EXTERNAL EXAMINER´S OPINION OF DISSERTATION THESIS

External examiner: doc. Ing. Tomáš Novák, Ph.D., VŠB-TU Ostrava
PhD student: Nayab Khan, M.Sc.
Theme: A NEW METHOD FOR COLOR MEASUREMENT OF COTTON FIBER

Assessing whether the topic of the thesis corresponds to the field of the dissertation and is current in terms of the present state of science:

The implementation and design of new measuring methods for evaluating qualitative (color) cotton properties that would be able to replace subjective assessment is a significant task not only from the point of view of eliminating the influence of each individual evaluator, but also from an economic point of view. Globalization and the ability to compare the color properties of cotton produced in different countries require increased pressure on the repeatability and provability of the measured qualitative parameters. In this work the author took advantage of two resources, which are currently being developed and improved. It is on one hand the measuring chain the usage of LEDs that correspond to daylight not only from the point of view of the color temperature, but especially from the point of view of the similarity of the spectral emission, so that it can be evaluated at all wavelengths causing visual perception. Standard white LEDs do not meet this qualitative aspect. The second means of measurement that the author used in his work is based on measuring the whole color map of the studied materials using camera chips, trying to leave a point measurement that integrates the color properties of whole studied samples that are inhomogeneous. So far, these inhomogeneities have been eliminated only on the basis of the experience of subjective observers (assessors).

I see the author's merit especially in performing a whole range of comparative measurements using the above-mentioned technologies. In my opinion the outputs measurements on specific samples with the specific types of LED and camera chips could be used in the construction of measuring STAND with LED and with camera chips, which will be supplemented by a standard evaluation software and a new internationally approved methodology for evaluating the color properties of cotton.

Opinion on the original parts of the work with the specification of their originality

The theoretical part of the dissertation deals with the history of the evaluation of the color properties of cotton in interesting, but very voluminous way (Chapter 1). This part can be understood as a textbook research of influences on the color properties development of cotton sorting itself. Chapter 2 provides an assessment of new light sources through a number of assessing methods and using different options (systems) to assess color systems. I consider very interesting the pointing out the possibility of assessing the spectral reflection of the tested cotton samples, so that there could be eliminated the influence of the light sources under which these properties are tested. Chapter 4 extends the possibilities of assessing color properties of cotton using photographic (multi-pixel) methods that are able to solve the properties of the studied samples not integrally, but per-partes as a map of individual assessed coordinates mathematically recalculated from visual to colorimetric channels. The use of camera systems also allows the implementation of

mathematical methods for the elimination of impurities from the color assessment. I was especially attracted by a relatively simple method using histograms. In Chapters 4 and 5, the author describes a whole range of experiments assessing the above mentioned methods of cotton sorting.

However I dare to reproach for some formal mistakes that decrease the quality of the work. I believe that the theoretical states mentioned particularly in Chapter 4 should be listed at the beginning of the work and not nearly at the end of it. I would also point out a large number of images that are unreadable or with missing units or a complete description of the axes. The list of abbreviations and relations is not complete either. Generally speaking, the work should be on a higher level in structural and formal aspect.

Opinion on publications related to the core of the dissertation:
The core of the dissertation was published at the international textile and light-technical forum. The author published the issue in indexed journals focusing on material properties and at the level of the International Commission of Illumination (CIE). Segments of the work were also published in domestic conferences.

Opinion on the applicant's scientific activity:
Based on the list of creative activities, it can be said that the applicant is with a scientific erudition. Attention is drawn to the fact that the author's publishing activity is not only theoretical, but deals with practical problems in determining the quality of cotton all over the world. The author was able to use not only samples of cotton from many sources, but he also used the ability of subjective evaluators who have been sorting it so far.

Conclusion:

I recommend Nayaba Khan´s, M.Sc. dissertation thesis for the defense.

Questions for defense:
Please explain why you have not dealt more with the possibilities of cotton assessing by its spectral reflection.

Can you explain the reasons for choosing the PANASONIC SDR-H280 from the point of view of the chip spectral sensitivity and scanning multiple images?

Could you specify more the spectral requirements for LED applicable to the color assessment of cotton?

In Ostrava 31th August 2017   doc. Ing. Tomáš Novák, Ph.D.

