

**AN INVESTIGATION ON THE CYCLIC TENSILE AND
IMPACT STRAINING OF YARNS**

A THESIS

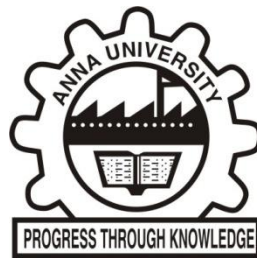
Submitted by

SRIKRISHNAN M R

in partial fulfilment for the requirement of award of the degree

of

DOCTOR OF PHILOSOPHY



FACULTY OF TECHNOLOGY

ANNA UNIVERSITY

CHENNAI 600 025

MAY 2013

ANNA UNIVERSITY
CHENNAI 600 025

BONA FIDE CERTIFICATE

Certified that this Thesis titled “**AN INVESTIGATION ON THE CYCLIC TENSILE AND IMPACT STRAINING OF YARNS**” is the bona fide work of **Mr. SRIKRISHNAN, M. R.** who carried out the research under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other scholar.

Place : CHENNAI

Date :

Dr. RAMESH CHANDRAN NAYAR

SUPERVISOR

Professor

Department of Textile Technology

A.C. College of Technology

Anna University chennai-600 025

Tamilnadu, India

ABSTRACT

In general the textile materials are subjected to repeated strains of various forms, the cyclic strains, during their manufacture and in their use by which they get fatigued at different levels. This is true of both industrial and domestic textiles. The various forms of cyclic strains are tensile, torsional, bending, compression, impact etc. The characteristic behaviour of the textile materials changes with time in its life cycle as per the nature of the cyclic strain it encounters. This dissertation is based on cyclic straining of yarns and has been designed to accommodate a number of variables at various levels, the straining amplitude, straining speed, straining cycles, their cumulative application, specimen length, testing parameters, material construction and chemical treatments along with interaction between forms of straining. Among the various forms of straining, the cyclic tensile and cyclic impact straining of yarns are selected in order to study their effects on yarn characteristics.

The cyclic tensile and impact straining of ring, rotor and compact yarns have been carried out and their effects on the tensile breaking force, breaking extension and impact breaking force values were studied. In order to carry out these straining operations the following machines were designed and fabricated. a) Cyclic tensile straining cum strength tester for yarn, b) Cyclic impact straining machine for yarn and c) Impact strength tester for yarn.

An investigation on the influence of various cyclic tensile straining parameters, strain level, strain rate and strain cycles at five different levels, on the breaking force and

breaking extension characteristics of compact yarn of count 14.75 Tex has been carried out. The strain level of 8 mm, the strain rate of 400 mm/min and the number of strain cycles of 2500 have resulted in the maximum drop in the breaking force and extension values of the yarn. The investigation on the influence of yarn specimen length, in cyclic tensile straining, on the tensile characteristics of compact yarn exhibits higher resistance when it is strained at shorter gauge lengths. The cumulative application of the strain levels and strain rates on compact yarn in cyclic tensile straining has resulted in the following findings. The loss % in breaking force and breaking extension % values is low in cumulative straining as compared to the normal straining. Among the two types of cumulative straining, the strain level type exhibits minimum loss in the breaking force and breaking extension properties.

An investigation has been carried out to compare the cyclic tensile strained and unstrained ring and compact yarns of count 9.85 Tex for tensile breaking force and extension characteristics tested at different strain rates and gauge lengths. It is observed that the rate of increase of breaking force and breaking extension % values of strained ring and compact yarns, with increase in strain rate, is lower than that of unstrained yarns. Also it is seen that the rate of decrease of breaking force and breaking extension % values of strained ring and compact yarns, with increase in gauge length, is higher than that of unstrained yarns.

An investigation on the influence of various cyclic longitudinal impact straining parameters, yarn tension, dropping height and strain cycles, at five different levels, on the impact breaking force values of compact yarn of count 14.75 Tex is carried out. The yarn tension of 1.6 cN, the dropping height of 15 cms and the number of

strain cycles of 2500 have resulted in the maximum drop in the impact breaking force value of the yarn which is 23.5 % lower than the average breaking force value of the unstrained yarn. The cumulative application of the yarn tensions and dropping heights on compact yarn, in cyclic tensile straining, has resulted in the following findings. The loss % in impact breaking force value is low in both types of cumulative straining. Among the two types of cumulative straining, the yarn tension type exhibits minimum loss in the impact breaking force value.

An investigation on the influence of cyclic tensile and impact straining of compact yarn of 14.75 Tex, at the selected strain parameters, on the tensile and impact characteristics has been carried out. The loss % of the tensile breaking force value at various strain cycles is lesser than the loss % of impact breaking force values. Also it is seen that the difference between the % loss of tensile and impact breaking force values due to cyclic tensile straining is lower than that of cyclic impact straining. An investigation on the influence of cyclic mixed straining (tensile and impact) of compact yarn of 14.75 Tex, at the selected strain parameters, on the yarn tensile and impact characteristics has been carried out. Higher proportion of tensile straining in the mixed straining has good impact on the loss % of the tensile breaking force, breaking extension % and impact breaking force values.

An investigation on the cyclic tensile straining of ring and rotor yarns of 29.5 Tex on the tensile and impact characteristics has been carried out. It is seen that for ring yarns the loss % in tensile breaking force value is lower than that of impact breaking force value at all strain cycles studied. But in the case of rotor yarn the loss % in tensile breaking force value is higher than that of impact breaking force value at all strain cycles

studied. The loss % of the tensile breaking force in ring yarns is lower than that of rotor yarns at all the strain cycles studied. The loss % of the tensile breaking extension in ring yarn is higher than that of rotor yarn at all the strain cycles studied. The loss % of the impact breaking force value in ring yarn is found to be higher than that of rotor yarn at all the strain cycles studied.

An investigation on the influence of the cyclic impact straining of ring and rotor yarns of 29.5 Tex on the tensile and impact characteristics has been carried out. Similar trend is observed as that of cyclic tensile straining.

Finally the investigation of the influence of chemical treatments on the tensile and impact characteristics of the ring and rotor yarns, in cyclic tensile and impact straining, has resulted in the following findings.....