.K.M.	"	ns	12.1	11.7 to 13.2		12.25	10.8 to 13.4	
Elong. (%)	"	ns	6.4	5.6 to 7.0		6.08	4.7 to 7.6	
U%	1	12 to 14	13.4	13.1 to 14.1	1	14.5	13.1 to 14.8	5
Cone wt. (g)	1	1200 to 1400	1347	1278 to 1390		1294	973 to 1372	1

ns = not specified

N = number of deliveries outside Contract Standard

Table 2.3 **Ne 32 COMBED HOSIERY YARNS**

SUMMARY OF TESTS ON YARN FROM RING TUBE

Mill	Yarn Ne	Count CV%	Irregularity U%	Imperfections per 1000m Thin	Thick	Nep
1	31.3	3.8	13.6	132	604	536
2	32.9	5.8	13.9	152	512	536
1 & 2	32.1	5.6	13.75	142	558	536
USTER Experience Value. 50% level.		2.5	12.0	17	57	59

based on 30 samples collected at random from each mill.

U% integrated over 5 minute period at 5m/min yarn speed

Sensitivity: Thin -50
Thick 3
Nep 3

Table 2.4 **SIGNIFICANCE OF DIFFERENCES IN MEAN VALUES, TESTS ON YARN FROM RING TUBE**

Parameter	Yarn Count		Irregularity		Imperfections per 250m					
	g/120yd		U%		Thin places		Thick places		Neps	
Mill	1	2	1	2	1	2	1	2	1	2
Mean Value $\bar{x}$	2.07	1.97	13 6	13.9	32.7	38.0	150.7	128.1	134	134
Σx^2	128.98	116.6	5631.3	5863.5	86305	104247	767427	611258	-	
n.	30	30	30	30	30	30	30	30	-	
pooled estimate of Variance σ^2	4.234		198.2		57.3		23770			
$t = \bar{x}_1 - \bar{x}_2 / \sqrt{1/n_1 + 1/n_2}$	0.1957		0.083		0.36		0.57			
From tables.	Significance Limits of t. for $\overline{n_1+n_2} - 2 = 58$. 5% probability Value = 2.00									
Significance of difference of means at 5% level.	None		None		None		None		None	
Combined mean Value	2.02		13.75		35.2		139.4		134.0	
Converted values	Ne 32.1		13.75		142/km		558/km		536/km	

Table 2.5 NE 32 COMBED HOSIERY

Tests on ring tube June '85

Significance of difference of Count Variation.

Mill No	n	$\bar{x}$ g/120 yd.	σ	CV%
1	30	2.072	0.079	3.8
2	30	1.968	0.1145	5.8

$$F = \frac{0.1145^2}{0.079^2} = 2.10$$

From Table with degrees of freedom $V_1 = 29$ & $V_2 = 29$.
5% level of probability lies between 1.64 and 1.90.
Since the calculated value of F exceeds this, there is evidence of a real difference in the variability of yarn count between the two mills.

