LASER TREATMENT OF KNITTED COTTON FABRICS

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- Cotton fiber is one of the most valuable fiber because of it's unique properties. Cotton clothes breathes the body, absorbes the human sweat, supplies comfort to wearers'.

- But pilling of cotton knitted fabrics has been a problem for a long time, so most of the studies in the literature about pilling involve knitted fabrics containing cotton fibers.

- To solve this problems several new methods has been investigated like plasma treatment, enzymatic treatment and etc. And also conventional method such as singeing and biopolishing is used commonly.

- It is well-known that laser technology is used in several industrial applications but, it is limited in textile industry, except for denim finishing.
- In this study, laser technology was firstly tried to prevent pilling problem of cotton fabrics with CO_2 laser (10600 nm wavelength). At the reason reduction of water and chemical consumption achieved.

What is laser?

- **L**ight **a**mplification by **s**timulated **e**mission of **r**adiation (**LASER**) is a mechanism for emitting electromagnetic radiation, typically light or visible light, via the process of stimulated emission.

Types of Lasers

- Gas lasers  CO_2 Laser (10600 nm Wavelength)
- Chemical lasers
- Excimer lasers
- Solid-state lasers
- Photonic Crystal lasers
- Semiconductor laser
- Free electron lasers etc…

- The first application of lasers visible in the daily lives of the general population was the supermarket barcode scanner, introduced in 1974. The laserdisc player, introduced in 1978, was the first successful consumer product to include a laser, but the compact disc player was the first laser-equipped device to become truly common in consumers' homes, beginning in 1982, followed shortly by laser printers.

Usage Fields of Laser

- **Medicine:** Bloodless surgery, eye surgery, dentistry
- **Industry:** Cutting, welding, etc.
- **Research:** Spectrosopy, laser interferometry, etc.
- **Entertainment:** Laser light shows
- **Cosmetic:** Skin treatment, acne treatment, hair removal.
- **Defense:** Marking targets, alternative to radar, blinding enemy troops.
- **Product development/commercial:** Laser printers , CDs, barcode scanners, thermometers, laser pointers
- Cutting hundreds of layers of fabric at once in clothing factories
- Denim finishing

Laser Safety

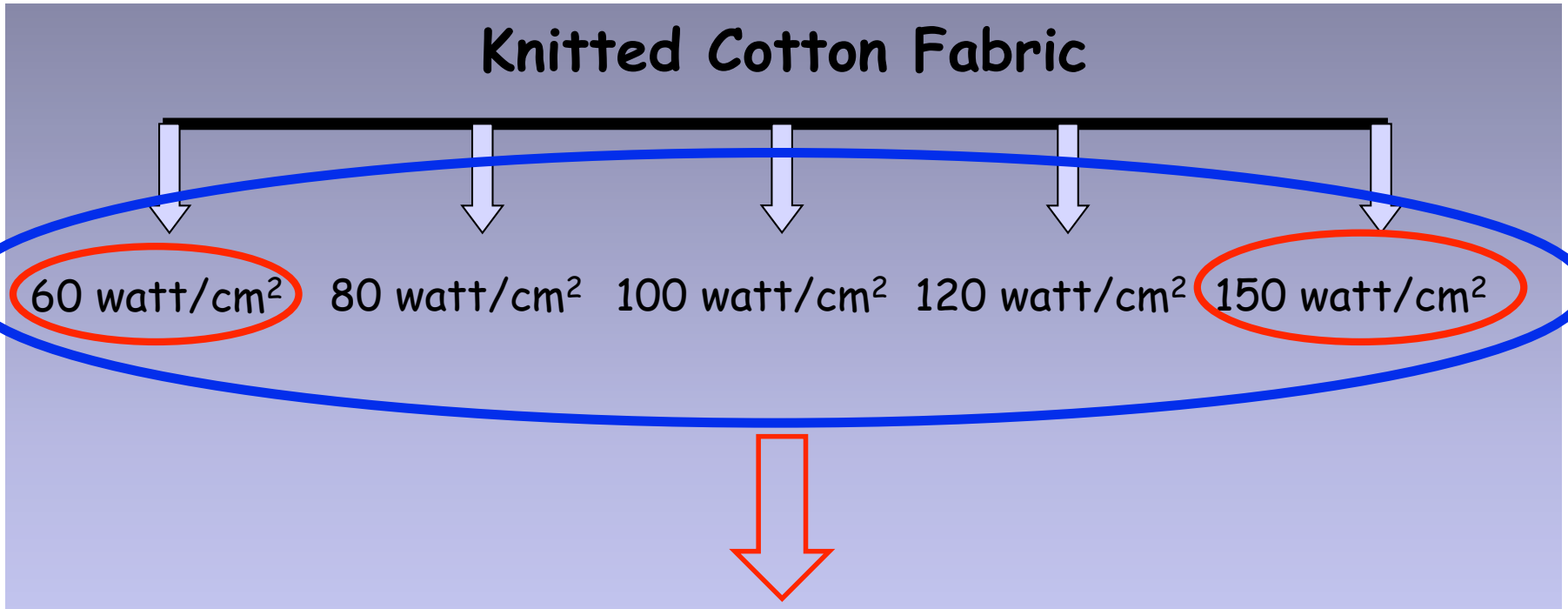
Lasers are usually labeled with a safety class number, which identifies how dangerous the laser is:

