EXPERTIP

Category	FORMING
Keywords	Forming fabric, fabric life, wear rate, removal of caliper, wear constant, cycles run

Tips for Calculating and Monitoring the Wear Rate of a Forming Fabric

Increasing machine speeds, more rigorous cleaning activities, and the addition of abrasive fillers all place new demands on machine clothing. One of your goals is to extend your forming fabric's useful life (or at least maintain the current life cycle even with these ever-increasing demands).

To achieve this goal, you need a reliable method to describe, measure, and monitor the wear rate of machine clothing.

Measuring Fabric Wear

There are four main methods to measure and describe forming fabric wear. You should become familiar with the method that your clothing supplier uses so you can talk with the same language. The four methods are:

1. **PCA METHOD:** This method calculates the fabric wear based on the amount of diameter loss on the running surface wear strands and a wear factor depending on the style of fabric; e.g. single layer or double layer or SSB.
2. **STRAND DIAMETER:** Wear can also be expressed as a % loss in the diameter of the strand. While this defines what percentage of the strand has worn away, it gives you no guidance about the margin of safety.
3. **CALIPER LOSS:** Fabric wear is often reported as caliper loss expressed as a percentage. The advantage to this method is that you can measure caliper of the fabric while it is on the machine, giving you a real-time indication of fabric wear. However, it does not necessarily offer any guidance on the margin of safety, or indicate when a catastrophic failure might occur.
4. **REMOVAL CALIPER:** This method measures and calculates the removal caliper or critical caliper based on two independent factors:
    a. The wear on the bottom surface CD strand; the fabric is considered worn out when 90% of the bottom surface CD strand diameter has been worn away.
    b. The wear on the bottom surface MD strand; the fabric is considered worn out when 50% of the bottom surface MD strand diameter has been worn away.

Depending on the topography of the wear surface, the CD strand or the MD strand may wear out first and since it takes this into account it is the best method for generating a wear rate curve. Like Caliper Loss, this method can be performed while the fabric is on the machine. The calculation of the wear rate is as follows:

$$\%\ Fabric\ Wear = \frac{New\ Caliper - Wearing\ Caliper}{New\ Caliper - Removal\ Caliper}$$

Note: The New Caliper and Removal Caliper figures can be supplied by the fabric supplier.

Creating Your Fabric's Wear Rate Curve

Plotting a wear rate curve helps you quickly visualize and monitor the life of your forming fabric. Once the curve has been created, it is easy to monitor changes -- both positive and negative.

The wear rate on a forming fabric is plotted as a power curve with respect to running time, since forming fabric wear is a constant volume loss process, not a constant caliper loss process. This explains why the caliper of a new fabric changes much more quickly than the caliper of a fabric that has been running for a while. Figure 1 shows slices of equal volume of a typical forming fabric wear surface at 20, 40, 60, 80 and 100% wear volume loss; figure 2 shows a plot of the data.

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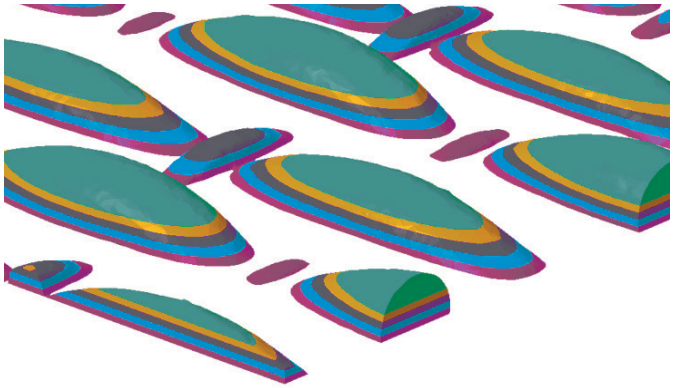

Figure 1. Each layer of colored slices represents the same wear volume.

