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DEVELOPMENT OF COTTON FABRIC FRICTION CALCULATOR: NEW DEVELOPMENTS

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Abstract

A multidisciplinary approach has been followed to derive and automate the calculation of the fabric friction factor. Visual Basic programming language has been used to develop the software to calculate the novel fabric friction factor. The logic and the approach followed in deriving the fabric friction calculator is elaborated in this paper.

Introduction

Friction of fabrics plays an important role in determining the overall quality of fabrics. Friction in polymeric textiles is a complex phenomenon. Most recently, a major upsurge in research on the frictional characterization of textile materials has taken place primarily due to the need for a simple, reliable and logical method to objectively quantify the friction of fabrics. Recent research at Texas Tech University has resulted in the development of a normalized friction factor, R. The normalized friction factor averages the effect of normal loads on the friction values. Furthermore, it enables the characterization of friction of fabrics using a single composite factor. The calculations that are needed to derive the friction factor are cumbersome. To enable the calculations to be simple, a Visual Basic Application (VBA) based software has been developed. This software automatically calculates the friction factor and outputs the results. The present paper elaborates the procedure behind the development of the friction factor calculator software.

Friction Factor Calculation

The friction force-normal load relationship in polymers and textiles can be conveniently represented using Equation 1.

Friction Force – Normal Load Relationship

The nonlinear relationship between the friction force and normal load can be represented by the following power equation:

$$F/A = C\,(N/A)^{n} \qquad (1)$$

where,
F: Friction force in Newton;
N: Normal applied load in Newton;
A: Apparent area of contact in m^2;
C: Friction parameter in Pascal to the power 1-n [(Pa^{1-n})] and
n: Friction index (non-dimensional)

The frictional parameter, C and the friction index, n are obtained by solving the Equation 1. These two values are then used in Equation 2 to obtain the normalized friction factor, R.

Normalized Friction Factor [R]

$$R = C/n \qquad (2)$$

where,
C: Friction parameter in Pa^{1-n}
n: Friction index and
R: Friction factor in Pa^{1-n}

The normalized friction factor, R takes into account the surface mechanical properties and the material characteristics of the material. The composite factor gives the cumulative value of the frictional properties of textile materials.

Experimental Methodology

The static and dynamic friction forces over a range of different applied loads are obtained using the sliding friction apparatus as shown in Figure 1. A standard sled rubs the surface of the fabric as the crosshead of the tensile tester moves up. The fric-

tional interactions between the fabric and the sled are recorded by the load cell, which registers the friction force values. The friction force values are then used to calculate the friction factor.

User Friendly Friction Factor Calculator

As briefed in the introduction of this paper, the calculations involved to solve Equations 1 and 2 are cumbersome and involve some training in mathematics. The user-friendly software developed automatically calculates the friction factor from the friction force values. The software is written in Visual Basic 6.0 programming language. The overall "Calculator" software is built with different forms: 1) Input form, 2) Output form, 3) Search form and 4) Help form. The major steps that are involved in the software implementation are:

a) Step 1: Entering the static and kinetic values obtained from the friction tester.
b) Step 2: Calculation of the friction factor - the built-in code does this process automatically and
c) Step 3: Storing and the presentation of final results.

Figure 2 shows the Input screen of the software. The output screen is shown in Figure 3. The software is very user friendly and has "Search" options. The "Search" screen is shown in Figure 4. In addition, the software also has help menu (Figure 5).

Conclusions

The user-friendly Visual Basic based software developed is a simple and practical solution to the complex issue surrounding the frictional characterization of textiles. The software is helpful for people untrained in techniques as the data entry errors are displayed then and there avoiding further errors and complications. More importantly, the software is easy to install and handle.

