Kawabata Evalution System For Fabric

Arsheen Moiz, Mansoor Iqbal, Aleem Ahmed and Kamran Farooq.

KAWABATA EVALUATION SYSTEM

ARSHEEN MOIZ, MANSOOR IQBAL, ALEEM AHMED AND KAMRAN FAROOQ

Applied Chemistry Research Centre (Textile Section)
PCSIR Laboratories Complex, Off University Road, Karachi-75280, Pakistan

The Kawabata Evaluation System (KES) is used to make objective measurements of hand properties. The KES instruments measure mechanical properties that correspond to the fundamental deformation of fabrics in hand manipulation. Five different tests can be performed using KES and the main mechanical characteristics produced, are described below.

The Kawabata system of instruments, featured in the fabric hand laboratory, measures properties of textile fabrics and predicts the aesthetic qualities perceived by human touch. The Kawabata Evaluation System (KES) includes five highly sensitive instruments that measure fabric bending, shearing, tensile and compressive stiffness, as well as the smoothness and frictional properties of a fabric surface. This evaluation can include measurement of the transient heat transfer properties associated with the sensation of coolness generated when fabrics contact the skin during wear. KES provides a unique capability, not only to predict human response, but also to provide an understanding of how the variables of fiber, yarn, fabric construction and finish contribute to the perception of softness. A standard specimen size of 20 x 20 cm is used in three replications. All measurements are directional, except for compression, and are made in both the lengthwise direction, and in the crosswise direction of the sample. Appropriate instrument settings are used for the material being tested.

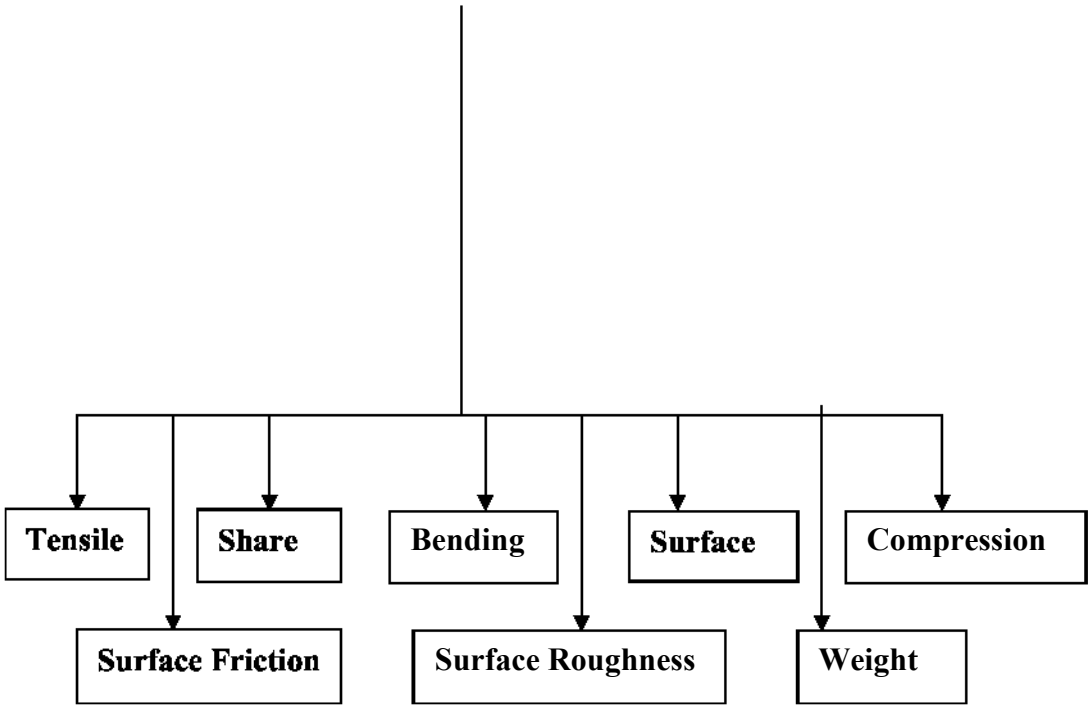
Scientifically designed protocols used to determine subjective ratings or rankings of fabric softness are also conducted in the laboratory. These studies analyze tactile response to the texture, softness, and other hand properties of fabric materials. Human panel evaluations, used in conjunction with the KES are useful for engineering desirable hand qualities into textile materials.

The system was developed by a team lead by by professor Kawabata in the department of polymer chemistry, Kyoto University Japan. The initial work started in 1968 and the system became commercially available in its present form since 1978.

