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PREDICTING RING YARN STRENGTH FROM FIBER PROPERTIES Past studies at the Textile Research Center have shown that certain cotton fiber properties can be used for predicting open-end yarn strength as measured by the skein method. Furthermore, the studies showed that strength was linearly related to yarn number. Subsequently, it was found that the coefficients of the equation developed for calculating yarn strength can be estimated from fiber properties, thereby permitting the estimation of yarn strength for a wide range of numbers.

While it has been realized for some time that a linear relationship between strength and number exists for ring spun yarns, until now no attempt has been made to estimate the coefficients of such relationships from fiber properties, as was done for rotor yarns. One reason for this was that studies performed at the Textile Research Center suggested a non-linear behavior of the measured elongation at break when plotted against yarn number. Examination of spinning specifications revealed that the load applied to a yarn by the traveler was not constant for a given number. When comparing this with rotor spinning experience, it was thought that the departure from linearity may have arisen as a result of using take-up tension at spinning disproportionate to the linear density of yarn being spun.

In a study conducted to demonstrate this effect, it was shown that increased centrifugal force applied to the yarn did produce a linear increase in yarn number, initial modulus, and non-uniformity. However, elongation, specific work of rupture and hairiness all decreased linearly. For rotor spun yarns, the analysis required that the coefficients of equations be derived for each bale of cotton. In turn, regression equations for coefficients based on fiber properties were derived. In our studies dealing with ring spun yarns, however, it was decided to derive equations in which the centrifugal force acting on the traveler (as an estimate of the spinning tension) and yarn number were included together with fiber properties as independent variables. However, it was found that centrifugal force had minimal influence on yarn strength, and in the end it was not accepted for the equation.

For each set of fiber properties obtained from each aggregate of instruments, the multiple regression equation was identified whose independent variables made contributions to the explanation of yarn strength which were statistically significant at the 0.1% level. These equations for ring yarn strength, expressed as Count-Strength-Product (CSP), are presented in the following table. (Text is continued on page 4.)

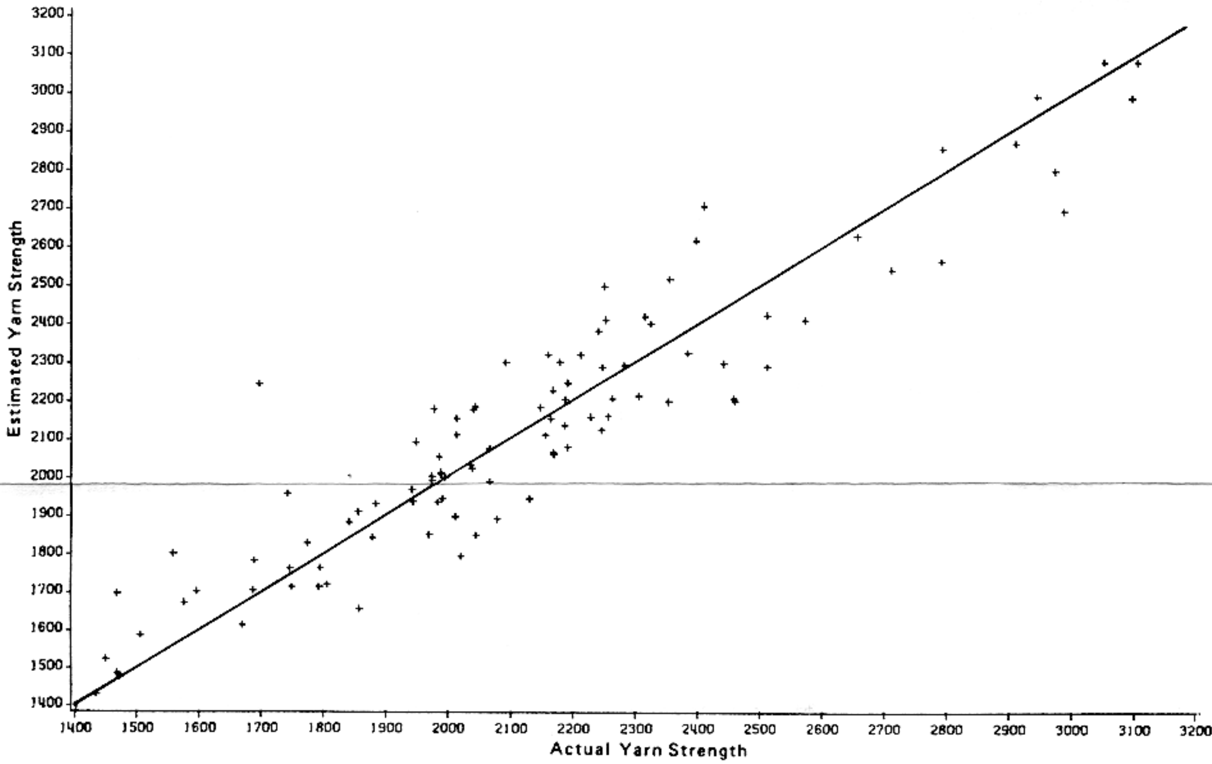
GENERAL REGRESSION EQUATIONS FOR RING YARN STRENGTH