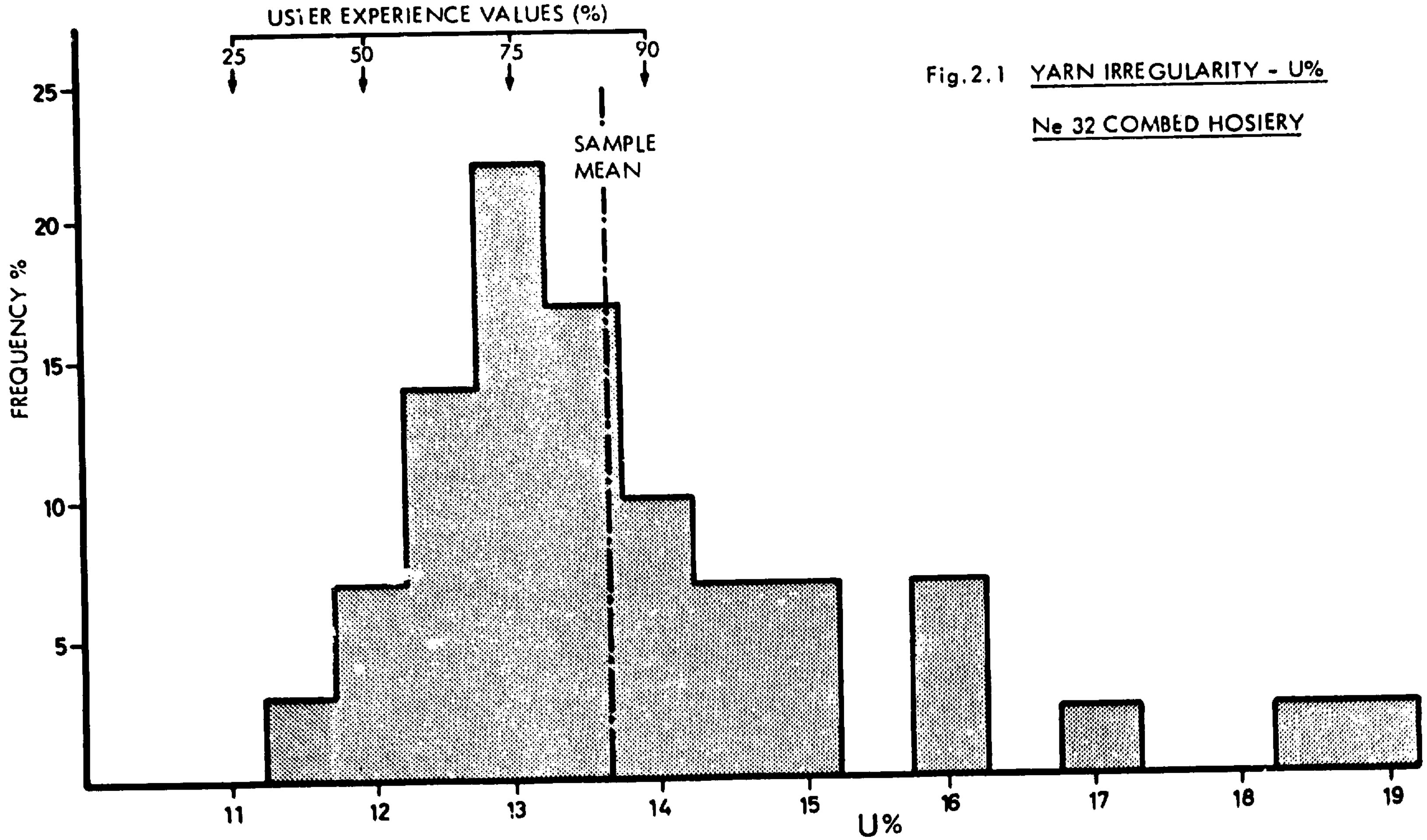

Fig.2.1 YARN IRREGULARITY - U%

Ne 32 COMBED HOSIERY

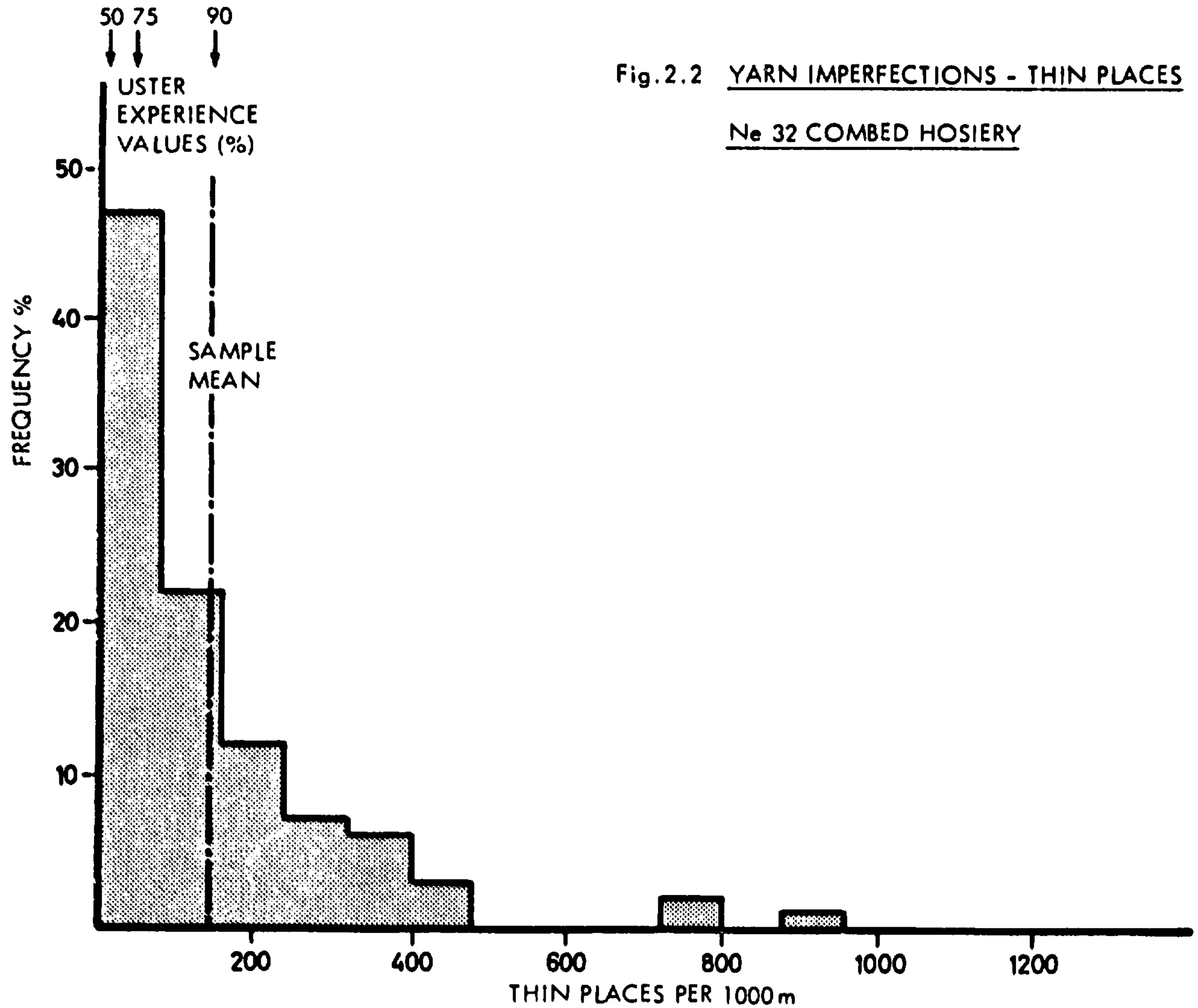

Fig. 2.2 YARN IMPERFECTIONS - THIN PLACES

Ne 32 COMBED HOSIERY

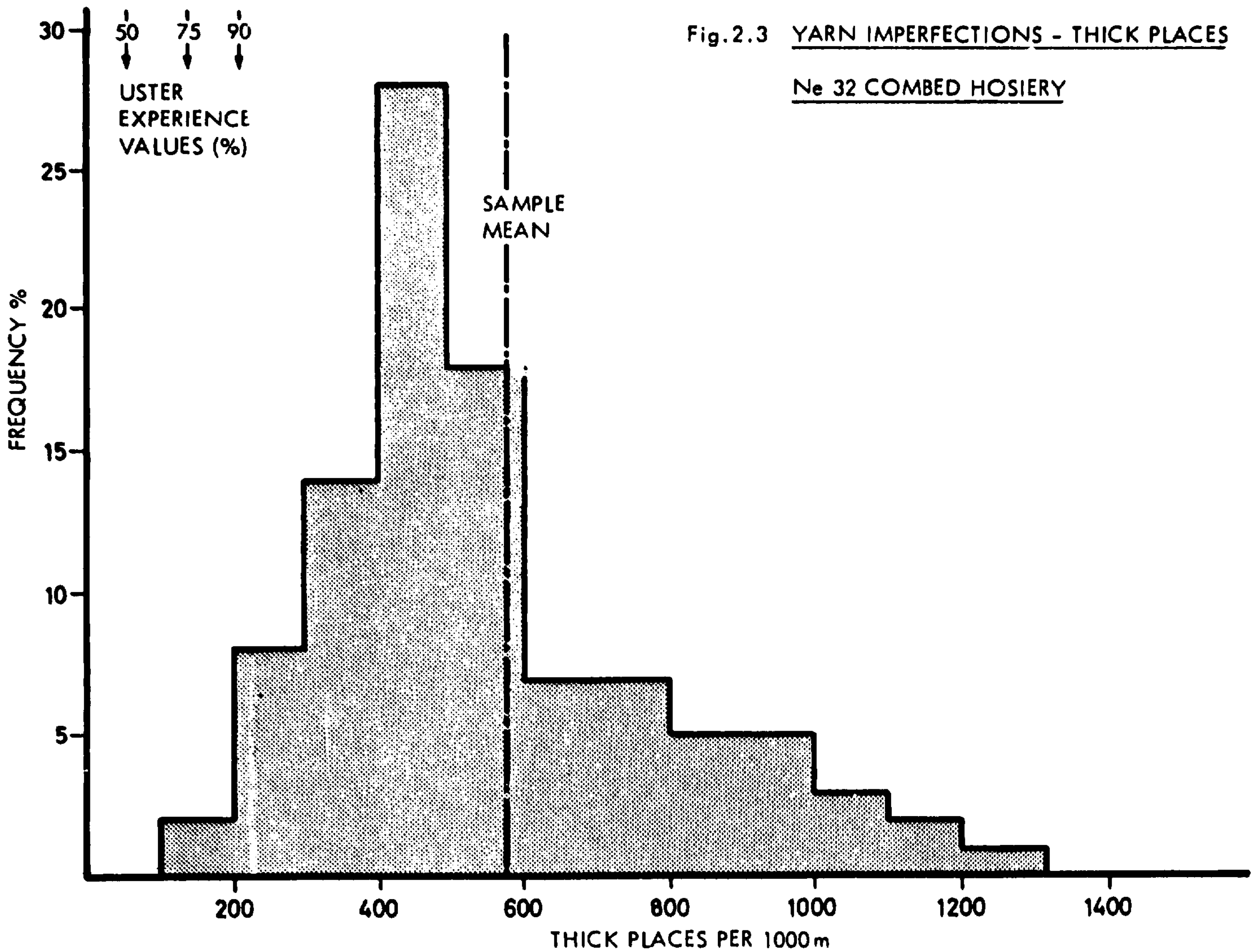

Fig. 2.3 YARN IMPERFECTIONS - THICK PLACES

Ne 32 COMBED HOSIERY

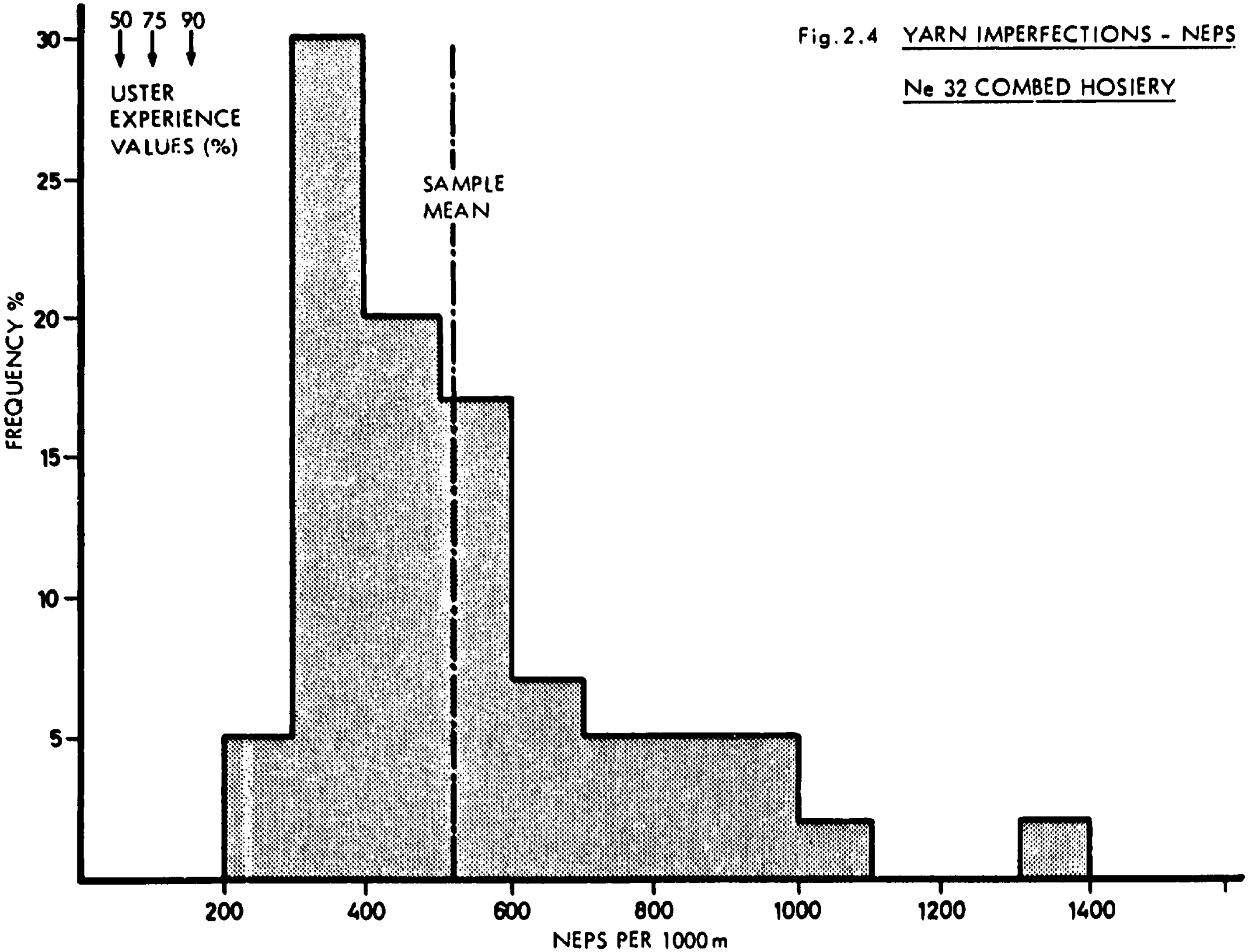

Fig. 2.4 YARN IMPERFECTIONS - NEPS

Ne 32 COMBED HOSIERY

3. YARN HANDLING

The cross-wound coue is the preferred supply package for circular knitting, worldwide: this form of supply provides a convenient and economically acceptable input of cleared yarn, which under normal conditions unwinds freely at the modest yarn speeds used in knitting. Unfortunately, by virtue of its mass, density and shape the cone of yarn is vulnerable tc careless or rough handling.