The system was originally aimed at the objective evaluation of fabric hand, but the sensitivity and comprehensiveness of the tests offered by the system led to its widespread application in other areas such as product, process development process control.
The system measures fabric mechanical and surface properties at load level typical of normal handling and end-use applications. The following properties can be measured:

- Compression.
- Surface friction.
- Surface roughness.
- Bending.
- Shear.
- Tensile

KAWABATA EVALUATION SYSTEM FOR FABRIC
(KES-F)



STANDARD TEST PARAMETERS

Property Block	Symbol	Description	Unit
TENSILE:	LT:	Linearity of Extension Curve.	-
	WT:	Tensile Energy	gf.cm/cm^2
	RT:	Tensile Resilience	%
	EMT	Extension at 500gf/cm Load.	%
SHEAR:	G	Shear Stiffness	gf/cm.deg
	2HG	Shear Hysteresis (0.5 º)	gf/cm
	2HG 5	Shear Hysteresis (5 º)	gf/cm)
BENDING:	B	Bending Stiffness	Gf.cm2/cm)
	2HB	Bending Hysteresis	Gf.cm/cm
SURFACE	MIU	Coefficient of Friction	-
	MMD	Mean Deviation of MIU	M
	SMD	Geometrical Roughness	-
COMPRESSION	LC	Linearity of compression Curve.	-
	WC	Compression Energy	gf.cm/cm^2
	RC	Compression Resilience	%
	TO	Thickness at 0.5gf/cm2 Pressure	Mm
	Lm	Thickness at 50gf/cm2 Pressure	Mm
WEIGHT	W	Weight per unite area	Mg/cm^2

Measurement of the Mechanical Properties of Fabric

SHEAR:
Shear properties are measure of inter –yarn friction force, the represent the stability of fabric to withstand in plane mechanical distortion. It measured to a maximum shear angle of ± 8º.

G: Shear Stiffness OR Shear Rigidity (G, G_1).
Shear stiffness or shear rigidity are generally similar (theoretically they should be same) and the average value of (G) of G_1 and G_2 normally used. Typical G value B/w 0.6-0.9 gf.cm/dreg for suiting fabric.

2HG: Shear Hysteresis:
Measurement of energy loss during shear deformation. This energy loss is mainly caused by the years to yarn friction at cross over points.

TENSILE:
A constant tensile force I is applied to the fabric is one direction and the amount of stretch is measured. This is deformation is called" Strip Biaxial Deformation. The deformation rate is kept constant at 0.2mm/sec.

EMT:
Fabric extension at a fixed maximum load (%).
The standard maximum load for woven fabric is 500 g/cm.100%=completely elastics, 0%= completely inelastic. Higher values indicate a stretchier material.

RT: Tensile Resilience. %:
The recovery of the fabric after extension when the applied force is removed. A higher value indicates greater recovery from having been stretched.

LT: Linearity of Load -extension curve:
This parameter is a measure of the deviation of the load - extension curve straight line.

WT: Tensile Energy, (gf.cm/cm^2)
Represent the energy required to extend a fabric to the fixed maximum load.

COMPRESSION:
Compression properties of a $2cm^2$ area are measured from 0.5to 50gf /cm^2.The sample is placed on the bottom plate and plunger comes down at a constant rate (0.02mm/sec) and compresses the sample. As soon as the compressional force reaches the upper limit force (50gf/cm^2) the plunger reverse back to its original position.

LC: Linearity of Load -Compression Curve.
This parameter's a measured of the deviation of the load thickness curve from a straight line.

WC: Compression Energy, gf.cm/cm^2

Represent the energy required to compress the fabric to be prefixed maximum load level.

RC: Compression Resilience, %
The extent of recovery, or the regain in the thickness, when the force is removed. Higher values indicate a better recovery from being compressed.

