A RELIABLE METHOD TO PREDICT FABRIC LIFE

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MINIMIZING THE WEAR RATE OF FABRIC CAN DRAMATICALLY IMPROVE A MILL'S OVERALL COSTS.

IN THE MIDST OF INCREASED PAPER MACHINE SPEEDS, more rigorous cleaning activities, and the addition of more abrasive fillers, there remains the ever- increasing demand for machine clothing to endure longer life cycles, or at least maintain current ones. A major challenge for clothing manufacturers is the development of a method to reliably describe the wear rate of forming fabrics.

In our search for opportunities to assist the papermaker in minimizing the wear rate for each machine, it has been useful to calculate wear constants during the run of a particular piece of clothing, rather than wait until end of life to perform a "post-mortem" of the fabric. The method described in this paper provides a useful way to calculate wear constants on the run, which is an effective tool for improving forming fabric life.

FABRIC WEAR RATE

Fabric wear is primarily a result of drag, lubrication, and abrasiveness between the fabric's machine side and the various machine components—foil units, low-vacuum drainage units, high-vacuum drainage units, wire return rolls, etc.—which the fabric contacts. The highest wear rate usually is associated with the high-vacuum drainage units of the forming section, where drag loads usually are highest.

It is both interesting and useful to note that the wear rate can be related to the time the fabric has run on the machine in a predictable manner. Because of this fact, wear information can be obtained and the rate of wear can be calculated. With this information, the papermaker can reduce the calculated wear rate and begin to improve clothing life.

The fabric wear rate equation

The wear on a fabric follows a parabolic relationship to the days the fabric has run[1]. The equation (Eq. 1) is as follows:

$$\%W = k(t)^n \qquad (1)$$

where

%W = *the measured percent wear of the fabric*
k = *the calculated wear rate constant*
t = *the days the fabric has run on the machine*
n = *(related to the design type of the machine) is usually between 0.4 and 0.5.*

Notice that the wear on the fabric is close to being proportional to the square root of time. This makes sense when considering the factors of fabric wearing are considered. When the fabric is very new, its caliper changes much more quickly than when the fabric is older. Papermakers who have monitored fabric calipers closely have known this for a long time. The percent wear (%W) part of the equation can be calculated in a number of ways. This method proposes a simple approach that will be discussed shortly.

As stated earlier, the objective of this paper is to help the papermaker improve life by reducing the rate of fabric wear, so we will use Eq.1 to calculate wear constants, or k's. For this approach, it is best to rearrange Eq. 1 to read:

$$k = \%W/(t)^n \qquad (2)$$

We now have a convenient formula for calculating fabric wear constants. We'll call this Eq. 2.

Example

The method of calculating wear constants begins with obtaining fabric calipers, as the fabric wears on the machine. From this point, it is simple to determine k. To calculate %W, obtain the new and suggested removal caliper from your fabric supplier. The %W calculation is measured by formulating a ratio comparing wearing and new caliper to the removal and new caliper. The wearing

[1] Private communicatons, Sam Baker of JWI Ltd.

Given: Fabric caliper as new = 0.0350 in.[i]
Removal caliper = 0.0275 in.[ii]

Measured: Caliper vs. time
Calculated: %W and wear constant, *k*

Caliper (in.)	Days run	%W	
0.0350	0	0.0	
0.0320	14	40.0	
0.0310	28	53.3	k = 14.2
0.0300	42	66.7	
0.0298	56	69.3	n = 0.4
0.0295	70	73.3	
0.0289	84	81.3	
0.0284	98	88.0	
0.0277	112	97.3	
0.0275	126	100.0	

From these data, you can solve for *k* and *n*, obtaining
$\%W = 14.2t^{0.4}$

[i] and [ii] provided by fabric supplier

1. Percent wear (%W) example and wear constant, k

caliper is, of course, the fabric caliper measured by the mill at some known time (*e.g.*, a machine shutdown). By this definition, %W can be obtained by the following relationship (Eq. 3):

$$\%W = \frac{(\text{New caliper - wearing caliper})}{(\text{New caliper - removal caliper})} \times 100 \qquad (3)$$

Table 1 displays data obtained from a machine for this example.

By conducting continuous fabric caliper measurements, mills can establish values for n and k. Historical data will help the mill determine which variables—such as fabric design, wet-end operating configuration, stock changes or equipment changes—have a significant positive or negative effect on wear rates. Furthermore, it may be possible to detect changes in machine wear rates from deviations in well-established caliper loss curves—for example, when a bad lot of abrasive filler is introduced to the stock system.

To conclude, a rigorous program to reduce the wear rate of forming fabrics can dramatically improve the mill's overall costs. A very good method to improve fabric life is to reduce the fabric wear rate (*i.e.*, k). The method described in this paper provides a way of calculating a wear constant, k. A vigorous effort to reduce the wear constant can greatly increase the mill's average fabric life. For example, a wear constant of 17 would have about an 80-day fabric life, while a wear constant of 14 would yield about 125 days of usable fabric life. The outlined method will help the papermaker improve clothing life simply by measuring fabric caliper and calculating the corresponding wear constant. **TJ**

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