The Journal of The Textile Institute
Vol. 101, No. 3, March 2010, 276–281

A qualitative assessment of seersucker effect through spectral density and angular power spectrum function algorithms

F.G. Ghahraman, H. Tavanai* and S.A. Hosseini

Department of Textile Engineering, Isfahan University of Technology, Isfahan 84156-83111, Iran

(*Received 5 January 2008; final version received 8 August 2008*)

The seersucker effect is formed when stripes on a cotton cloth shrink, and as a result the nonshrink parts are forced to take up a wavy form. Printing stripes on cotton cloth with pastes containing sodium hydroxide is one method of producing this effect. Until now, seersucker effect has been assessed quantitatively by measuring the percentage shrinkage of the shrunk parts. In this study, two algorithms, namely, spectral density function and angular power spectrum function, are presented. These algorithms are capable of assessing the three-dimensional seersucker effect qualitatively and are far superior to percentage shrinkage method. Various seersucker effects were produced by choosing different conditions for some major independent variables, such as sodium hydroxide concentration, fabric pretreatment, weft density, and the kind of weft yarn. These were successfully analyzed by the algorithms qualitatively.

Keywords: cotton cloth; seersucker effect; sodium hydroxide; spectral density function; angular power spectrum function

Introduction

Seersucker, also known as crimp effect, is characterized by the presence of a three-dimensional (3D) wavy effect (puckered) and relatively flat sections, particularly in stripes, as shown in Figure 1. The seersucker effect is formed when the alkali-printed stripes of a cotton cloth shrink and force the nonprinted stripes to take the characteristic wavy form. Printing paste usually contains concentrated sodium hydroxide. Similar effects can be obtained by embossing or choosing different tension levels in parts of the warp beam placed behind weaving machines (Robinson & Marks, 1973). As a result of alkaline treatment, the secondary hydroxyl groups of cellulose react with sodium hydroxide, leading to the formation of alkaline cellulose. Meanwhile, the sodium ions penetrate the internal structure of the cotton and break down the hydrogen bonds acting between the cellulose molecules, leading to a new bulk microstructure known as cellulose II. Raw cotton is considered as cellulose I. Cellulose II has a lower degree of crystallinity when compared with cellulose I (Carter, 1971, pp. 7–8). To get the seersucker effect, a relaxed cotton cloth is printed usually in a stripe form (a check form is also possible) using a highly alkaline paste as already mentioned. This can be considered as tensionless mercerizing. After printing, the cloth is left to relax for 15 to 30 minutes in the relaxed state. During this period, the printed stripes shrink, and as a result the nonprinted stripes are forced to take a wavy form. At the end of the relaxation time, the samples are treated in a dilute acid solution to neutralize the alkali and finally rinsed.

The seersucker effect has usually been judged quantitatively by measuring the percentage shrinkage of the length of the printed stripes. Obviously, this method cannot characterize the seersucker effect qualitatively as far as the wavelength and the amplitude of the wavy form are concerned. It is obvious that seersucker effects with equal percentage shrinkage can have different characteristics and appear differently. The aim of this research was to develop a new method capable of characterizing the 3D seersucker effect qualitatively. To fulfill this task, with regards to the periodical nature of the seersucker effect, Fourier transform derivatives, namely, spectral density function and angular power spectrum function were employed and different Seersucker effects analyzed. To the best of the authors' knowledge, this has not been done before.

Theoretical background

Image

In image processing, an image is defined in two domains, namely, spatial and frequency. In the spatial domain, the image shows the variation of lightness and color of every pixel (single point) of the object. In the frequency domain, image is formed through a spectrum of different frequencies (Pratt, 2001). One can transform a frequency domain image into the original spatial domain without losing any information. This transformation can be carried out through Fourier transform. Fourier transform can process periodical and nonperiodical functions. Any periodical function with

*Corresponding author. E-mail: tavanai@cc.iut.ac.ir

ISSN 0040-5000 print / ISSN 1754-2340 online

DOI: 10.1080/00405000802399536
http://www.informaworld.com