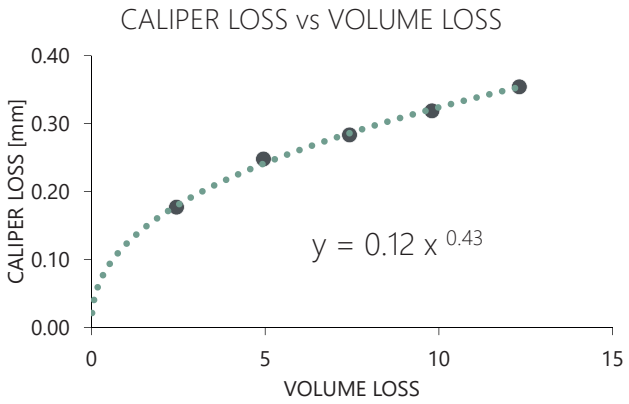

Figure 2. Plot of caliper loss against volume loss shown in Figure 1.

The equation for fabric wear as a function of caliper loss is:

$$\%\, W = k \times t^n$$

where

- *%W* is the percent wear of the fabric (measured value)
- *k* is the wear rate constant (calculated)
- *t* is the time (days or cycles) that fabric has run on the machine
- *n* is usually between 0.4 and 0.5 (related to machine configuration and design)

To manage fabric life, the goal is to reduce the rate of wear. By taking caliper measurements at regular intervals and using a spreadsheet to calculate the power curve, you can establish your values for k and n. Smaller values for k and n mean slower wear rates; i.e. fabrics last longer.

A sample wear rate curve for seven different fabrics run on a particular machine is shown in Figure 3. Once you create the curve, it is very easy to evaluate if a change in fabric design or a machine component has been positive (F) or negative (G). Historical data will help you document which variables – fabric design, wet-end operating configurations, stock changes, equipment changes – are having a significant effect (positive or negative) on forming fabric wear rates.

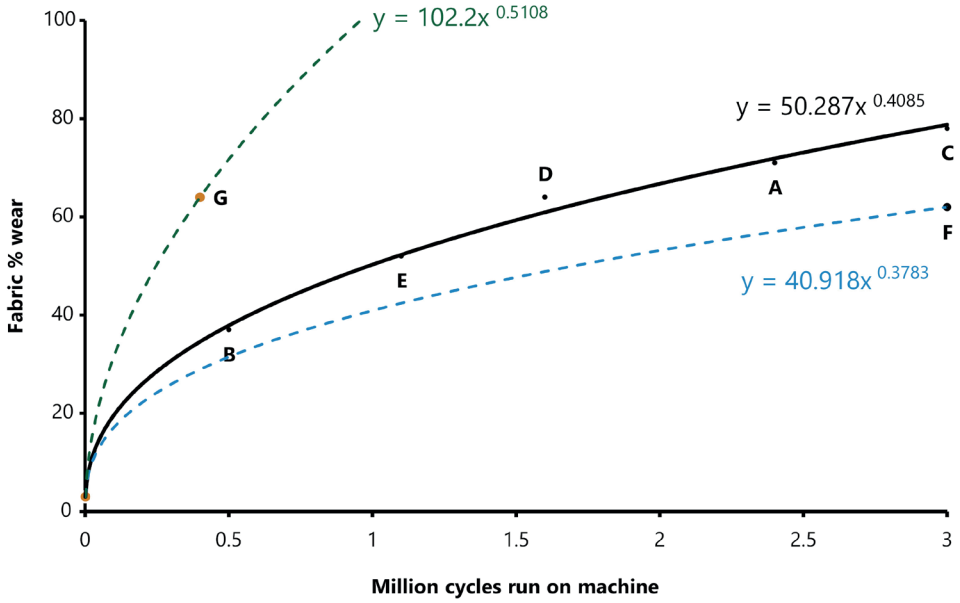

Figure 3. Plot of seven (A-G) consecutively run fabrics

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Table 1 shows a typical series of fabric caliper measurements taken near the edge over the life of a fabric; the data is plotted in Figure 4.

Note that the % Wear Volume column cannot be calculated from fabric caliper measurements but requires data from 3D micro tomography scans of the fabric and is shown only to illustrate the difference between caliper loss and volume loss. When plotted against the run time (gold points), it has a linear relationship with time.