Acknowledgements

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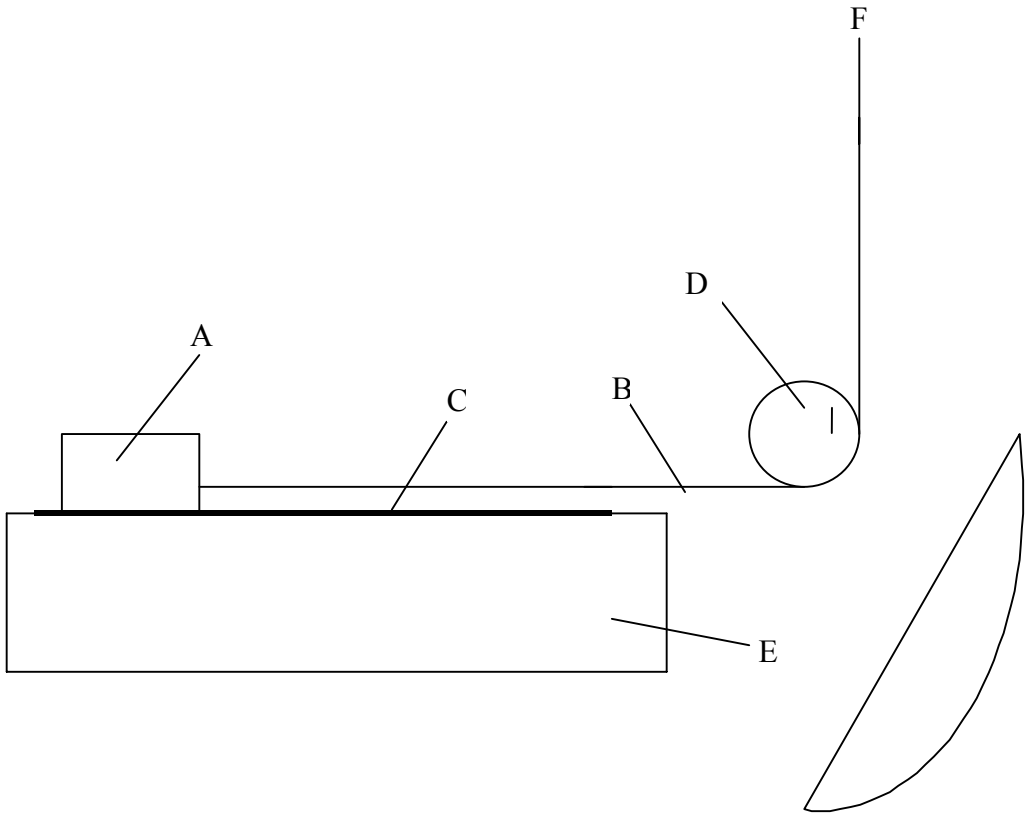

A – Steel sled; B- Nylon thread; C- Fabric; D- Pulley; E- Steel base; F- To tensile tester crosshead.

Figure 1. Sliding Friction Apparatus.

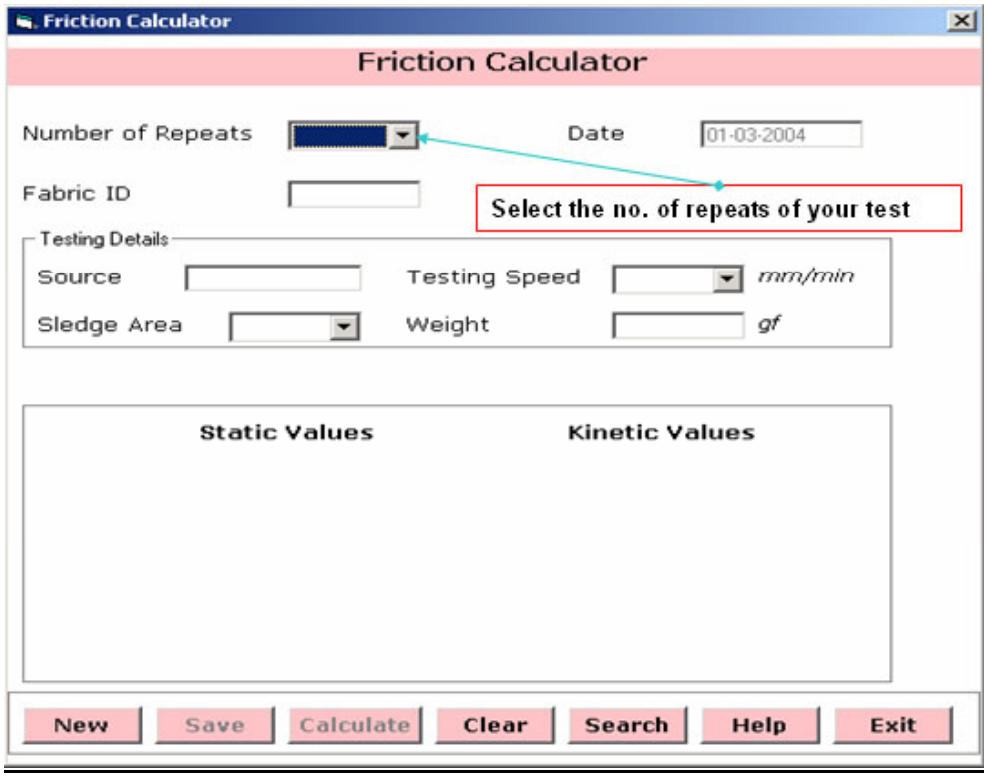

Figure 2. Snap Shot of the Input Screen.