In transferring the Ne32 combed hosiery yarn from Hama to Orient the handling, packing, transport and storage of the cones is extremely rough and, in fairness, this situation is not due to carelessness; the system is designed, accepted and preserved by both supplier and recipient. Whatever the economic or social justification for persisting with the existing method it is very wasteful. Between cone winding and knitting yarn waste should not normally exceed 0.5%, the present method yields at least 5%, not counting the unnecessary stops in knitting and damage to bare cones. Some of the yarn which cannot be used at the knitting machine because of damaged packages is recovered by rewinding part cones at the knitting mill. However it must be noted that rewound yarn is a second grade product because of its high knot frequency and because of the twist disturbance in winding which always tends to further reduce the strength of any soft weak places.

The basic problem starts at the winding machine in the spinning mill; as the cones are doffed they are <u>thrown</u> into wheeled trucks. In the warehouse full cones from winding are <u>thrown</u> into a pile on the floor in a walled bay, from which each cone is individually placed in a plastic bag (unfortunately this wrapping process which would normally provide the opportunity for visual inspection is entrusted to workers who are disabled due to blindness). The cones are then <u>thrown</u> into sacks, rammed by hand to ensure tight packing, the sacks are then sewn, weighed (about 35kg per sack) and stacked six high on trucks for transport to tne finished yarn store where the sacks are <u>thrown</u> from the truck and piled six high on the floor. The loading of the road transport for the 150 mile journey to Orient and the unloading at Damascus follow a similar pattern. The static pressure on the bottom cones in the bottom sacks is some 6 x 35kg borne on a few of the cones' relatively sharp edges and this is increased to unknown levels by dynamic loading when the truck encounters a bump in the road. When the yarn is issued to the knitters sacks are dragged from yarn store to knitting room, the cones emptied onto the floor until required.

It is worthy of note that cones of yarn for export which are eventually packed in cardboard cartons are treated in exactly the same manner up to the point where they are then re-arranged into a systematic pattern, 16 cones to one layer, and each layer separated by a cardboard sheet.

The packing densities of yarn in sacks and yarn in cartons are very similar. In sacks the gross transport density is about 240kg/m^3 of which 95% is yarn. In cartons the corresponding values are 240 kg/m^2 and 90%. Sacks cost about 6 Syrian lira each and sustain two round trips on average: cartons are imported and cost some 26 lira each for the single journey.

The recommendations must be that in future, inspection and packing are done in the winding room directly from the winding frame to carton gently and with care. Cartons should be held at convenient height at loading stations feeding a conveyor equipped with an automatic closing and strapping station, and an automatic weighing station. The cartons could then be palletised and moved by fork lift to store, from store to road transport, from road vehicle to store and from store, individual cones by pin truck to knitting machine.

The finished cone of Ne32 combed hosiery has a value of about 32 Syrian lira; to throw it on the floor and to subject it to such rough handling would be regarded as bordering on sabotage in most Western European mills. The fact that such treatment is tolerated prompts two observations:

- it underlines the view that despite the lip service paid to quality and quality control, the pervading and abiding interest is with output; production for its own sake with scant regard for product quality.
- it emphasises one aspect of the Syrian style of working, namely that when bulk and weight have been moved it will be done with a cheerful macho vigour and enthusiasm, reminiscent of harvesting, quite out of place in yarn packing.

4. MILL OPERATION

When a process as mechanically complex as modern cotton spinning is introduced into an area where there is no background or tradition of industrial manufacture there is inevitably a learning phase largely associated with the difficulties of personnel in adapting to the discipline of factory life. At another level there are the problems of understanding the process and machinery and of controlling all these aspects by people who initially have little or no previous experience. Under these circumstances the choice of a manageable level of technology, and of well designed and constructed machinery are vital ingredients, and the realisation of the designed productive capacity becomes the prime target.

At Hama Cotton Yarns the level of technology is right, the machinery is, in the main, right, the organisation is effective and the production targets have been met, (albeit with gross overmanning in some sections.) The second, equally inevitable and difficult phase is now beginning, namely the achievement of quality standards which will justify the investment by earning hard currency and making a net positive contribution to the Syrian economy.

Both mills are equipped with machinery which at modest speeds, by today's peak values, will permit the production of high grade hosiery yarns, doubling weft or weaving yarns at the finer end of the range which can be made from 100% Syrian cottons. Ideally this is from Ne24 to Ne36 but given longer finer staples the same machinery is capable of spinning finer yarns say to Ne60 or even Ne80. Some modification has been introduced into the first mill since its commissioning in 1971: the manual winders have been replaced by automatic machines with electronic clearing, and the drafting mechanism at the ring frames have been replaced by a German-made model of essentially similar style - but possibly better performance than the original Chinese-made system. There are plans, now well advanced to introduce new automatic winders in the 2nd mill, commisssioned in 1976 and which still relies on the old manual winding system with mechanical slub catchers.

With the exception of the cards, machines are in good order, and systematically and thoroughly maintained according to a schedule derived from the Chinese. Although scouring, oiling, attention to bearings, gears and mechanical parts is religiously carried out and supervised, cleaning with the machines running is inadequate. Stationary flat clearers on the roving and rotating under-clearers operating on the back rollers of the ring frames are not cleared often enough. In consequence tufts of fibre ('eyebrows') are too often in evidence and these are a source of 'spun-in fly' which is a common cause of short thick places which mar the appearance of the yarn. Similarly the frequency of roller picking which is entrusted to special cleaners is insufficient and should be at least doubled to ensure good spinning.

Cards are dealt with separately in Section 6, and combing, Section 7, is one area where the process technology requires correction by introducing a further head of drawing in lap preparation.

The mill is clearly well organised to meet its production targets and in the process of achieving these targets, yarn quality considerations have been forced to take a back seat. Priority has been given to production at the expense of quality to the extent that grossly obvious malpractice in the handling and storage of roving and yarn is tolerated, even ignored. Before entering into complicated technical considerations involving spinning technology, attention to 'housekeeping' procedures, in particular cleaning, handling, transport and storage has now become an important basic requirement in any campaign to upgrade Hama's cotton yarns.

There is no need to reduce output at any stage to achieve better quality.

Allowing for the replacement of winders with new automatics, there is no immediate replacement of machinery required.

The refurbishing of the cards is vital and should go ahead as soon as possible.