Review of the PhD dissertation
Nayab Khan, M.Sc.
"A Novel Method for Color Measurement of Cotton Fiber"

The main aim of the PhD dissertation is to develop a novel approach and a system for measurement of cotton color measurement and color grading that eliminates the disadvantages of visual grading system and HVI system.

Cotton fiber, which is one of the most important natural fibers used in textile industry, is produced in different regions of the world and its quality characteristics may possess a high variation. Accurate grading of cotton without confusion is important not only for textile processes which use cotton as raw material but also world cotton marketing. The grading process is mainly based on different fiber properties such as length, strength, Micronaire, thrash content and color of the cotton fiber and traditionally human classifiers are used for inspection and classification. Instrumental measurement is realized using HVI (High volume instrument) system for measurement of cotton quality characteristics in order to obtain quantitative data in addition to visual inspection.

Cotton color grades, one of the most important cotton properties, can be determined by human classifiers using visual inspection and/or HVI system using Rd and +b parameters measured by the system. Unfortunately, high disagreement between visual grading and HVI measurements is present. Although an objective instrumental grading system is needed for many reasons, it was not possible to eliminate the human inspection from the cotton color grading process until today due to the shortcomings of the instrumental measurement approach. The topic of this dissertation is up to date and the main aim of the research conducted is to overcome this worldwide problem. In order to solve the big problem, Khan partitioned it into parts each of which can be regarded as separate thesis. The chapters are dealing with each part extensively.

Khan researched the illuminants for color measurement of cotton in the first chapter and experimented LED illuminants having full range of spectrum (400-700 nm) to be used for color measurement instead of incandescent lambs which are generally used. In this part author experimented two different instruments for measurements; one is the standard portable spectrophotometer and the other is telescopic system as is used for non-contact method. Enough experimental work has been done in order to derive conclusions. In the second chapter, Khan researched a novel approach for color measurement which is capable of eliminating drawbacks of HVI system. Noncontact method using telescopic system is used to measure the color variation in the cotton sample which is not possible by HVI system. In this chapter also digital color camera is used for measurement of color variation. After trials and experimental studies the results obtained from noncontact method are compared with the data obtained from HVI and Hunter Lab Miniscan XE. In this chapter it is concluded that non-contact method can be used for developing an instrumental approach for color measurement of cotton which is also capable of acquiring color variation as well. The third chapter is an extensive experimental work for examining visual grading approach. Author developed a novel improved HVI diagram for color grading which consists of three parameters instead of two used in classical HVI diagram. 24 cotton samples were used for the visual classification which is consist of USDA standard cotton samples and Pakistani cotton samples. The visual

comparison is performed not only to grade the cotton but also it was performed to rank the cotton according to its whiteness. It is shown that the instrumental measurement of color and visual grading of cotton have some differences due to the presence of the trash particles. This finding leads to another very important chapter where a system is developed for cotton color measurement using digital color camera and using image analysis methods which eliminates thrash particle regions while measuring color.

A complete theoretical and experimental research work has been done in the dissertation in order to examine the parameters which can affect the proposed grading system. This indicates the student's expert and theoretical knowledge is sufficient for developing novel scientific research on the subject of cotton color measurement and developing a novel grading system.

The dissertation consists of 181 pages including table of contents, acknowledge, list of figures and tables, list of abbreviation, abstracts in English, Czech and Turkish, and body of the thesis consists of 6 sections in addition to back-matter including appendix, references and Curriculum Vitae of the author. Tables and figures are given clearly within the dissertation and contribute to represent the results of the experimental work. At the end of each chapter novel contributions are derived, results are discussed in addition to the overall conclusions given in section 6 "New Findings of the Research". Khan has made several publications in indexed journals in addition to oral and poster presentations in conferences.

I believe that Khan achieved main goals in his dissertation and his findings contribute the field with completely novel and original knowledge. The topic in this dissertation is very important not only for the scientific community but also for the whole cotton related industries in the world. The problem solving approach in this work and its presentation were scientifically sound.

Depending on my evaluation, I consider the PhD thesis "A Novel Method for Color Measurement of Cotton Fiber" is a valuable scientific contribution and I RECOMMEND the PhD THESIS FOR THE DEFENSE

Assoc. Prof. Dr. Bekir YILDIRIM
Erciyes University
Kayseri (Türkiye) 30.07.2017