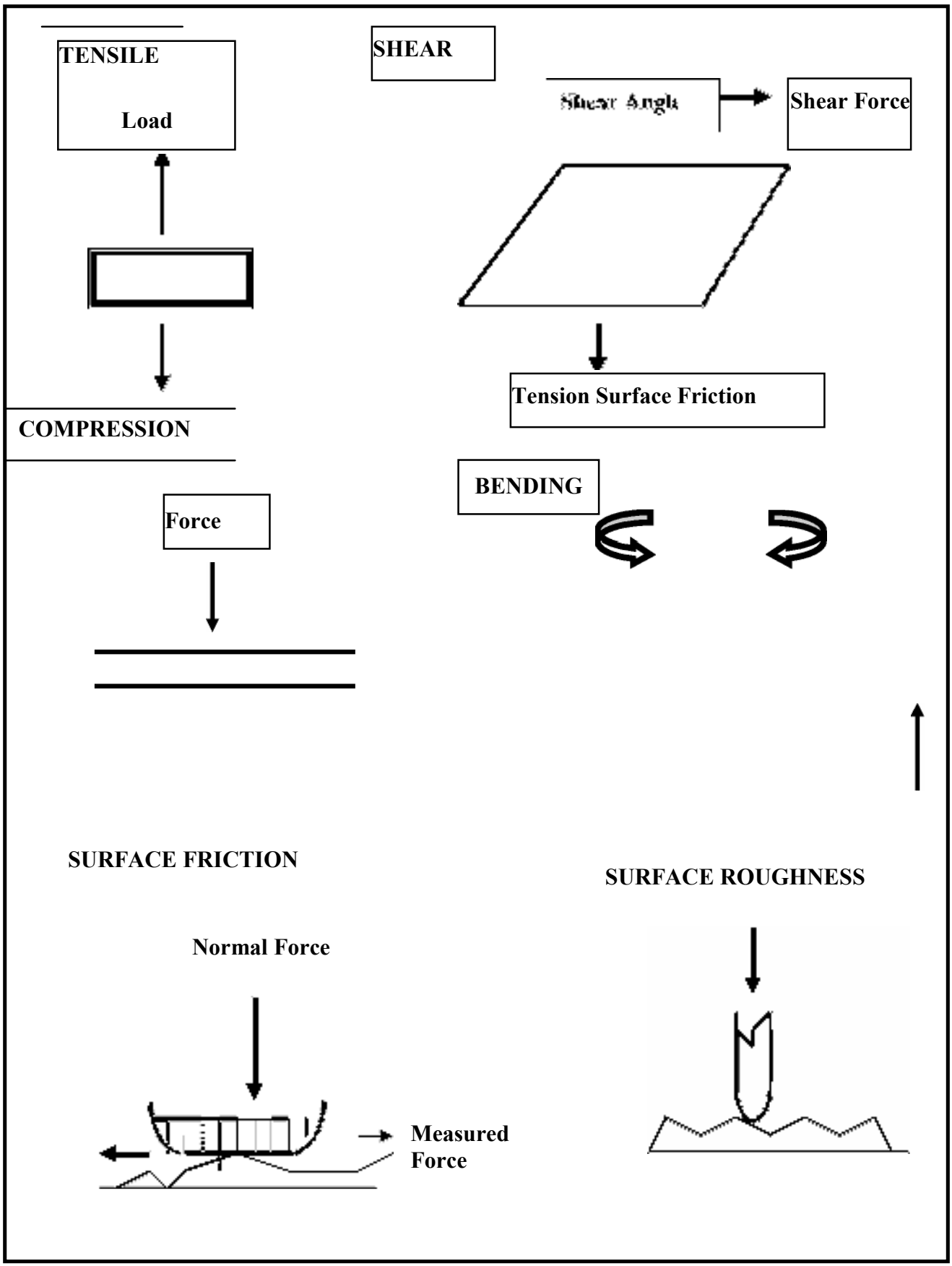
TO: Thickness at 0.5gf/cm^2 pressure, mm TM: Thickness at 50gf/cm^{2}pressure, mm**.**

SURFACE:
To measure surface friction a sensor, which was designed to simulate the human finger, is placed on the fabric surface Appling a total load at 50gf. To measured surface roughness a vertical sensor touches and fabric with a constant force of 10gf.

MIU: coefficient of friction, 0 to 1 values.
Measures the resistance/drag of the sample. Higher values in indicate greater friction, resistance and drag.

MMD: Mean deviation of the coefficient of friction.

SMD: geometrical roughness (~m)
Measure the surface contour, a higher values indicates a geometrically roughness surface.


TENSILE
Load
SHEAR
Shear Angle
Shear Force
Tension Surface Friction
COMPRESSION
Force
BENDING
SURFACE FRICTION
Normal Force
Measured Force
SURFACE ROUGHNESS

Application of KES System

Hand of Textile Materials (Including Tissues)
By the examining the process of how people judge the hand of fabric and other textile materials close correlation between subjective judgment and objectively measured mechanical properties have been established. Using these correlations, the various hands of fabric (e.g. fullness, smoothness and stiffness) can be calculated based on objective materials. As a result, numerical hand standards can be set (and have been set in some sectors) and the hand of textile materials can be compared and controlled objectively.

Drape and other Fabric Performance:
Fabric drape and other end-use performance can also be predict from objective measurement. These offer great opportunities in quality control and development.

Product and Process Development:
The development of silk like polyester fabric in Japan is one of the most famous applications of KES. The KES was used to explain the difference b/w silk and ordinary polyester fabric. A caustic weight reduction process was then developed to bring the fingerprint of polyester fabric close to that to silk. The Japanese's are now the dominant player in this silk like fabric polyester market.

Fibre and Yarn Related:
Investigation and controlling the influence on the hand and other performance of fabric by various fibre and yarn related factor such as.

- Fibre type and fibre blend ratio
- Fibre fineness and crimp levels.
- A yarn count and twist.
- Different spinning processes and yarn process consistency of yarn properties.

References:

1-Lecture notes from Manchester textile Institute.
2-Principal of textile testing, E.P.Booth.
3-Textile testing and quality control, Grover.
4-Physical testing of textile, Savila, Woodhead Publisher.
5-Fabric testing, Woodhead Publisher.