Future planning should include the possibility of new drawframes, particularly after combing, and the possibility of splicing instead of knotting. Both possibilities should be carefully researched with actual trial on the company's materials before decisions are taken.

5. QUALITY CONTROL

The essential requirment in quality control is a re-direction of energie: and skills to concentrate on the Control aspect.

The mills have well equipped and adequately staffed testing laboratories. As with many companies, the attitude towards quality control and quality assurance is that this function is primarily concerned with testing and totally and exclusively the responsibility of the quality control department. This philosphy permits the kind of 'double think' which allocates hours of laboratory testing to the issue of Quality Certificates and at the same time daily, monthly, yearly continues to ignore th fact that finished, cleaned and waxed yarn on cone is thrown onto the floor as a matter of course.

Quality control implies the ability to discriminate, to select or to reject materials and products according to their fitness or conformity to agreed standards. This is where the testing comes in, to measure fitness and conformity and unfortunately this is often where the process stops. Quality control also implies action, remedial action, to correct and prevent the continued manufacture of substandard goods.

Testing has a part to play in this process, but even here testing is not being pointedly directed to the detection and elimination of faults. For, example a most valuable piece of equipment in any spinning laboratory is the USTER evenness tester; at Hama this machine is in daily use recording the general yarn irregularity, (U%) mainly for use in Quality Certificates which accompany all deliveries. No use is made of the instrument's capability to give an automatic Imperfection Count in the same time as it measures U%. It is evident from the tests made during this study (section 2) that this is one area in which Hama yarns fall well below accepted standards as expressed in USTER Experience Values. No use is made of the irregularity diagram which is a readily available first indication of mechanical faults in sliver, roving, or yarn, and no use is made of the Spectrogram which analyses yarn irregularity on the basis of the variance-length curve which is the most powerful tool in diagnosing and pinpointing the causes of irregular yarn.

Again, for example, during the course of this study a nep count at all cards dedicated to the production of Ne32 combed hosiery yarn revealed immediately that 49% were by the mills own standard 'poor' and 18% in the 'very bad' category. This is a simple and quick test for which the equipment and skill is available and which identifies immediately where action is needed at least to deal with the worst offenders: however, the test is not done on a frequent or regular basis, not even to denote where regrinding is thought to be needed. This is a clear case in which the testing capability is not integrated into the remedial action sequence which ought to be its main function.

Quality control, by definition must involve all those with managerial and supervisory responsibility for the product and this includes production, technical and maintenance management as well as laboratory staff. Information for quality control is available not only from the laboratory but also from simple straightforward diligent observation. To improve the yarn quality will require very little new in testing facilities, but it will require the active interest of responsible staff and the direction of this interest towards detecting, diagnosing and eliminating the causes of yarn faults.

It is fortunate that the normal pattern of faults and failures in a multi-unit system is that a large proportion of faults are created by a small fraction of the productive units. For example some 80% of end breaks in spinning occur on about 20% of the spinning spindles and when these are identified the process of curing the faults is well under way. The number of mishapen cops, readily identifies bad ends at the spinning frame, their location can be marked and their causes found and cured without recourse to laboratory work. Similarly, inaffective clearers inadequate cleaning, roving bobbins with an outer coating of fly can all be spotted and action taken without recourse to testing.

On the other hand, periodic faults arising from roller eccentricity, ovality, slip, vibration or other irregular roller movement can be effectively hunted down and eliminated by use of the USTER evenness diagrams and spectrograms. During the study an attempt was made to demonstrate the use of these functions, unfortunately the spectrogram in place was not in reliable working condition and its proper adjustment was beyond the capability of mill staff or consultant and required the attention of a specialised service technician. Nevertheless it was possible to identify some sources of mechanically induced periodic irregularities, for example a serious wave form in a finisher drawframe sliver, which must contribute to increasing yarn count variation.

Recommendations for Quality Control:

- form a Quality Action Group, comprising production technical and maintenance leaders to recast the company's practical policy on day to day aspects of yarn quality

- place routine testing close in place and time to the production processes and re-direct skilled technical effort to 'trouble shooting', i.e. the detection and removal of the causes of yarn faults

- emphasise the remedial action aspects of quality control; dont be content to sample, test and file the result, insist on diagnosis, cure and prevention of recurrence

- use the USTERR equipment to its full capacity in fault finding. Some training will be needed here

- use also frequent observation particularly by member of the action group whose patrols should be conciously geared to looking for opportunities to improve procedures

- double, at least, the actual time spent in cleaning rollers and clearers in roving and spinning frames

- keep all materials, bobbins, and intermediate products off the floor. Ban throwing and indiscriminate piling of roving bobbins, ring tubes and cones

- restore the capability for cotton fibre testing and use this capability to check on the fibre content of card waste, comber noil and in a systematic campaign to improve combed sliver (see section 7, and the example of fibre test results done during the study

- use the control chart technique, demonstrated during this project, as a sensible basis, with visual appreciation for the control of key routine measurements such as drawframe sliver count

- insist on daily checks on the setting of clearers in winding, here again a wall chart helps the patrolling controller to quickly assess what action is needed.

Cotton - Fibre Tests

The mixing in current use for Ne32 combed hosiery yarn is:

Number of bales	Grade	Length	Equivalent U.S.Standard
4	1.2	$1^1/_8$"	barely strict middling
3	1.3XXXX	$1^3/_{32}$"	middling
2	3.3	$1^3/_{32}$"	middling

All cotton is reputedly hand picked and saw ginned. It is reported that the latest crop, now in use suffered due to abnormal rainfall at harvest time, certainly some bales exhibited stringyness and nep which could be a result of too high a moisture content at ginning.

Fibre tests from the General Organisation's Research and Design centre based on a sample representative of the mixing in use on 10 June '85

Length. max	(mm)	33
effective	(mm)	28
mid.	(mm)	20
Short fibre (<14 mm)	(%)	29.2
Micronaire		3.9
Maturity (%)		79.6

N.B. The maturity measured as the ratio of micronaire readings on dry cleaned fibres before and after treatment with 18% caustic soda solution for 3 minutes.

Maturity tests carried out at the mill on another representative sample of the same mixing gave 69.9%.

For comparison, fibre tests made at Shirley Institute on a sample of mixing in use on 10th June'85, and on flat-strip, combed sliver and noils gave the following results.