TABLE 1. % Wear Example and Wear Constant k

Given:	Fabric Caliper New = 0.889 mm Critical Caliper = 0.699 mm
Measured:	Caliper vs. Time
Calculated:	% Wear and Wear constant k, n

Caliper [mm]	Time [Days]	% Fabric Wear	% Wear Volume
0.889	0	0	0
0.813	14	40	12
0.787	28	53	24
0.762	42	67	40
0.757	56	69	44
0.749	70	73	50
0.734	84	81	63
0.721	98	88	75
0.704	112	97	94
0.699	126	100	100

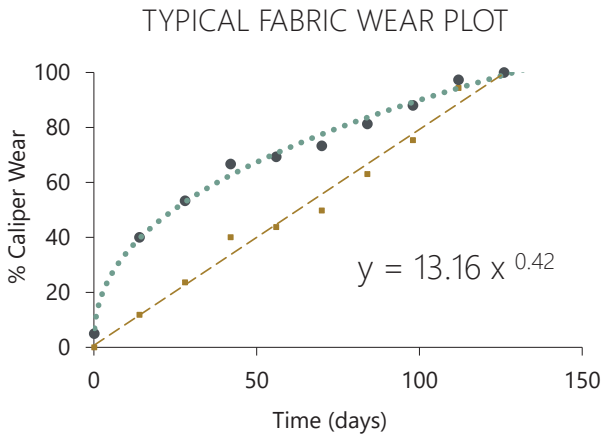

Figure 4. % Wear vs Time.
Wear curve coefficients: k = 13.16, n = 0.42.

Days Run vs Cycles Run

The term most frequently used for describing forming fabric life is "Days Run." While this terminology may be useful for accountants (because it easily converts to cost), it does not convey much useful information about the efficiency of various components in the forming section. Also, "Days Run" does not permit comparison between different positions and different machines.

A more useful and informative measure of fabric life is "Cycles Run." A cycle is the number of revolutions of the fabric around the machine. This is important since it describes how many times the forming fabric has had contact with the surface of each machine component during its operating life.

"Cycles Run" takes account of the machine speed, which has a very direct effect on fabric wear, as well as the fabric length, which is also very important and frequently overlooked. "Cycles Run" is determined as follows:

$$Cycles\ run = 1440\ mins \times life\ (in\ days) \times \frac{Fabric\ Speed\ (m/min)}{Fabric\ Length\ (m)}$$

An accurate and repeatable method for measuring and monitoring wear rate will give you a better understanding of the main factors influencing forming fabric life. A disciplined program to reduce the wear rate coefficients (k and n), which is key to improving forming fabric life, will improve your mill's costs and the fabric's performance on your machine.

Visually Estimating Fabric Wear

Sometimes it is not possible to obtain accurate caliper measurements of the fabric caliper. In these cases, a visual examination of the fabric wear side using a microscope can be used. By comparing the visual appearance of the fabric wear surface through the microscope to a library of reference images (Figure 5) provides a good estimate of the wear level and indicate if the fabric is approaching the removal or critical caliper.

Depending on the structure of the fabric, the wear levels of the CD and MD yarns can be quite different when the removal caliper is reached. Recall that the determining factor for fabric removal is either 90% wear on the CD yarns or 50% wear on the MD yarns whichever occurs first. Figure 6 shows three different scenarios at the removal or critical caliper.

A note of caution: the removal caliper quoted by the clothing supplier generally assumes that all of the fabric wear occurs on the bottom side of the fabric. In many cases, there is some degree of top side wear and in SSB fabrics, internal wear that can be quite significant. This is why it is always a good idea to examine both sides of the fabric with a microscope when determining the amount of life left in a fabric.

