

Interdisciplinary and Specialized Programmers Used in the Practical Part of Teaching a Technical Course

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Abstract

This paper deals with a concept of the present pedagogy which combines scientific and technical information with students' practical applications. An interdisciplinary education means that information taught to students is the result of a mixture of different disciplines: physics, chemistry and textile finishing. Being a computerized didactical-scientific-technical „filter” of these disciplines and their practical applications in the laboratory, this paper becomes a useful, attractive and stimulating teaching instrument both for the students and the teachers. Combining formal and non-formal education, students are able to achieve necessary skills and abilities for their future work in a computerized technical environment.

Keywords: AeL lessons, Spectrophotometer, Dye, Diagrams

1. Introduction

Starting from the idea that lessons have to be attractive and bring new information to students, this paper focuses on a practical application for the textile finishing discipline. This course is taught in the 12th form of the technical high schools specialized in textile-leather and it combines practical and theoretical information from other fields – physics, chemistry – with the specialized ones.

AeL lessons are a precious help, as through animation students get a better glimpse of the chemical, physical and technical phenomena they are taught. Interdisciplinary helps students achieve general and specific abilities, as well as practical skills related to working with technical equipment.

AeL lessons in the field of chemistry (for instance natural and synthetic coloring agents, water) (<http://advancedelearning.com/materiale/new/chi/>) and physics (light dispersion) (<http://advancedelearning.com/materiale/new/fiz/>), combined with specialized ones on the coloring of textile materials (dyeing and printing operations) offer students the chance to learn how to interpret the diagrams which result from the analysis of dyeing agent concentration in different situations, using the Spectrophotometer Kontron.

As AeL lessons in the fields of chemistry and physics are well-known, this paper deals with the specialized practical application – coloring cellulose textile materials with specific dyeing agents.

When dyeing textile materials, we need to take into account various factors which may have an influence upon the finished material – the Microner index, dyeing agent concentration, work parameters, etc. (Bucurenci and Bucurenci, 1994).

The case study presented here deals with the dyeing operation of materials made of 100% cotton. Different dyeing samples were prepared and tested with the help of the spectrophotometer Kontron.

The paper consists of the following parts:

- Introduction
- Part I presents a history of the spectrophotometer and some notions on the dyeing of different cellulose textile materials with various specific dyeing agents;
- Part II describes the practical application which uses the Spectrophotometer Kontron – variations in the concentration of the one dyeing agent (the tub dye) used in the experiment, depending on the wave length, time, number of determinations, initial dyeing concentration, etc.
- Conclusions;
- Bibliography.

Experimental data interpretation leads to a correct choice for the work parameter values and to obtaining textile materials which prove to have good and very good technological resistance.

Part I

Modern equipment used in the instrumental measurement of color

In the 50s only 10 spectrophotometers measuring the dyeing concentration were in use. In the 60s, the most per formant one needed at least 10-15 minutes to read the textile sample reflexion values at 16 points, values which were then used in more complex calculations. During the 70s, the measuring time was reduced to less than a minute and then to only a few seconds.

The prices one had to pay for these devices were very high:

- In the 70s, it was the equivalent of 30 Volkswagen cars;
- In the 90s, it was the equivalent of 3-4 Hyundai cars.

Colorimetry is nowadays represented by a large variety of spectrophotometers and colorimeters connected to a computer and having an internal memory unit. Newer results show a significant growth of the measuring speed, precision, reproducibility and application flexibility. An important optical change is the extension of the wavelength to the infrared area (which is important for the measurement of the camouflage materials) as well as the ultraviolet area (important for the measurement of the fluorescent bleaching agents).

The features of the spectrophotometer are the following:

- Double spot measurements every 10 nm;
- Using slots with a good reproducibility rate;

- A range of the reflex ion values of 0-200%;
- The existence of some light source;
- Manual or automatic calibration.

The big brands in the field (Data color International, Macbeth, Minolta, Tree Point) modify and upgrade their programmer packages in order to continuously improve the answers that the equipment offers the beneficiaries. An important characteristic of the software used is that Windows now provides us with great graphical operational features. The continuous upgrade of the measurement equipment leads to an improvement of the existing solutions, but as far as the dyeing recipes are concerned, the final decision is always taken by the professional colorist.



*Figure 1. Spectrophotometer
Keyboard and monitor*



*Figure 2. Spectrophotometer
area for the analysis of the bath solutions*

1.1 Dyeing with direct dyes

Direct dye molecules contain:

- Chromospheres groups which can be di or poliazoic;
- Aminic or hydroxylic auxochrome groups;
- Soluble sulphonic groups.

Direct dyes are a fine dust with a high water solubility value and they come in various colors and shades. The factors which influence dyeing are: coloring agent and auxiliary substance concentration, temperature, ph of the dye bath, time length of the dyeing process (Mureşan, 2000, Butnaru and Berdea, 1998).

The dyeing procedures are the following:

- a) The discontinuous procedure – when the dye bath is low alkali nous or neutral; either dark or light shades can be achieved through this procedure.
- b) The semi-continuous procedure – for cotton and viscose materials.
- c) The continuous procedure – which is more difficult to use because of its complex technology.

The dyeing substances are: NaOH, Na silicate, industrial salt, and direct coloring agent.

The dyed material is treated again with the aim of improving the dye resistance.

1.2 Dyeing with tub dyes

Tub dyes have been used for a long time now, beginning with the time when they were extracted from plants and cockles.

After synthesizing indigo in 1897, the first anthrachinonic dye was synthesized in 1901. This type of dyes can be used in order to achieve all shades. They need to be diluted in order to be used for dyeing.

The factors which influence dyeing are: coloring agent and auxiliary substance concentration, temperature, time length of the dyeing process, ph of the dye bath.

