New Generation Tensile Tester: CTT

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ABSTRACT

The tensile properties of spun yarn are accepted as one of the most important parameters for assessment of yarn quality. The tensile properties decide the performance of post spinning operations; warping, weaving and knitting; hence its accurate technical evaluation carries much importance in industrial applications. An important aspect of dynamic tensile testing of spun yarns is the possibility of predicting the performance of yarn in subsequent processes. Continuous tensile testing of spun yarn involves transporting the yarn under constant tension at constant output speed. Thus, in continuous testing every inch or millimeter of yarn is tested to generate true elongation of yarn at specific dynamic tension & speed condition, and the tensile characteristics are continuously assessed. Dynamic tensile properties measured by continuous testing simulate actual manufacturing conditions more closely than the static tensile testing.

Keywords: *Constant tension transport (CTT), dynamic yarn strength, lint loss, spun yarn, yarn friction*

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INTRODUCTION

Standard measurement of yarn strength is executed on a gauge length of 500mm. A clamped yarn breaks in its weakest place according to the so-called principle of the weakest link[1] and this strength value is assigned to the whole length. As the test sample is gripped at the two ends and maintain that static state during the testing process, the evaluated tensile properties are often treated as static tensile properties and the strength measured by single thread tensile test method is referred to as static yarn strength. Standard evaluation is the result of a measured strength file of the weakest links, while the strength of the other places situated on clamping lengths is not measured. The basic characteristics of distribution (average value, standard deviation and coefficient of variation) of the measured values are as a rule calculated but the order of the measured values and the relations between these values and the length of links are not usually examined.

An important aspect of dynamic tensile testing of spun yarns is the possibility of predicting the performance of yarn in subsequent processes. Researchers have experimentally determined that the static yarn strength measured at 500mm length is more appropriate to simulate the mechanical properties of fabrics and cannot accurately predict the running behaviour of yarn on subsequent machines; warping, weaving and knitting[2]. Continuous tensile testing of spun yarn involves transporting the yarn under constant tension at constant output speed. Thus, in continuous testing every inch or millimeter of yarn is tested to generate true elongation of yarn at specific dynamic tension & speed condition, and the tensile characteristics are continuously assessed. Thus, dynamic tensile properties measured by continuous testing simulate actual manufacturing conditions more closely than the static

tensile testing[3-6]. Dynamic yarn strength is the maximum tension level under which the yarn is transported without any break for a length of 200m, at a speed of 40m/min. The measured extension at this maximum tension level is considered as the dynamic extension[7].

UNIVERSAL DYNAMIC TESTING INSTRUMENT (CTT)

The dynamic tensile properties of yarns are measured by the Constant Tension Tester (CTT), developed by Lawson-Hemphill. CTT is the only yarn test instrument that is available as a mini-textile laboratory. The machine allows more than 10 different yarn quality control tests to be run on the same machine. This is a major advantage in terms of investment cost and space requirements for a laboratory. The unique CTT design provides the ability to test natural and synthetic yarns as well as the high performance yarns such as carbon, glass or hybrid yarns that cannot be tested with conventional capacitive based systems. The CTT uses dynamic test principle to measure the yarn properties. This means every section of the yarn will be tested as the tension on the yarn remains constant. The basic CTT is a dynamic yarn transport with the ability to apply a selectable test speed (from 20m/min to 360m/min) at a selectable tension range (1g-700g). The representing image of basic CTT instrument is shown in the Figure 1.With the basic unit, a dynamic stress-strain test can be made on any yarn. It is important that the dynamic stress on "loading "on the yarn is much better simulation compared to actual fabric production conditions (knitting or weaving). Whereas, traditional stresses-strain testers do not apply loads (stress) dynamically like the CTT or knitting/ weaving. Another advantage with the CTT, it tests every millimetre of yarn and totally 360metres in a one minute test, where as a stress-strain meter only tests one meter. The CTT can quickly analyse production variability unlike traditional stress-strain testing. There are several test modules in this instrument for measuring different yarn properties and the tests provide complete statistical reports, graphs, and ability to export to a database. The various modules available with basic CTT are as follows[8].

- Friction Testing (CTT-DTT)
- Dynamic Shrinkage/ Elongation Test(CTT-DSET)
- Lint Generation (Lint shedding) Test (CTT-LGT)
- Yarn abrasion Tester (CTT-YAT)
- Yarn Profile Testing and Software Modules

Figure 1. Basic CTT Instrument

Friction Testing (CTT-DTT)

With this option, Lawson Hemphill CTT supplies the ability to test yarn-to-yarn friction, yarn friction over any surface or hot-pin friction. The flexibility of the CTT Friction Testers offers the following benefits:

- Any input tension can be set and the coefficient of friction & tension is made, after the contact between yarn and friction surface.
- Universal ASTM tests can be made very accurately and reported with limits (out of tolerance) indication, statistical reports and graphic features.
- Measuring the tension build up after the yarn contacts any surface can make a very unique yarn break potential analysis. For example, a yarn may break while knitting because of the strength of the yarn and/or if the yarn has high friction. With the CTT

friction test, the cause of yarn breaks in knitting, for example, can be made to see whether of friction, strength, or combination of both.