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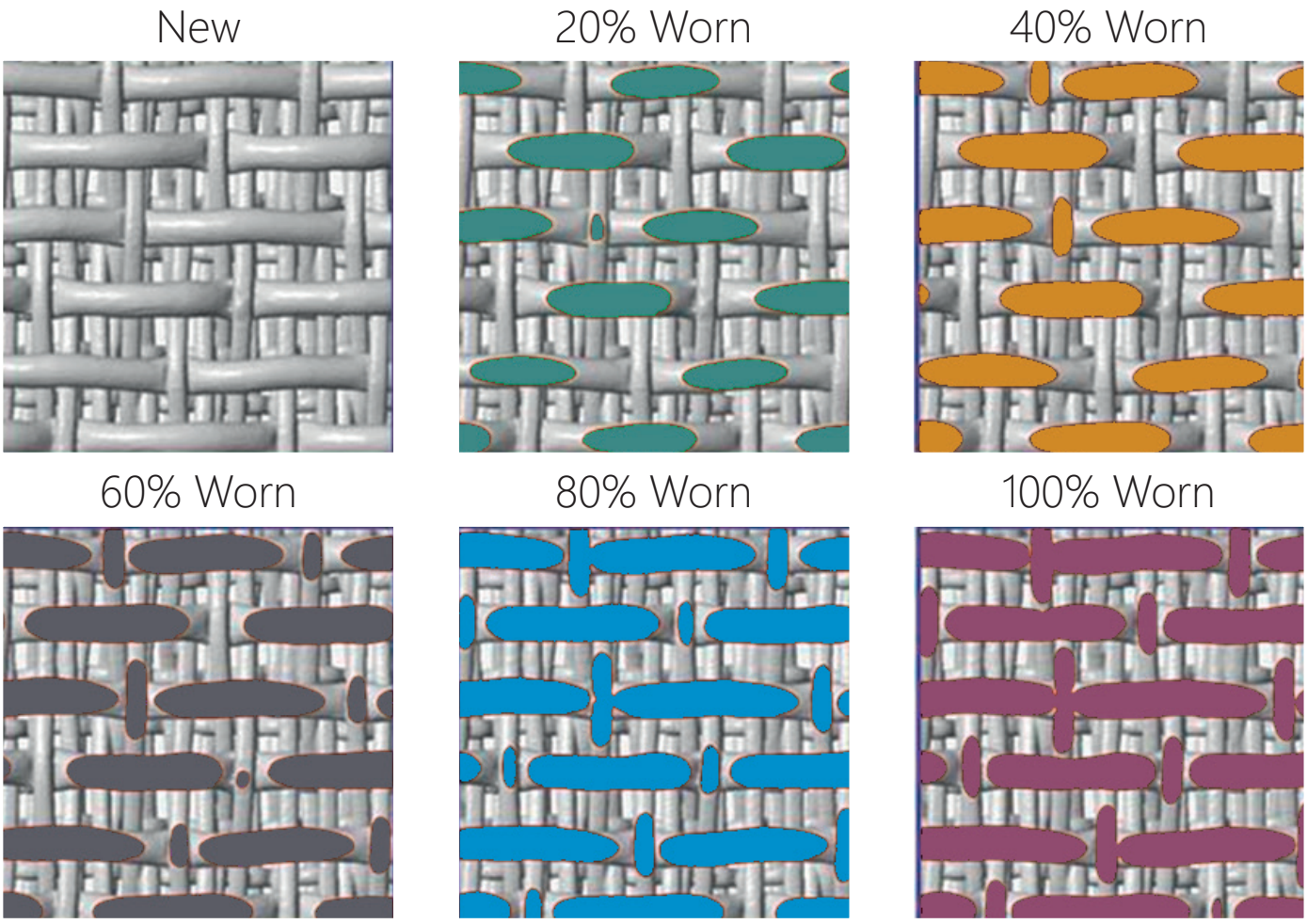

Figure 5. Wear Level Reference Images

Figure 6. Visual Estimation of Wear Levels

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Got Questions?

We are here to help. We distribute **ExperTips** to help you improve the performance of your paper machine. Not just fabric performance, but the overall efficiency, reliability, and productivity of your mill.

If you have questions about anything you see here, please contact us by emailing **expertip@astenjohnson.com** or visiting our website **www.astenjohnson.com/expertips**.

And, if you have suggestions about other topics you would like to receive an ExperTip on, we would love to hear from you!

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