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APPLICATION OF STATISTICAL QUALITY CONTROL IN YARN SPINNING

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A study was conducted on the application of statistical quality control tech nique on end-processing units in the Koh-i-Noor Textile Mills Ltd., Faisalabad, The collon MNH-93 spun for 20's yearn characteristics was examined by SQC charts for quality control. Correlation coefficients were also established between various parameters of fibres and yarn.

INTRODUCTION

The fibres (from their fibrous state to the final form of yarn) pass through many many operations through different types of manufacturing machinery. In the present competitive age of textile products, quality product is the most desirable factor at purchase counter for the consumer. As such the application of statistical quality control (SQC) is of pivotal importance in improving the quality of the products. It is also helpful in keeping the cost of production within satisfactory level (Zulfiqar, 1988).

The main object of SQC is to secure standardized production, comparing to the dictated specifications. Control is carried out on the basis of samples taken from the process flow. Textile industry consists of various sections and each section differs from others in its manufacturing product. However, the main purpose in each section is the same, i.e. to systematically find the causes of variations and, for this purpose different statistical control charts are used. The purpose of a control chart is to detect the undesirable deterioration of the process (Bertrend, 19(3). Shewhart (1939) chart is a graphic device for detecting the occurrence of assignable causes showing significant change in a running process (Juran, 1962). Asian Productivity Organisation recommended that the results of the experiments in textile industries must be analysed objectively by means of statistics in order to attain the desired quality standards, maximum productivity and the lowest cost (Handa, 1970). A control chart helps indicate when to leave process alone and when to take action to correct the trouble (Grant, 1952).

In this paper the application of SQC charts has been attempted to check the end-product for its quality characteristics against variations and fluctuations due to assignable causes in machinery performance. The entire data were operated upon a computer programming language BASIC.

MATERIALS AND METHODS

This study was carried out at the Koh-i-Noor Textile Mills UU., Faisalabad. This unit produces cotton yarn by ring spinning system. Lint cotton MNH-93 was used as raw material which was converted into cotton yarn of 20's through a series of intermittent processes. The data were collected from end-product processing units namely Ring Spinning and Winding Sections,

Table 1. Quality characterlstlcs of cotton MNII-93 used in spinning process

Characteristics	Average	Chisquare test for homogeneity		
		Range	Chisquare calculated	Chisquare tabulated
Span length (mm)	26.938	1.402	11.196740*	42.56
Uniformity ratio (%)	49.635	3.156	11.196740*	42.56
Fineness (j,l.g/in.c.h)	4.273	0.626	8.042284*	42.56
Fibre-strength (000 Ib/inch)	90.624	4.295	1t348778 *	42.56
Moisture (%)"	8.371	26.389	20.402560*	42.56
Trash (%)	5.010	1.773	22.035660*	42.56

!"Homogeneity exists in data.

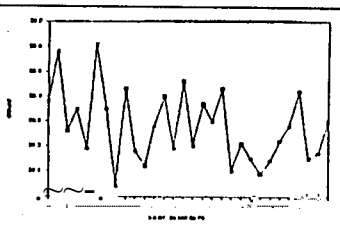
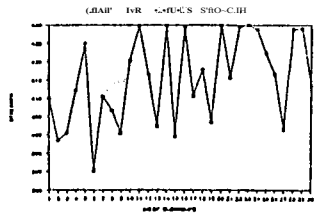
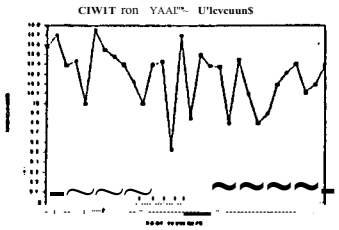
Before spinning, the raw material was thoroughly mixed and tested for its quality characteristics (i.c. span length, uniformity ratio, fineness, strength, moisture and trash) under standard conditions on Spinlab's most modern instruments (Anonymous, 1990). Chisquare test was applied to judge the homogeneity in these data (Steel and Torric, 1980). The data on spun yarn quality characteristics (i.c, yarn number, strength, unevenness and imperfection) were processed for their quality control with the application of SQC charts (Handa, 1970). Thc data were also computed for coefficients of correlation between various parameters of fibrous matcrial and its yarn (Zulliqar, 1~88).

RESULTS AND DISCUSSION

The cotton lint MNH-93 being used in the mills was evaluated for its quality characteristics the average valucsof which arc given in Table 1. Since the consistency and uniformity of the end product mainly depend upon the homogeneity in the characteristics of the material used (Grant, 1952), these characteristics were studied for their homogcncity by Chisquarc test (Table 1). These results showed that the cotton used was of good quality with homogeneity in its characteristics which is a desirable merit in spinning.