Dyeing procedures are: discontinuous, semi-continuous and continuous.

The dye resistance is good and very good (Butnaru and Berteau, 1997).

Part II

Determining dye solutions concentration in the dye bath

The method is based on determining the concentration depending on the wavelength, as it is well-known that every color matches a certain wave-length in the UV spectrum.

The dye concentration is determined with the help of a measuring curve. The tables with the concentration values for the one dye can be found below, together with the experimental data – tables and curves of the dye concentration – determined through experiments using the Spectrophotometer Kontron (Butnaru and Bucur, 1996).

*Table 1. Determining the concentration of the tub dye in the dye bath **before** the dyeing operation, on the Spectrophotometer Kontron*

Wavel	No.	Value_S	Value_S
350.0	1	0.9348 1	0.9340 2
450.0	2	1.1468 1	1.1474 2
550.0	3	1.1994 1	1.1983 2
650.0	4	1.2028 1	1.2024 2
700.0	5	1.2026 1	1.2020 2
750.0	6	1.1020 1	1.1020 2
850.0	7	1.1200 1	1.1223 2
900.0	8	0.6466 1	0.6471 2

*Table 2. Determining the concentration of the tub dye in the dye bath **after** the dyeing operation, on the Spectrophotometer Kontron*

Wavel	No.	Value_S	Value_S
350.0	1	0.6785 1	0.6815 2
450.0	2	0.4608 1	0.4619 2
550.0	3	0.6570 1	0.6600 2
650.0	4	0.8078 1	0.8099 2
700.0	5	0.0339 1	0.0349 2
750.0	6	0.1549 1	0.1543 2

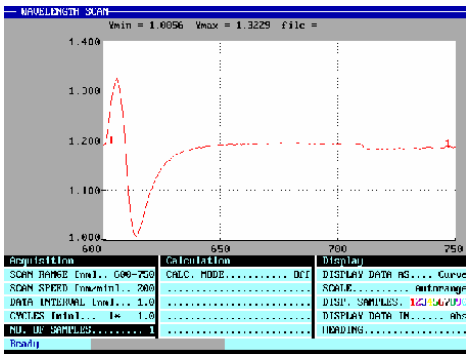
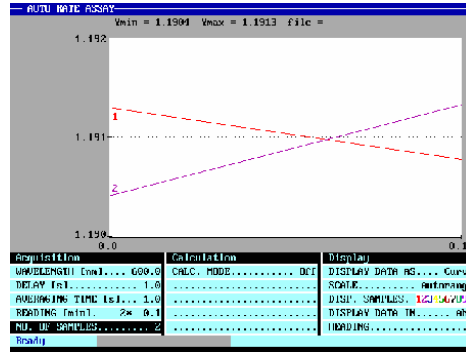
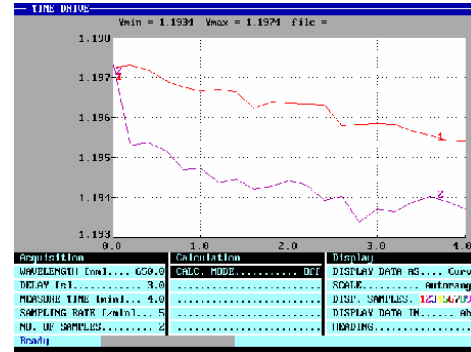


Figure 3. Determining the concentrated solution of the tub dye on the Spectrophotometer Kontron

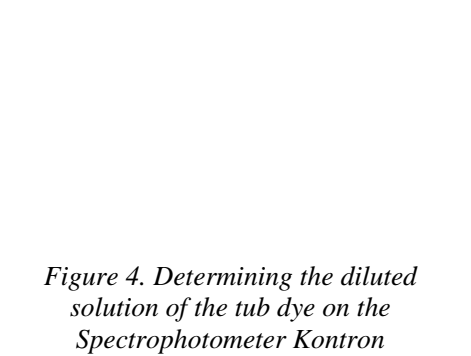
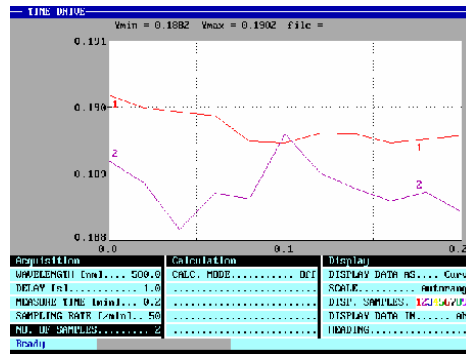
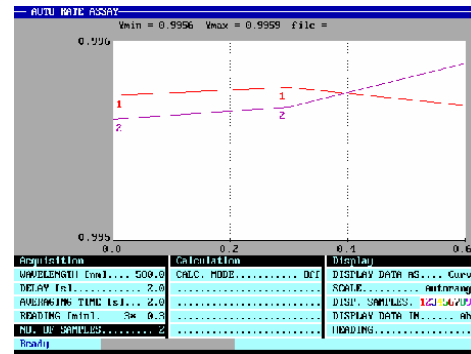


Figure 4. Determining the diluted solution of the tub dye on the Spectrophotometer Kontron

Conclusions

- based on these diagrams and tables, when dyeing cellulose materials, one can calculate the optimum values of the coloring agents used, depending on various parameters – wave length in order to determine color intensity, time length in order to obtain a uniform dyeing, degree of recovery of the dye from the dyeing bath in order to use it for further dyeing operations;
- cellulose textile materials will be better quality ones as flaws will thus be removed (Bertea, Bertea and Butnaru, 2000);
- students will be better trained in using specialized technical equipment;
- students will acquire various skills in different fields – chemistry, physics, textiles – thanks to the interdisciplinary character of the lessons and the practical applications.

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