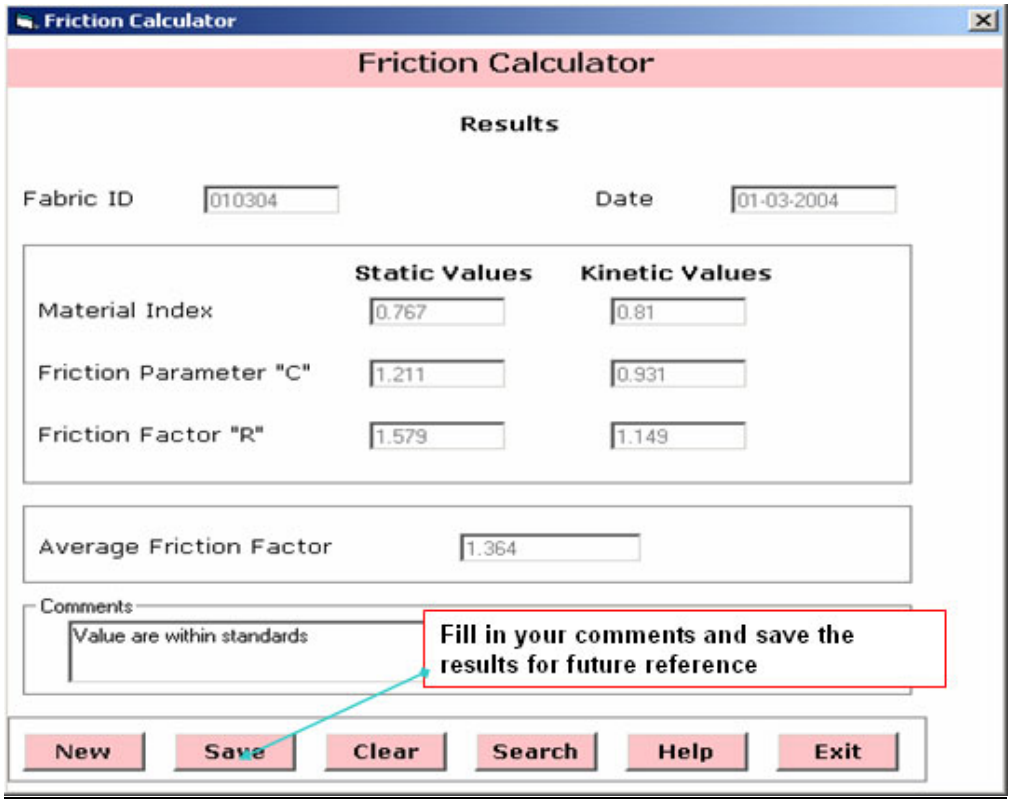

Figure 3. Snap Shot of the Output Screen.