Condition for Acceptance of Variable: 0.1% Significance Level

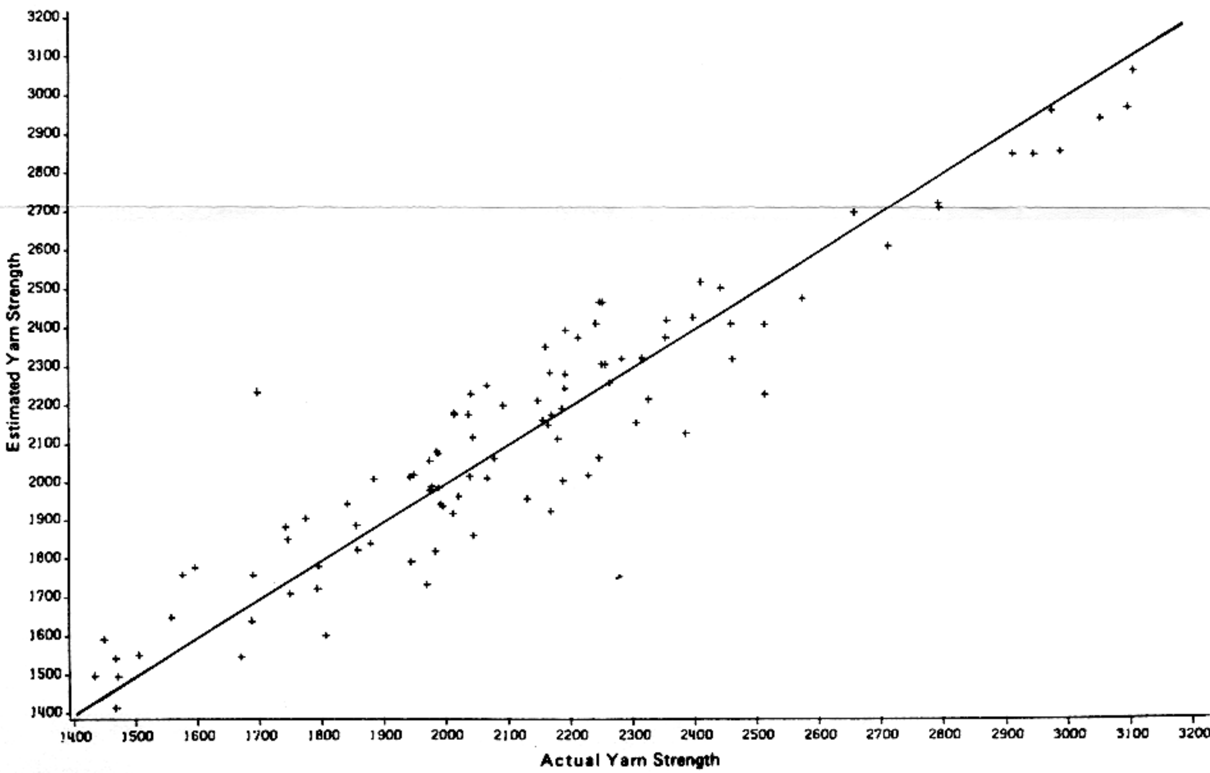
Instrument Aggregate	Regression Equation	Correlation Coefficient (r)	Coefficient of Determination (r^2)	Residual Standard Deviation
MCI 3000	$CSP = -7714 - 15.96\, N_e + 58.82\, s + 1550\, l + 99.04\, u_r - 202.3\, m_i$	0.9472	0.8971	128.6
Spinlab HVT	$CSP = -2814 - 16.24\, N_e + 79.78\, s + 2297\, l + 18.19\, u_r - 108.1\, m_i$	0.9526	0.9075	122.0
Individual (with Micronaire)	$CSP = -2390 - 16.48\, N_e + 89.52\, s + 1923\, l + 22.84\, u_r - 65.61\, m_i$	0.9751	0.9509	88.9
Individual (with IIC/ Shirley F/MT)	$CSP = -2213 - 16.64\, N_e + 86.64\, s + 1907\, l + 25.15\, u_r - 2.16\, f$	0.9766	0.9537	86.3