	Fibre length (mm)		
	Effective	mean	Short fibre %
Mixing	28	20	27
Flat strip	26	17	39
Comb sliver	31	23	22
Noil	24	15	45

Fineness	179 (Millitex)
Maturity Ratio	0.85
Micronaire	4.10

* Measured by the Shirley/IIC Fineness maturity meter.

This sample was considered to be slightly immature, capable of being carded quite well and of being spun up to Ne40 combed.

6. CARDING

There are sufficient cards, all of good design and sound construction to permit good carding at modest production rates. The problem in this section lies in achieving and maintaining good carding surfaces.

The high incidence of nep in the yarn is directly attributable to the poor condition of the card wire, and this in turn is the result of neglect and abuse.

Virtually all the cards need new flats, and most cylinders and doffers are in need of restorative grinding or reclothing. The present condition of the cards is but a stage in the steady deterioration of these machines, which in the absence of corrective treatment will continue.

It is reported that new flats had been ordered, initially from China without delivery after a two year delay, and now re-ordered from a British supplier. Although adequate spare parts are essential, correct grinding techniques are equally important.

The preferred method for deciding when grinding is due, and for monitoring the actual grinding process is by examination of the wire points, using an illuminated portable microscope. This technique was demonstrated and a number of cards were examined in this way, revealing mainly wire points in poor condition.

The need to put the cards into good order is a vital and urgent first step in producing good quality yarn and to achieve this, three actions are recommended:

- replacement of all damaged wire, be it on flats, cylinder, doffer or licker-in,

- purchase of the best available card grinding equipment with grindstones to the recommended specification of the card clothing manufacturers,

- training in up to date grinding methods based on the use of the card wire microscope. Such training should be fundamental in both theory and practice, thorough and should be given not only to card maintenance men but also to technical, production, and quality control middle management personnel to emphasise the vital importance of good carding and good card maintenance.

Bearing in mind that the mills of the Hama Cotton Yarns Company are considered to be the best organised and most effective cotton spinning units in Syria, the introduction there of modern methods of card maintenance would improve all their products and could also establish a centre of excellence, a cadre of expertise, a nucleus from which a beneficial influence could grow and extend throughout the spinning sector of the General Organisation for textiles. In short, investment in upgrading cards and carding which is necessary now at Hama, would pay off twice, once by contributing to the immediate need to restore yarn quality and again by other leading mills along a similar route.

7. COMBING

The efficiency of combing depends to a very large extent on the correct direction of presentation of the fibres to the comber. This effect was brought to light by the classic researches of Morton and Nield at Manchester in the early '50's, and has become the basis of best practice in combing.

Due to the greater incidence of trailing hooks in the ends of the fibres leaving the card, the correct direction of presentation of the fibres to the comber is achieved automatically when there is an even number of machine processes in lap preparation, i.e. between the card and the comber.

Given the correct direction of fibre presentation, increasing the pre-comber total draft has also been shown to further improve comber effiency and reduce waste extraction by preserving a higher fraction of longer fibres in the combed sliver.

At Hama Cotton Yarns Company, the Chinese-made combers in use are virtually identical to the Platt 'Hartford' model high production comber, and are working well. However, the lap preparation consists of three stages between carding and combing and this arrangement constitutes a flaw in process design which prevents the best results being obtained from the combing process.

It is recommended that the lap preparation be changed to include three stages of drawing and the lap former. In this way the fibre presentation to the combing elements will be correct and the pre-comber total draft will be increased eightfold. An experiment was made to test the immediate effect of this arrangement and the results (in Table 7.1) show a 15% increaes in yarn strength, indicating a more efficienmt use of the available fibre length.

It is also recommended that the fibre extract in combing should be increased slowly and systematically, step by step towards 18%, measuring and evaluating the effects of each step change particularly in terms of yarn strength, yarn irregularity and imperfection count.

To properly evaluate and to understand the effects of changes in lap preparation and comber setting it is best to have fibre length diagrams from sliver and noils at each step.

It should be noted that good combing depends very much on good carding and lap preparation, and in setting out any series of experiments designed to optimise combing efficiency, constant card sliver quality and lap preparation method is an essential pre-requisite.

Table 7.1 **EFFECT OF COMBER LAP PREPARATION**

Yarn	Ne32 Combed Hosiery
Cotton	Regular mixing
Comber Extract	14%

		Normal Production	Mill Trial 13/14 June '85
Lap preparation		Drawframe Drawframe Lap former	Drawframe Drawframe Drawframe Lap former
Nominal count	(Ne)	32	32
Actual count	(Ne)	32.2	32.1
Count CV	(%)	3.5	2.4
Strength	(g)	223	259
Strength CV	(%)	12.3	10.3
Evenness	(U%)	14.0	13.5
Imperfections			
Thin	(per km)	142	85
Thick	(per km)	558	608
Nep	(per km)	536	456

8. WINDING

Spun yarn is wound onto 9°15' cones of average 1.3kg for delivery to knitting. During the winding process the yarn is waxed and cleared. In the No.1 mill at Hama automatic winding machines, by Karl Mayer, transfer the yarn at 850 m/min, these machines are fitted with optical/electronic clearers, the Loepfe FR60 model. The No.2 Mill still retains the original Chinese manual winders (based on the 1950 Leesona 'Roto-coner) operating at 450 m/min, fitted with simple mechanical slub catchers.

It is claimed that the Ne32 yarn from No.1 mill is superior to that from No.2 mill and this claim is largely based on the efficacy of the respective winding processes. Neither knitter nor spinner has been able to quantify this claim beyond the statement at Orient that there is a significant difference in knitting performance which has a real effect on the knitter's production bonus.

The knitter is interested only in those faults which are still in the yarn when he receives the cone and not at all in those faults which have been removed in winding; he seeks to minimise those defects which can reduce the efficiency of the knitting process and which downgrade the quality of the fabric. In this context it is important to note that each fault removed in winding is replaced by a knot and that in selecting the type, size and length of faults to be taken out in winding, a balance must be reached between the disturbing effect of these blemishes which may be allowed to remain and those which are better replaced by knots.

<u>Calculation of Knots</u>

Average weight of yarn on ring tube	(g)	60
Average weight of yarn on cone	(g)	1300

Ne32 = N_m 54.4 = 54,400 m/kg.

