NEW METHOD OF REACTIVE DYES FIXATION

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EXTENDED ABSTRACT

Key Words: heat-setting method, CO_2 laser, reactive dye, cotton fabric

1. INTRODUCTION

There are many papers focused on the interaction of UV lasers and polymers. These lasers can be used in surface modification of polymers [1]. Lower attention is concentrated on CO_2 lasers. These lasers are widely used for the cutting of textile materials such as a non-conventional method. Other possibility is consisted in the decolouration of denim fabric.
The aim of the paper is studied the chance of reactive dye fixation on cotton fabric by means of CO_2 laser. Nowadays the most used groups for dyeing and printing of cotton fabric are reactive dyes. Hot brands reactive dyestuffs belong to monochlorotriazine group suitable for printing and padding applications due to its low substantivity and reactivity. The advantages of reactive dyes are: wide palette in solid or liquid form, easy way for application, a lot of methods of fixation, good washing fastness. The main disadvantage of reactive dyes is their complicated way of application and high content of reactive dyes in waste water [2,3].

2. MATERIAL AND METHOD

2.1 Used fabric

A 100% cotton fabric was used for this experiment. The fabric was treated by standard methods such as the scouring and the bleaching. Fabric had a plain structure with 21 picks per 1 cm and 26 ends per 1cm. The thickness of cotton fabric was 0,28 mm. The areal weight of fabric was 143,4 $g.m^{-2}$.
Reactive dyes were chosen for the dyeing of cotton fabric C. I. Reactive Blue 5, C. I. Reactive Yellow 85 and C. I. Reactive Red 24 (Figure 1). These dyes are convenient for dyeing of cellulose fibers. It is required the high temperatures for its fixation on the fibers. It can be used for textile printing and the application of heat-setting process. All dyes were separately applied on the fabric.
The dyeing bath contained the dye (40 $g \cdot l^{-1}$), urea (100 $g \cdot l^{-1}$) and sodium carbonate (20 $g \cdot l^{-1}$). Cotton fabric was immersed in the bath and were gone throug the padding machine. The speed of rotation was 2 $m.min^{-1}$ and the operating pressure was setted to 2 bar.
The dryeing of cotton samples was performed by hot air in the fixation frame in Mathis device at 40°C temperature. The recipe of the application process of dye was inspired by the heat-setting procedure. The dye fixation was made by CO_2 laser during the irradiation of cotton fabric.

2.1 CO_2 laser device and temperature measurement

Laser Marcatex 150 Flexi is a pulsed laser device. It is possible to set these parameters: duty cycle [%], frequency [kHz] and pixel time [μs]. The power of laser device is 100 W and the wavelength of laser is in the infrared range in 10,6 μm.
Laser device is controlled by the program Easy Mark 2009. DPI was 34 and pixel time was setted on 30 μs. Duty cycle was the maximal value of 50% and the frequencz was 5 kHz. The threshold colour was default value of 220. Samples were irradited from the front side.

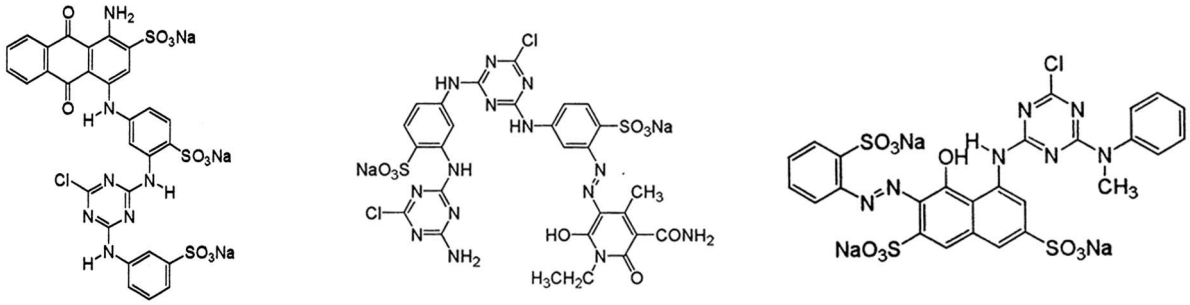

Figure 1. Structure formula of reative dyes - C. I. Reactive Blue 5 (on the left side), C. I. Reactive Yellow 95 (in the middle), C. I. Reactive Red 24 (on the right)