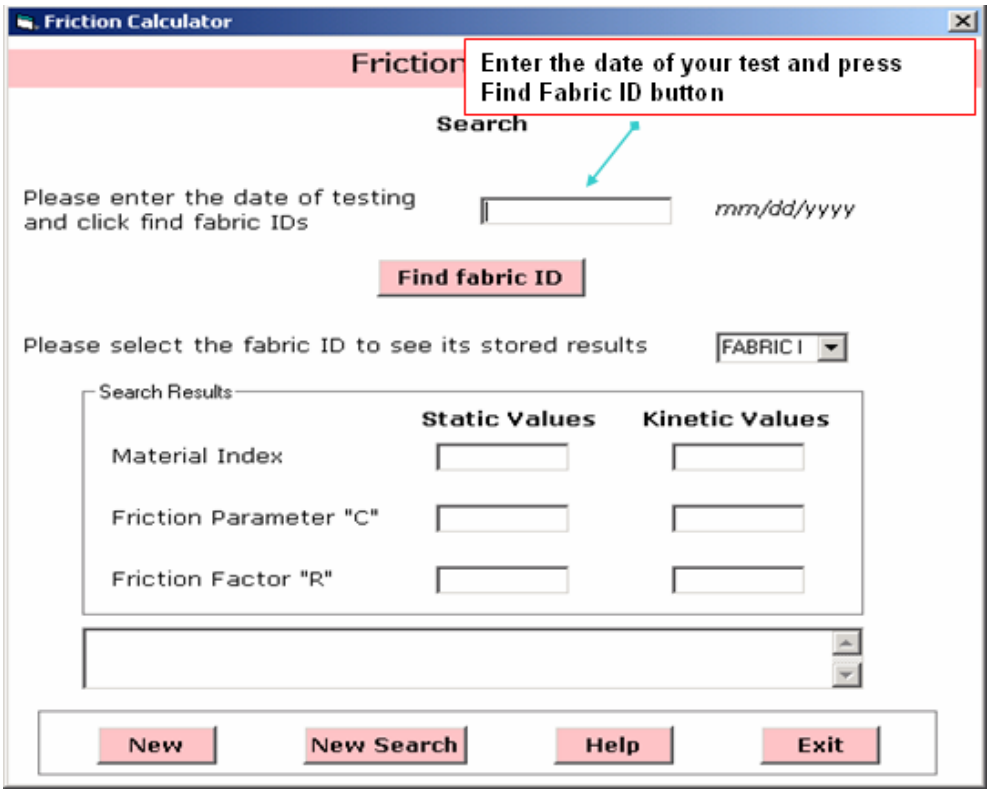

Figure 4. Snap Shot of the Search Screen.

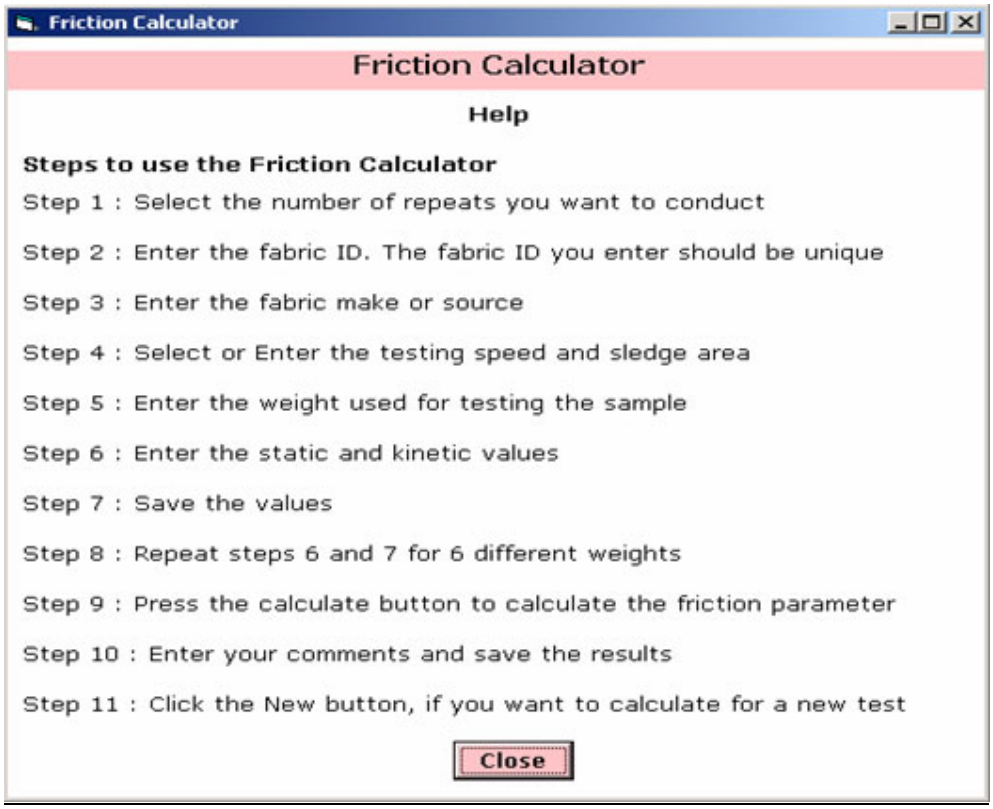

Figure 5. Snap Shot of the Help Screen.