Source	Frequency of Knots per Cone	per Kg	per 100 Km
Mill No.1 Automatic Winders-Electronic Clearers			
from bobbin changes	22	17	31
* from tension breaks, due to winding	5	4	7
* from faults removed by clearers	22	17	31
totals for Mill No.1	49	38	69
Mill No.2 Manual winders, mechanical slub catchers			
from bobbin changes	22	17	31
* from winding breaks and faults removed by slub catchers	8	6	11
totals for Mill No.2	30	23	42

* based on data from company's work study department.

Comparison of the knot frequencies calculated above for Mills 1 and 2 at Hama is made with the experience values quoted by Douglas [2].

	Knots/100km of yarn No.1	No.2	Experience values
Bobbin changes	31	31	16
Yarn breaks	7		3
		11	
Number of faults in winding	31		7 minimum
	69	42	26

In comparing the totals it should be noted that the experience values are based on a larger ring tube and hence fewer knots due to bobbin changes. Evidently the winding procedure in No.1 mill is much more effective in removing yarn faults than the simpler method in Mill No.2.

An attempt was made to verify the calculated knot frequencies by an experiment in which ten full cones from each mill were re-wound on the manual winder with the slub catchers set at approximately 1.5 x the estimated yarn diameter with the intention of catching most, if not all, of the knots.

The conditions of test and the results were:

Yarn diameter (D) estimated from:

$$D = 0.0357 \frac{Tex}{S} \quad (mm)$$

for cotton yarns S is taken in the range 0.8 to 0.9, (say 0.85) mg/mm^3

Ne32 = 18.45 Tex

$$\text{hence } D = 0.357 \frac{18.45}{0.85} = 0.17mm$$

slub catcher setting 0.17 x 1.5 = 0.25mm

Winding speed 450 m/min

N.B. It could not be positively stated that every break observed during the rewinding test was due to a knot, neither could it be absolutely guaranteed that every knot was detected. The results therefore, expressed as 'breaks' per 100Km are an indication only of the comparative knot frequencies.

	Rewind test Breaks/100Km	
Yarn source	No.1 Mill	No.2 Mill
	29	21

The result confirms the calculation in the sense that the electronically cleared yarn from No.1 mill contains more knots than does the mechanically cleared yarn from No.2 mill. Since a similar fault rate exists in the yarns from each source before cone winding, (this is verified by recent tests - see section 2), the clear implication is that the yarn on cone leaving No.2 mill contains fewer knots but more spinning faults than that from No.1 mill. This observation is reinforced by the opinion of the knitter's at Orient who claim about 15% better performance from No.1 mill's yarn and also by Elson's knitting trial [3] in which this yarn yielded fabric of significantly better appearance.

On balance, the decision, already taken by the Hama Company to replace its manual winders in No.2 mill by new automatics with electronic clearers is sensible and justifiable in view of the urgent need to upgrade yarn, fabric and garment quality and appeal in hard currency markets. Most knitters in W.Europe now specify that their yarns must be electronically cleared, some even specify the level of clearing required in terms of the 'Classimat' test.

Two cautionary notes:

- the fact that the modern automatic winder with electronic clearers provides a 100% yarn inspection facility and can be set to remove many faults should not be regarded as any kind of reason or excuse for permitting the spinning of inferior yarn: every fault removed is replaced by a knot which is itself a hazard to the knitter; also clearers cannot cope with yarn count variation, a notorious source of low grade interlock and single jersey; nor with nep which always lowers the aesthetic appeal of quality cotton underwear. Thus the installation of new winding equipment must not be allowed to mask the underlying basic and vital necessity to produce a better yarn at the spindle tip.

- the full benefit of modern automatic winding lies in understanding and manipulating the compromise between faults removed and total knot content in the yarn delivered to the knitter. The day-to-day regulation and setting of the clearers, knotters and winding elements calls for regular skillful attention and tight supervision without which the benefits of the new system are seriously diminished and the investment wasted. The event of replacement of winders should be made use of to train and retrain (recruiting if necessary) competant technicians who will ensure the best performance <u>in terms of yarn quality</u>.

At this juncture it would be appropriate to start preliminary enquiries leading to trials to investigate the potential of <u>yarn splicing</u> (as a possible future replacement for knotting).

APPENDIX 1

BACKGROUND INFORMATION

The textile industry, a traditinal sector in Syria, plays an important role in the country's socio-economic development. This industry, however, is presently facing challenging and difficult problems which needs to be overcome. The issues involved were discussed extensively between the Minister of Industry of the Syrian Arab Republic and the Executive Director of UNIDO in October 1984, who concluded that there is an urgent need to:

- assess the performance of this sector with respect to production, technical and economic aspects, detecting bottle-necks and weaknesses in the Syrian textile industry compared with similar ones in more developed states;

- set up practical solutions for coping with such obstacles and promoting this traditional industry to better levels of performance.

It was recognised that the above would have to be implemented in successive phases. Under the circumstances, the Government has decided that, as a first stage, the two underwear factories in the public sector, the Orient Underwear Manufacturing Company and the Arab Company for Underwear in Alleppo, including their yarn supplying spinning mill, Hama Company, would receive UNIDO technical assistance.

The subsequent UNIDO fact-finding mission carried out extensive discussion with the Ministry of Industry, the General Organisation for the Textile Industry, the Orient Underwear Manufacturing Company and visited the factory. As a result, the following conclusions emerged:

(i) Marketing problems cause inefficency in the mill.
Around 50% of the output is exported.

(ii) Marketing problems originate from
- inadequate styling;
- improper wet processing and finishing of fabrics;

- irregular yarn qua :
- price/quality/style relation.

(iii) Efficiency related to technical shortcomings are

- inadequate yarn packaging at delivery;
- unutilised knitting machinery because of lack of proper yarn counts, knitting technology (single jersey, body length, jacquard patterned ladies' underwear and pile (plush) fabrics and styling for this type of products);
- disrupted production planning (priority for sudden export orders);
- hand packaging of final products, where mechanisation is a factor of availability of the appropriate type of plastic bags.

In order to solve these problems, an urgent UNIDO assistance is required in the field of spinning, knitting design, wet processing, and cost accounting.