N_e = Yarn Number (English count) s = strength (Stelometer) (g/tex) l = length (inches, expressed as a decimal)
u_r = uniformity ratio (percent, expressed as whole number) m_i = micronaire; f = fineness (mtex) (F/MT)

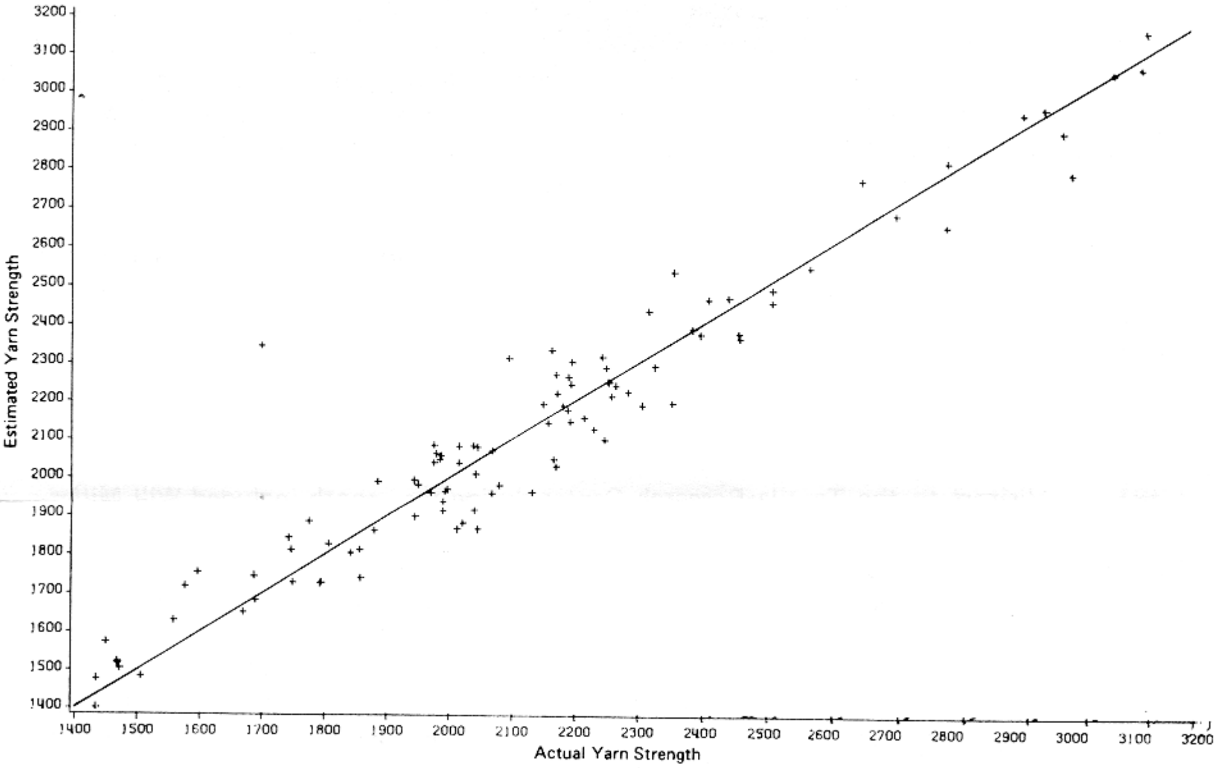
GRAPH 1: ESTIMATED VS. ACTUAL YARN STRENGTH (Motion Control Data)