- Class I/1 is inherently safe, usually because the light is contained in an enclosure, for example in CD players.
- Class II/2 is safe during normal use; the blink reflex of the eye will prevent damage. Usually up to 1 mW power, for example laser pointers
- Class IIIa/3R lasers are usually up to 5 mW and involve a small risk of eye damage within the time of the blink reflex. Staring into such a beam for several seconds is likely to cause (minor) eye damage.
- Class IIIb/3B can cause immediate severe eye damage upon exposure. Usually lasers up to 500 mW, such as those in CD and DVD writers.
- Class IV/4 lasers can burn skin, and in some cases, even scattered light can cause eye and/or skin damage. Many industrial and scientific lasers are in this class.

- The indicated powers are for visible-light, continuous-wave lasers. For pulsed lasers and invisible wavelengths, other power limits apply. People working with class 3B and class 4 lasers can protect their eyes with safety goggles which are designed to absorb light of a particular wavelength.

- Knitted cotton fabric was used for the experiments. During the trials a pulsed CO_2 laser with a wavelength 10.6 μm was selected and the laser powers were adjusted to

Experimental



Pilling Test (EMPA Standard SN 198525 K3, Martindale 2000 pilling machine)
Strength Test (James J Heal Bursting strength machine)

- Laser irradiation was performed only in one side of the fabric and within a specific marked area.
- Afterwards, fabrics' pilling tendency and strength losses were researched.
- In order to evaluate the results, pilling tests were performed in Martindale 2000 pilling machine and the pilling results after 2000 rpm were evaluated with the aid of EMPA Standard SN 198525 K3.
- The strength losses were measured by James J Heal Bursting strength machine (with 7.5cm^2 area and 30.5 mm diaphragm diameter).