- This allows a test to be customized according to the end use, where input tension can be set, output tension can be measured (control limits can be set) and the friction surface can be selected. Now a true simulation of yarn strength or break potential will include the effect and influence of friction.

Dynamic Shrinkage/Elongation Test (CTT-DSET)

The shrinkage/elongation test uses the same program where limits, average, and other statistics are provided with graphics capabilities and exporting features. The shrinkage test offers continuous dynamic measurement of the yarn's shrinkage. Unlike the traditional skein shrinkage method, this test provides a much higher test capacity, higher accuracy (no human preparation) and analysis of shrinkage variability. The elongation tester offers similar benefits like the shrinkage test compared to the stress-strain tester. With the shrinkage test, tests can be made at a specific temperature or shrinkage can be measured as the temperature increases from a low to a high temperature. This provides important information about the thermal behavior of yarns over a wide temperature range.

With the elongation tester, the elongation level and variation may be measured at a fixed tension or at increased tension levels. The CTT can accurately predict optimum tension levels a yarn can run in the next process and its survivability under specific condition. With the chart recorder and continuous testing, the effect of process variables on the yarn elongation can be studied very closely. A good example would be to study the bobbin change effect in winding and traversing effect of ring spinning in cotton spinning.

Dynamic Tensile Strength (CTT-DTT)

The CTT dynamic tensile strength test is designed to simulate the stress on the yarn during textile manufacturing. This is also known as “weak spot” test, and used to check the “local strength” of the yarn to see, if the yarn will survive the dynamic tensions that are created during winding, weaving or spinning. Conventional static tensile testers measure breaking strength and breaking elongation of the yarn; whereas the CTT measures, if a yarn can withstand a specific tension level as it is moving. This is the true yarn performance test to check the yarn survivability during manufacturing. The cost of yarn breakages causes productivity loss, thus increasing the manufacturing costs. An improvement in material quality and production efficiency is the result by testing possible yarn breakage before the yarn is used in production. During the CTT weak spot test, the instrument applies a selectable yarn tension between 1g and 700g at a variable speed up to 360m/min. This enables continuous measurements of more than 21 km of yarn in one hour, which will lead to early detection of the yarns that have weak spots before they enter the production.

Lint Generation (lint shedding) Test (CTT-LGT)

A major problem knitter’s face is broken needles. Lint build up is a big factor for causing breaks and affects efficiency. Lawson-Hemphill developed a test specially for measuring the amount of lint a spun yarn has the potential to generate. It works by applying a selected running tension and wrapping the yarn around itself while running. The amount of lint collected after a specific length of yarn is measured (weighed). Then different yarns can be compared based on their weight loss.

Yarn Abrasion Tester (CTT-YAT)

This test allows for measuring the yarn abrasion. The yarn is run over a tensioned standardised copper wire and the abrasion factor is measured as the length of yarn it takes to cut the wire. Yarn to yarn comparisons can be made to compare abrasiveness of yarns.

Another abrasion test can be to run the yarn over a surface (such as a needle) for a fixed length of yarn. Then the surface destruction can be measured with a microscope. This test can be very helpful for minimising abrasion on a yarn and increasing the effect of abrasion on guides, needles, etc.

Yarn Profile Testing and Software Modules

- ***Yarn Profiler*** is a graphic software package that shows the true image of a yarn's diameter. Tests can be made at any tension to see the effect of tension on intermingled areas.
- ***EIB Software*** allows for measuring the length distribution of entangled and non-entangled areas. Also, it can show their distribution graphically on a rectangular board.
- ***CYROS*** is a fabric simulation module, which can be integrated with the system. This special feature uses all the diameter values scanned by the optical camera (every 0.5 mm) to simulate a selected fabric. This software offers an array of weave patterns along with a jersey knit simulation. Densities, yarn colour and patterns are selectable for better simulation. Because of the sensitivity of the optical system, the effect of yarn faults can be seen in the fabric. This option is ideal for fabric design, yarn development and Research & Development applications.
- ***YAS*** software modules offer the following tools and features:
    a. Statistical and graphical yarn hairiness tester. This graphics can display the hairs and yarn core separately or together.
    b. Complete optical evenness tester with fault classification matrix.
    c. Statistical report, yarn board, and grading. With a minimum 0.5 mm length per scan, neps may be measured and counted.

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