

## Dissertation Review

# TENSILE BEHAVIOR OF STAPLE SPUN YARNS

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*In accordance with the internal "Study and Examination Rules" of the Technical university in Liberec Liberci" article 22 , I have worked up following Dissertation Review of the dissertation of PhD. Student Mr. Muhammad Zubair, M.Mc.*

Research and development focused to the improving quality of textile yarns is at the moment mostly running by the principle "try and error" when the samples of yarns, produced under different conditions, are tested in the laboratory for their mechanical properties without deep study of the internal structure of the yarn and the influence of this structure to the relevant yarn parameters. The possibility to predict the parameters of the yarn, based on the internal structure could be very interesting for continuous progress in the field of textile spinning and this dissertation could be a good step into such a direction.

The study starts with a description of stress-strain curves of fiber and yarn. The effect of yarn structure can be characterized by coefficient of fiber stress utilization in the yarn. Author of the dissertation work first analyzed accessible theoretical information from the literature and aggregated them. The four types of models, for coefficient of fiber stress utilization in yarn were introduced and explained. From these four models it seems that the "double integral" model suits the best to the experimental results, evaluated in the second part of the work and predict relatively well the coefficient of fiber stress utilization in staple spun yarns considering also random character of fiber inclination in the yarn..

The different types of fibers (viscose, cotton, polyester, linen, wool and acrylic) and yarns were used for experimental validation of proposed mathematical models for coefficient of fiber stress utilization before the breaking process of yarn. Viscose, cotton and polyester yarns were produced from both ring and rotor technologies while flax, wool and acrylic yarns were made from ring spun technology only. Combed cotton ring spun yarns from long staple cotton fiber were also used for verification of the model.

Theoretical results were confronted with the extensive set of laboratory results. It has to be appreciated at this place, that author has invested a really high effort to collect such a wide set of experimental results. The experimental part of the study was performed according the valid industrial norms and in some cases according the internal rules of the Technical university. The experimental results were processed by the utilization of Matlab system.

There were conducted experiment with all generally available fiber materials ( cotton, viscose, polyester and wool) which were spun on ring spinning machine and where feasible, also on rotor spinning machine. It is a pity, that no Airjet yarn was included to this study, because of its specific construction.

Concerning the rotor yarns, I am missing in the work the information about the nominal ( mechanical) twist, which was set on the machine, because the real twist of the rotor yarn, measured in laboratory is always lower, than the machine twist. The difference is

related to the several conditions on the machine, like rotor type, take nozzle etc. and the twisting difference could also bring some information, how the fibers are formed into the yarn.

It is a pity, that author on his own did not mention in the work, how this results could be used in the research and development of the new type of the yarns. It would be appreciated from the community if there will be available a methodology, able to show if the mechanical parameters of the existing yarns are already on its limits concerning the yarns strength or if there is still some reserve, coming out from the yarn construction

As is commonplace today, most of the doctoral work has been published on-line on the Internet, which undoubtedly brings benefits to the general public. Further work was published in the framework of seminars organized by the Technical University for PhD students. These seminars, however, serve primarily to improve future academic staff in presentation and communication skills, and the importance of these events for public is comparatively small.

I propose that the doctoral student answer the following questions in his defense:

- 1) How could the results of this work be used to improve the parameters of the yarns produced on existing spinning machines ?
- 2) Are the models also valid for the Airjet yarn (Murata MVS, Rieter J20), or what adjustments to the methodology would be needed?

**I recommend the dissertation for defense.**

in Usti nad Orlici 12<sup>th</sup> of May 2017

doc. Ing. Jiří Sloupenský, CSc.  
Rieter CZ s.r.o. Ústí nad Orlicí





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डा. एस.एम. इश्तियाक

प्रोफेसर एवं विभागाध्यक्ष

**Dr. S.M. Ishtiaque**

Professor & Head

Dear Ing Drasarova

19<sup>th</sup> June 2017

Dean, Faculty of Textile Engineering

I have examined the Ph.D thesis entitled "Tensile behavior of staple spun yarn " submitted by

Mr Muhammad Zubair.

The candidate has done a commendable job of organising and presenting the proposed research study. The candidate has demonstrated a very good understanding of the subject and the underlying limitations in the understanding of the tackling of knowledge that is needed in modelling the mechanical behaviour of staple spun yarns. The objectives of the present research are very well defined.

The thesis is very well documented and presented. The candidate has done very exhaustive survey of literatures by critically articulating the reasoning and understanding of the prior works in the present area of research. The overall flow of presentation of the thesis is excellent and bridging of one chapter to the next chapter has been maintained very carefully.

The candidate has made original contribution in the area of mathematical modelling for prediction of coefficient of fiber stress utilization from stress-strain curves of fiber and yarns considering yarn twist and fiber orientation and to validate the experimental coefficient of fiber stress utilization before yarn break, is a good example of his contribution to the profession of a technologist.

The candidate has made a very diligent attempt to experimentally measure the various parameters that characterize the tensile behavior of staple spun yarn.

The exhaustive and in-depth research of the present topic shows that the candidate is very hard working and competent in carrying out independent research.

The following observations given below need corrections in the thesis:

1. Page 4, section 2.1 – It should be modern not modern.
2. Page 8, Fig 2.5 – Citation of Fig 2.5 should have equation number i.e. equation 2.5 instead of giving full equation.
3. "Wool" is a material and "worsted" is a spinning process but number of places word worsted has been used as wool.
4. Why for linen fibre and linen yarn, technical fibre and technical yarn is used. Linen is simply a natural fibre.
5. Page 53, Table 5.1 – the values of yarn twist and diameter of viscose ring yarn has to be corrected. Finer yarn has higher twist and lower diameter in comparison to coarser yarn.
6. At few places the thesis needs some grammatical mistakes.

Based on the above observations, I strongly recommend the thesis for award of Ph.D. in its present form.

A handwritten signature in black ink, consisting of a stylized 'S' followed by a horizontal line and a small loop at the end.

Dr. S.M. Ishtiaque