Table 2a shows the mean (i.e. control limit) values as well as the calculated values of upper and lower control limits for yarn number, strength and unevenness. To see whether the processing machinery is running under state of statistical control, all data concerning each yarn character have been fixed in X statistical quality control (SQq chart, as X chart is considered the best for SQC which is shown in Table 2a against the rcspcctive character. From these charts, it was detected that some spinning frames went out of control. Thus it was revealed that some back processes were giving trouble which were set afresh under control. The data were then again collected and processed for yarns imperfection by c-chart which is used to control the defects (Juran, 19(2). The results obtained arc presented in Table 2b. These charts show that the yarn's quality against thin/thick places and ncps was satisfactorily under control,

Table 2a. Quality characteristics of cotton yarn spun for 20's

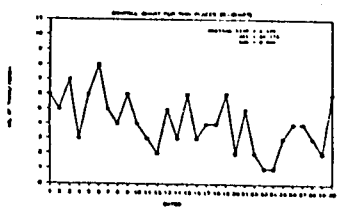
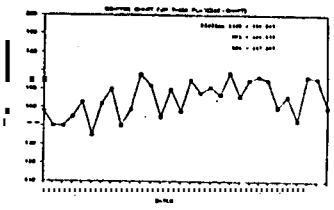
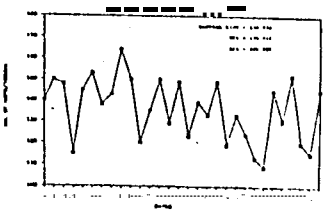
Characteristics	Control limits (calculated)		X - Charts
Yarn number (Ne)	V.CL. =	20.400	
	CL =	20.278	
	L.CL. =	20.200	
Yarn strength (eN)	V.CL. =	422.000	
	CL. =	415.363	
	L.CL. =	409.000	
Yarn unevenness (%)	U.CL. =	10.500	
	CL. =	10.279	
	L.CL. =	10.100	

V.CL. = Upper limit; CL. = Control limit; L.CL. = Lower limit.

Further, to ascertain the control over processing machinery, the end-product (i.e. yarn cones) was inspected against detectives by 100 p-chart and up-chart. The results have been presented in Table 3. This table also includes the control chart for per cent defective (100 p) and control chart for number defective (up-chart). These charts indicate that the process is fully under control as the manufacturing machinery has produced quality product which meets the dictated specifications. Most of the points falling around the central control line (i.e. average 100 p and np-values) provide sufficient satisfaction for the manufacturer.

The data were also processed for correlations between various parameters of the yarn produced and its raw material (Zulfiqar, 1988). These results are given in Table 4. The r-values show that (1) with the increase of span length of the cotton fibres,

Table 2b. Quality characteristics of cotton yarn spun for 20's

Characteristics		Control limits (calculated)		Quality control c-charts
Imperfection	Thins/100 m	U.C.L. =	10.175	
		C.L. =	4.100	
		L.C.L. =	0.000	
	Thicks/100 m	U.c.L. =	191.977	
		CL. =	154.667	
		L.c.L. =	117.375	
	Neps/100 m	U.c.L. =	170.910	
		CiL. =	135.933	
		L.c.L. =	100.933	

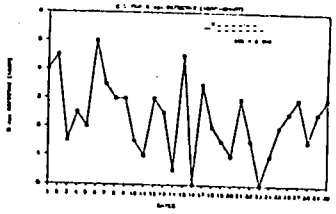
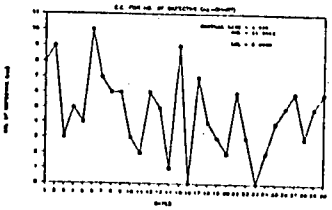
U.c.L. = Upper limit; CiL. = Control limit; L.c.L. = Lower limit.

yarn strength increases, (2) the more the uniform arc collon fibres, the lower will be unevenness, (3) increased uniformity produces stronger yarn, (4) fibres with greater rnicronaire value decrease the yarn number to be spun, (5) stronger fibres produce stronger yarn, (6) more the fineness of the cotton fibres, the stronger will be the yarn, and (7) the yarn with greater diameter is stronger than the yarn with smaller diameter.

CONCLUSION

It is concluded that quality control chart is an effective statistical technique for locating any trouble or variation in time due to assignable causes. However, it is sug-

Table 3. Cone inspection for defectives

Cone inspection			Control charts
	V.CL. =	5.5351	
By 100 p chart	CL =	2.3330	
	L.CL. =	0.0000	
	V.c.L. =	0.0553	
By np chart	CL =	4.6600	
	L.CL. =	0.0000	

V.CL. = Upper control limit; Crl. = Control limit; L.c.L. = Lower control limit.

Table 4. Correlation between various parameters

Correlation between	#r	Remarks
Yarn strength and span length	0.8728	With the increase in span length, yarn strength also increases
Yarn unevenness and fibre uniformity	-0.5072	More uniform the fibre, lower is the yarn unevenness
Yarn strength and fibre uniformity	0.40656	With the increase of yarn strength, fibre uniformity also increases
Yarn number and micronaire value	-0.80%	Fibres with greater micronaire values decrease the yarn number
Yarn strength and fibre strength	0.9048	Greater the fibre strength, better the yarn strength
Yarn strength	0.7402	Greater the fineness, better the yarn strength
Yarn strength and Yarn diameter	0.1)297	Yarn with greater diameter is stronger than the yarn with smaller diameter

gcsted that for strict quality control measures the data should be analysed slage by stage right from back processes to the end-product so that corrective measures can be adopted well in time if the process goes out of control at any point.

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