It is necessary to make the laundering of cotton fabric after dyeing. Samples were rinsed in cold water. Then samples were put into metal beaker with water at 70 °C for 5 minutes. After that samples were put into the laundering bath with a blend of sodium alkylbenzenesulfonate and sodium lauryl sulfate (2 $g \cdot l^{-1}$) for 10 minutes.
Samples were dryed in hot air in the laboratory dryer.
Temperature measurement was performed by an infrared thermometer GIM 3590. The thermometer was recorded the back side of the sample. The measuring geometry is evident in Figure 2.

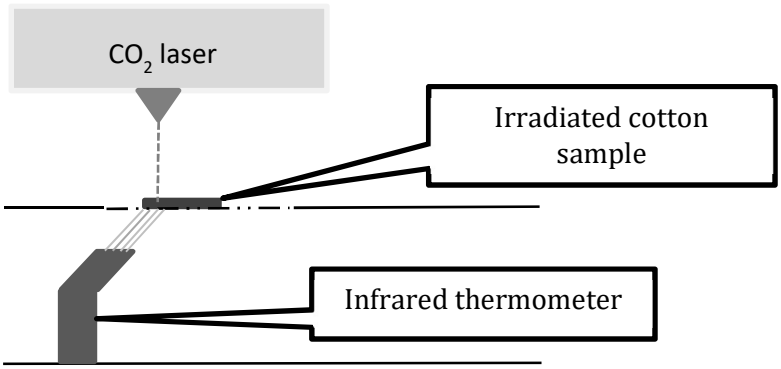

Figure 2. The diagram of temperature measurement of cotton sample by infrared thermometer

3. EXPERIMENTAL RESULTS AND DISCUSSION

Measured temperature of irradiated cotton sample is displayed in Figure 3. Color of samples after laser irradiation and above described after-treatment is in the range of light or medium deep shades. In all experiments there are the shades lighter in the comparison with standard dying methods with similar dosage of dyes.

Washing fastness and other similar are fastnesses are excellent due to used the standard reactive dyes with standard after-treatment.
Mechanical properties of cotton fabric are not so much influenced by laser light – strength decreases is about 8% by laser irradiation.

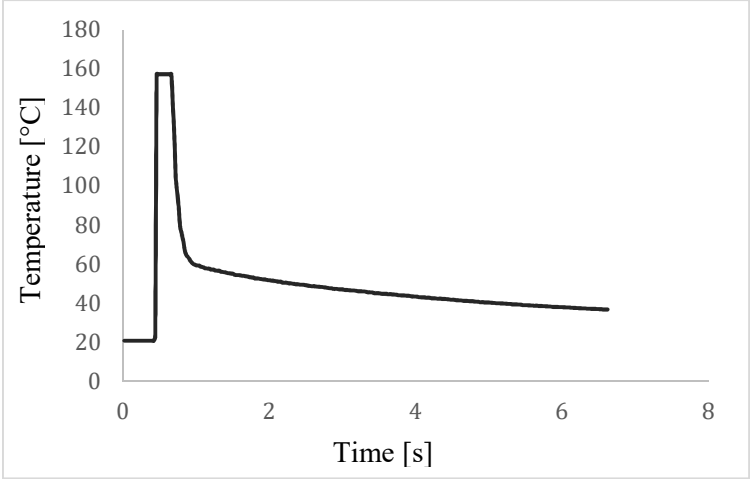

Figure 3. The graph of the dependence of the temperature of irrdiated cotton sample on the time

4. CONCLUSION

There is presented the new method of the application of reactive dye on the cotton fabric by CO_2 laser. It is the first attemp of the local heating of the textile for the dye fixation creating the pattern on the fabric.
Suggested and certified technique is very suitable as the substitution of the textile printing in the special cases. There is a need for the printing of the original print or small series of the prints. Other reason for the using of this manner is reaching of the especial desing effects on the fabric for example the dosage of dyes in various amount, the dosage of dye by the means of the spraying in small droplets or gets smudget of dyes on the fabric.

5. REFERENCES

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