A Study on Low Stress Mechanical Properties of Denim Fabric for Hand Evaluation

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Abstract

Denim is widely used by every age of people all over the world. As the use of denim is increasing progressively, till now the handle properties of denim fabric not reported at significant level. In the present study, five commercial denim fabric samples were used. Denim samples, weighing from 8.5oz/sq.yds to 14.5 oz/sq.yds, were processed as per standard commercial procedure for denim finishing. These finished denim samples were tested on Kawabata Evaluation System (KES) for low stress mechanical properties. The results of KES values are used for calculation of Total Hand Value (THV) using equation for summer suit. The obtained result for THV using equation for summer suit for denim samples is in the range from 1.62 to 3.30.These values of low stress mechanical properties values given by KES, can be used to engineer the denim fabric for bottom wear.

Keywords: Denim, Handle Value, KES, Objective evaluation

INTRODUCTION

The fabric production is known for more than 6000 years. However, the investigation in the area connected with perception of textiles during their contact with a skin started about a hundred year ago [1]. Clothes, which are used in direct contact with the human body, are mostly made of fabrics of planar fibre construction, that is, they are manufactured for the most part from textiles. Needless to say, the quality of clothes directly affects both the human mind and body. For this reason, it is essential to have a system which allows us to accurately and thoroughly evaluate the qualities and use-value of textiles [2].The “handle” or “feel” and the “drape of fabrics” are of great importance, to the user of textiles in clothing and home furnishings, as well as to the textile designer and the textile finishing mill. There is no consumer who, when buying clothing, interior textiles or evaluating upholstery of a car, has not touched the product to see what it feels like. The first attempt to evaluate the handle of textile products date back to 1926, when Binns set the beginning of systematic subjective evaluation [3,4,5].After introduction of Objective evaluation method of fabric hand from the basic mechanical characteristics of fabric was developed by Kawabata and Niwa and the objective evaluation equations are widely used for various end use such as men's or women's suits, women's fine dresses, outer or inner wear knits, and developed new equations for bed sheets, disposable diapers, nonwovens, terry towels, etc. [3,6,7,8]. However, hand evaluation for denim fabric is not reported at significant level. In this paper, subjective and objective evaluation of denim fabric is carried out.

MATERIALS AND METHODS

Materials

In this present study 49 denim samples used for the evaluation. Denim samples were collected from various denim industries in India. Samples having different weight (7.6 to 14.5 oz/sq.yds.), different finishing treatment and different yarn properties were employed for the study.A panel of 18 judges from the industry and educational institutes performed the subjective hand evaluation.

Table 1. Denim samples.

Sample weight [Oz/sq. Yards]	No. of samples
7.6 to 10	5
10.1 to 12.5	34
12.6 to 14.6	10
Total	49

Methods

Samples were supplied to Panellists one by one and asked them to rank the samples according to the intensity of feeling on the scale of 0 to 5 (5 being the best) to be used as bottom wear. Sample having following specifications is given highest rating among all 49 samples. The total sum of rating given by 18 panellists is 72.

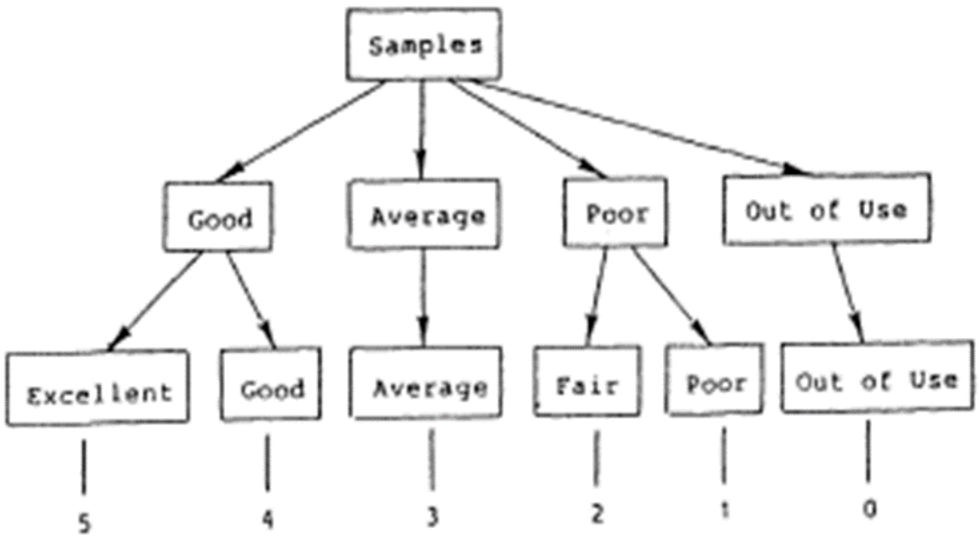

Figure1. Procedure for subjective evaluation of Total Hand Value of Denim samples.

Table 2. Properties of Highest Rated Denim Sample

Weight [Oz/sq. Yards]	10.38
EPI	72
PPI	60
Weave	3/1 RHT
Warp count	8.1^s Ring
Weft count	7.4^s OE

RESULT AND DISCUSSION

Significant test of variances was used to evaluate the level of agreement between each judge and the total mean of the remaining judges. Panellists tended to have a better degree of overall agreement among them which exhibited a higher percentage of significance, and therefore gave a higher level of overall agreement. For objective evaluation, KES-F system is used.

Table 3. Low Stress Mechanical Properties.

Tensile properties		
Linearity	LT	0.749
Tensile energy	WT [gf.cm/cm^2]	15.8
Resilience	RT [%]	43.13
Shear properties		
Shear stiffness	G[gf/cm.degree]	3.51
Hysteresis	2HG[gf/cm]	6.20
Bending Properties		
Bending rigidity	B [gfcm^2 /cm]	0.2730
Hysteresis	2HB[gfcm^2 /cm]	0.2833
Compression Properties		
Linearity	LC	0.349
Compressional energy	WC[gfcm^2 /cm]	0.301
Resilience	RC[%]	38.83
Surface Properties		
Coefficient of friction	MIU	0.207
Mean deviation of MIU	MMD	0.0249
Geometrical roughness	SMD[micron]	6.69
Weight	W[mg/cm^2]	35.36
Thickness	T[mm]	0.803

Table 4. Hand values for Winter suit (KN-101Winter).

Koshi	7.92
Numeri	3.93
Fukurami	5.30
THV (KN-301 Winter)	2.93

Table5. Hand values for Summer suit (KN-101Summer).

Koshi	8.68
Shari	5.33
Fukurami	4.85
Hari	8.68
THV (KN-301 Summer)	2.85

All the sixteen parameters describing fabric low stress mechanical properties were determined with four Kawabata instruments by prescribed procedure for sample which has been given highest mean rating by panellist. The details of KES-F test results are given in Table 3. Primary hand values and total hand values (THV) are calculated by using equations for summer suit (KN-101 Winter) and winter suit (KN-101 Winter).

CONCLUSIONS

Denim samples are evaluated for fabric handle by Subjective and objective evaluations. Following conclusions were obtained.

- Subjective evaluation of denim fabrics shows good agreement among panelists.
- Although the panelists has carried out subjective evaluations and given highest hand value rating for denim sample no.17, THV by objective evaluation for same denim sample is in the range of 3 by using summer and winter suit equations.
- Existing equation or primary hand values relations are not suitable for Denim fabric. Denim is no more a work wear fabric, however is one of the important material as for as clothing is concern and handle properties of denim is to be studied and new relationship of hand values is to be developed for denim.

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