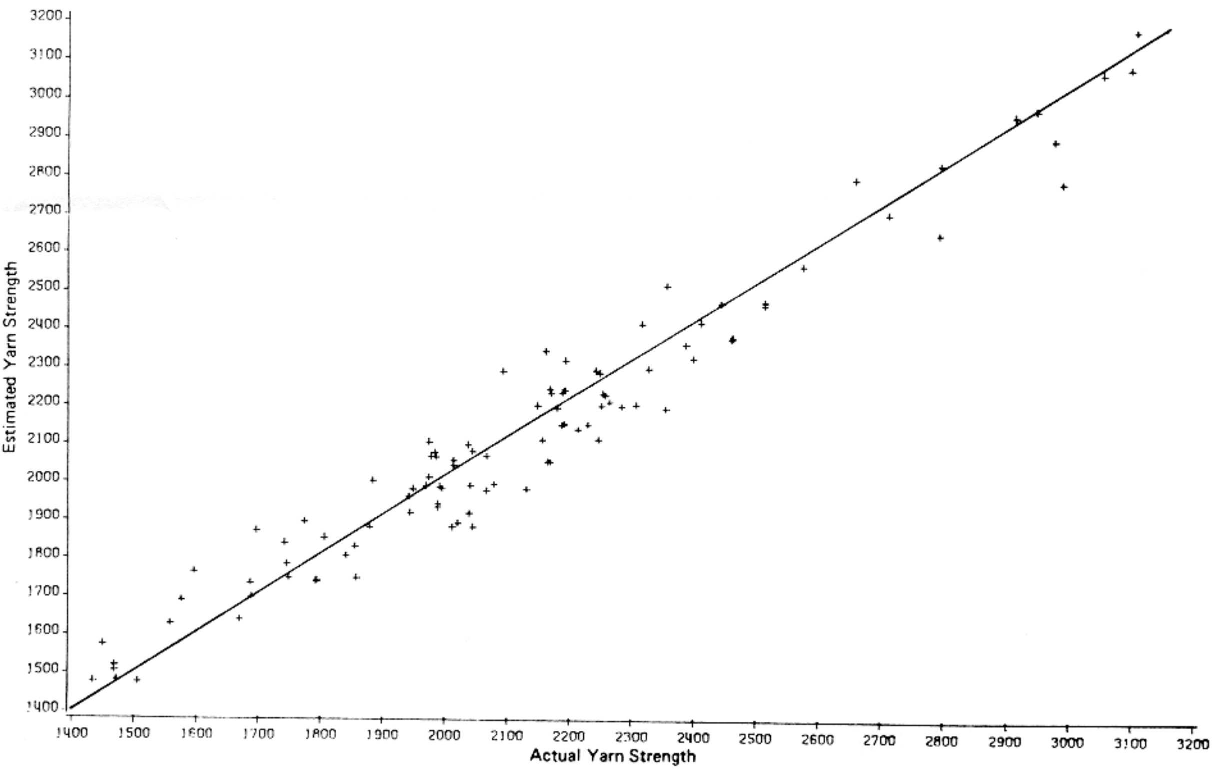
GRAPH 2: ESTIMATED VS. ACTUAL YARN STRENGTH (Spinlab Data)



GRAPH 3: ESTIMATED VS. ACTUAL YARN STRENGTH (Individual Instrument Data)



GRAPH 4: ESTIMATED VS. ACTUAL YARN STRENGTH (Individual Instrument Data Including F/MT Results)



Graphs 1 through 4 on the preceding pages show the relationship between estimated and actual ring yarn strength when using fiber properties measured with different sets of fiber testing equipment. Graph 1 represents the use of the Motion Control equipment. Graph 2 was developed using Spinlab HVT equipment for measuring the fiber properties, and Graphs 3 and 4 both present the correlation when determining fiber properties by individual instruments. Instruments used were Stelometer, Fibronaire, Digital Fibrograph, and the IIC/Shirley Fineness/Maturity tester (F/MT). It should be noted that the F/MT instrument was used to give fineness measurements included in the last equation in the table on page 1.

The information we are presenting in this issue of *Textile Topics* has been extracted from a larger report on this subject that was made to the Natural Fibers & Food Protein Commission of Texas (NFFPC), for which this research was conducted. The full report was prepared by John B. Price, head of New Spinning Technologies Research at the Textile Research Center. The generation and collection of data are the result of work by a number of TRC technicians. We would like to express our appreciation to the NFFPC for permission to publicize this report.

VISITORS Visitors to the Textile Research Center during the month included Will Miller and Dick Pusch, Woven Structures, Compton, CA; Frank D. Gac and P. D. Shalik, Los Alamos National Laboratory, Los Alamos, NM; Karl Mueller, American Wool Council, New York, NY; Roger Bolick, Allied Plastics & Fibers, Hopewell VA; Lindley E. Jones, Allied Fibers, Columbia, SC; Carl Cox and Jean Vandelune, Natural Fibers & Food Protein Commission of Texas, Dallas, TX; Jeffrey T. Langley, Henkel Corporation, Charlotte, NC; and Barnett Greenberg, North Texas State University, Denton, TX.

Also visiting were Wayne Spraggins, Avondale Mills, Sylacauga, AL; Robert Boslet, Cotton Incorporated, New York, NY; Doug Fain, Cotton Incorporated, Raleigh, NC; John Peirce, Clovis, NM; Deanna Schexnayder, University of Texas Natural Fibers Information Center, Austin, TX; Bruce L. Hubbard, John Deere Des Moines Works, Des Moines, IA; Peter J. Bernet, Reed Chatwood, Inc., Gastonia, NC; and Russell Crompton, Shirley Developments Ltd., Manchester, England.