The following mills where assistance is to be rendered is described as follows:

The cotton spinning mill, Hama Company, is equipped with two units of 30192 spindles each. All machinery are of Chinese origin (Unit I established in 1971, Unit II established in 1975). The cone winding machines of Unit I were replaced by Karl Mayer automatic winders and equipped with Loepfe electronic yarn clearers. In addition to the original drafting pendulum arms they were replaced by SKF manufactured pendulum arms. The cotton used is of medium and long staple and the emphasis is on the manufacturing of No.32/1 Ne knitting yarn. Other yarn counts are 20, 24, 26 and 30 Ne. The total output of 32/1 Ne knitting yarn is estimated to be 1600 tonnes yearly. (1200 tonnes - Orient Underwear Manufacturing Company; 400 tonnes - Arab Company for Underwear in Alleppo). The remaining capacity is sold to private knitting mills and weaving mills.

The Orient Underwear Manufacturing Company in Damascus with over 100 circular knitting machines (Albi), Kleinewefers bleaching range, and the sewing room, equipped with modern Rimoldi sewing machines, has a yearly output of approximately 1.5 million dozens. In addition, approximately 25,000 pieces of leisurewear (T-shirts) and children's pyjamas are produced. This output represents around 70% of its capacity: about 50% of the output is exported.

The main problems are appropriate styling, consistent quality of its knitted fabric, irregular finishing quality, sewing-room organisation, inefficient packing methods etc. The Arab Company for Underwear in Alleppo which is about one quarter in size compared to the Orient Underwear Manufacturing Company, faces similar problems. Both factories are in need of a cost/price/quality comparative study.

Extracts from Consulting Engineers Report

"Study for the Amalgamation, Modernistion and development of the Orient Underwear Manufacturing Company, Damascus." February 1974. Ref No.S349

"The levels of product quality, and of machine and labour productivity currently achieved at each stage of the process fall below world standards."

"The developments necessary to achieve world standards may be summarised as:

(i) modernisation of methods and equipment used in the technological processes,

(ii) improved control of product quality by specification of the standards and by more effective inspection and at key points during the process sequence,

(iii) improved standards of workmanship requiring education and training ...."

"Fabric Weight

In the industrially developed copuntries of Western Europe there has been a marked trend during the past 20 years towards the use of lighter fabrics in clothing....... The trend has been reflected in the whole range of apparel fabrics including underwear.......

It is acknowledged that the fabrics and garments produced by the Orient Underwear Company are somewhat heavier than the equivalent European products for similar end-uses, and that in the Syrian home market and in neighbouring Arab countries there is an established preference for these fabrics. Since 85% of the scheduled output of the new factory is destined for these markets the proposed production plans have been based on these heavier fabrics. It is probable that any shift in the future pattern of demand will be towards somewhat lighter fabrics, due possibly to the requirements of an expanding export market and/or to economic pressures to produce more garments from each kilogram of cotton. In the event the proposed plant ...... is sufficiently flexible to respond to the probable changes in demand without any need for drastic alterations."

"Colour

Quite recently in Europe there has been a marked increase in the use of dyed and printed fabrics, particularly in men's cotton underwear. One leading manufacturer estimates that 60% of mens briefs and slip pants are either dyed or printed ...."

"Quality

In general, the marketable quality of Orients underwear products falls well below accepted world standards. This is due to a combination of factors each of which is commented on below, and each of which will require attention .....

Yarn quality ...... the spinning systems in use are basically capable of supplying yarn of adequate quality for knitting underwear fabrics. However, observations of the knitted fabric and finished garments frequently reveal irregularities in the cloth caused by variations in yarn thickness arising from mechanical faults in spinning. The incidence of these faults suggests that tighter control on the quality of the spun yarn is required......

Modern knitting technology requires faultless yarn on cones of the highest quality. The ideal solution to the problems of supplying yarn to the knitting machines would be to concentrate yarn production in the hands of a single spinning mill which would be charged with the task of meeting the knitter's requirements for yarn quality. Initially it was proposed that the cone winding operation should be carried out by Orient at their new factory, mainly to offset the damage suffered by cones under the present methods of packing, handling, transport and storage. It is understood that this solution would be unacceptable to The Union" (then The Union of Textile Industries - now The General Organisation for Textile Industries - G.O.T.I.), "but that new coning machines will be installed at the spinning plant. Provision should now be made for the careful handling and transportation of yarn on cone and it is strongly recommended that the cones be packed in cardboard cartons (similar to those used for export.....). Recommendation are also made for quality checks to be made on yarn received at the Orient plant."

APPENDIX 2

DISSEMINATION OF INFORMATION

Each aspect of the work of the Hama Cotton Yarns Company mentioned in this report was discussed with representatives of the management concerned with production, quality control and the maintenance of production machines.

The results of mill trials, tests and demonstrations were presented, explained and debated 'across the desk' as they occurred on a day-to-day basis.

In addition, printed information was handed over where it was available and particularly relevant, for example:

- "Nep Counting at the Card", extracts from Shirley Institute Bulletin. Vol.XXVI.
- "The measurement of end breakage rate in Ring Spinning" , extracts from Shirley Institute Bulletins. Vol. XXIV; XXV; and XXVI.
- "The New Technique in Combing", extracts from Platt's Bulletin. Vol. VIII No.10 and IX No.6.
- "Rigid Wire Card Clothing on High Production Cards", extract from Shirley Institute Bulletin Vol. XL.
- Brief resume of conclusions and recommendations from the current study.

Participation in a technical seminar at Orient Company Damascus on 27th June '85. This meeting was mainly concerned with wet processing, finishing and garment making.

APPENDIX 3

WORK PROGRAMME

Date	Activity
May 26	Travel to Damascus
27	Meeting with GOTI directorate and Orient Underwear director
28	Visits to UNDP, GOTI Research and Design Centre, and Orient Underwear
29	Observations at Orient Underwear
30	Trials at Orient Underwear
June 1-14	Observations, trials, and demonstrations at mills of Hama Cotton Yarns Company
16-20	Report preparation in Damascus
22-25	Trials and demonstrations at Hama Cotton Cotton Yarns Company
26	Meeting at Orient Underwear
27	Technical Seminar at Orient Underwear
29	Travel to England

APPENDIX 4

REFERENCES

[1] Uster Statistics 1982
Combed Cotton Yarns. U%. Imperfections.

[2] Yarn Fault Characteristics of Spun Yarns.
K.Douglas. BSC. C.Eng. MI mech E.
Zellweger Uster publication. SE421.

[3] Elson. SI/SYR/84/801/11 - 53/31.7.B.