Figure. Laser-based antipilling system

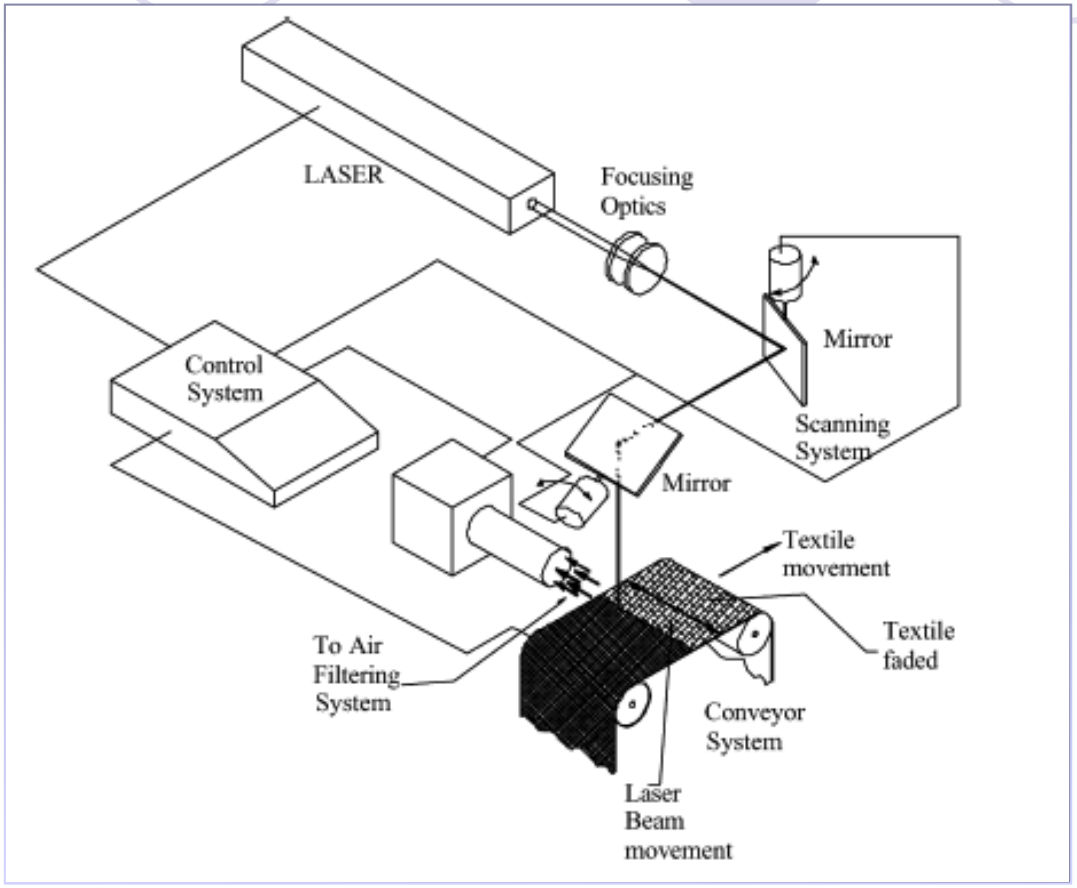


Table. Pilling values of laser treated cotton fabrics

	Pilling Value
Gray Fabric	2.5
Laser treated 60 watt/ cm2	3
Laser treated 80 watt/ cm2	4
Laser treated 100 watt/ cm2	5
Laser treated 120 watt/ cm2	5
Laser treated 150 watt/ cm2	5

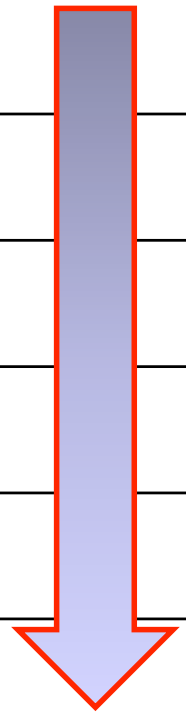
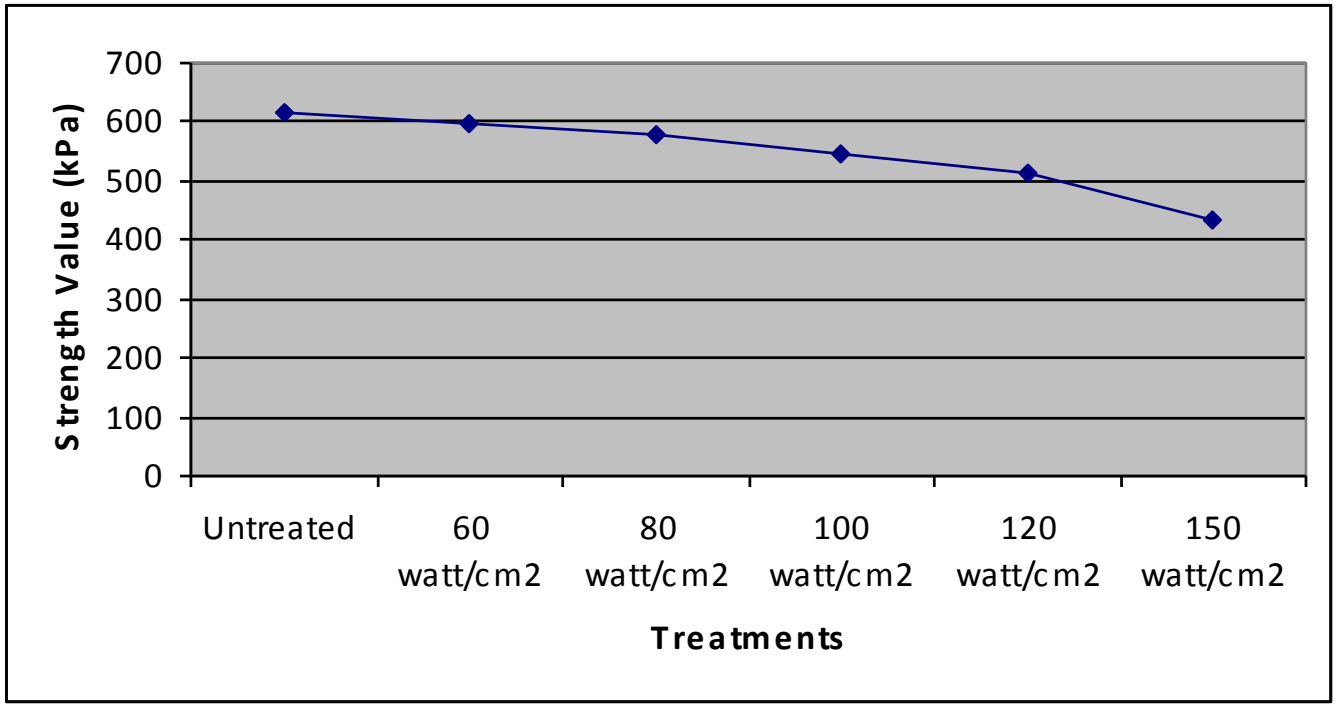


Figure. Strength values of laser treated cotton fabrics



Discussion

- It is thought that CO2 laser can be an alternative to conventional methods such as singeing and biopolishing to decrease pilling tendency of cotton fabrics. But laser power density must be regulate be carefully and check frequently during the process. Otherwise thermal damages can be occur.

THANKS FOR YOUR ATTENTION