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Converting operations: Troubleshooting slitter blade wear

A trouble-shooting guide for shear slitting systems can avoid application of unnecessarily costly solutions to relatively simple problems.

Part I: Blade-to-blade wear

As slitter blades wear, distinct patterns develop on the blade edges depending on the nature of the wear mechanism. By examining these wear patterns, you can identify how blades interface with the web and each other. Appropriate action is then possible with minimum guesswork and experimentation.

Blade wear fits into two broad classifications:

- Wear caused by the material being slit.
- Wear caused by the blade-to-blade interface.

This article will focus on blade-to-blade wear. Part II, to be published in the May issue of ***Solutions!***, will discuss web-to-blade wear.

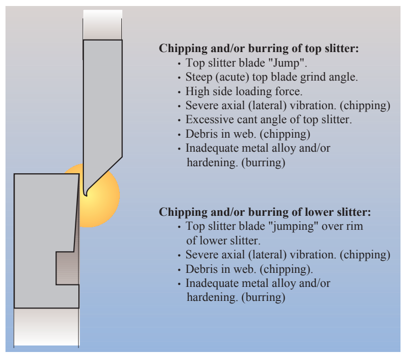

Figure 1: Slitter blade wear. Chipping and burring.

BLADE-TO-BLADE WEAR

The typical polished "wear band" seen on the contact faces of blades shows blade-to-blade wear. It is the result of two blades rotating in contact with each other. Closely related is blade-to-blade damage usually evidenced by chipped or deformed blade edges. This wear results from relatively high mechanical forces exerted at the metal interface between blades. Blade-to-blade wear leaves a distinctive "signature" on each blade, such as a rapidly forming bevel or concave wear band on the contact faces of a blade. Subclassifications of blade-to-blade wear follow distinctive pattern profiles:

- A chipped or burred blade edge (**Fig. 1**)
- A plane, straight wear surface (**Fig. 2**)
- A concave wear surface (**Fig. 3**)
- An elliptical wear surface (**Fig. 4**)

The shape of the "wear band" on the contact faces of slitter blades reveals how the two blades have interacted. If the wear band is a smooth, straight, plane surface, the blades are running smoothly—the wear is normal and uniform. This usually indicates normal wear due to blade overlap, with relatively few additional problems.

If the wear band is concave, problems exist. Look for excessive blade sideloading, excessive vibration, excessive run-out, or some combination of these. Under these conditions, most metal alloys surrender quickly. Correcting the operational errors is often a better approach than experimenting with more costly alloys.

If the wear band is elliptical, radial run-out is the culprit. The wear band will be elliptical, and the rate at which the wear band develops will be excessive. This is because the unnecessary radial movement contributes to blade-to-blade wear. The phenomenon is in addition to normal wear caused by blade speed differential in traction driven slitter systems.

If the blade edges have chipping or burring, the problem is self-evident. The blades have suffered impact or excessive sideload pressure. Impact caused by blades "jumping" is a common problem. Operators know immediately when it occurs. A more subtle form of chipping and burring may occur from inadequate metal alloy, overly acute grind angles, excessive cant (shear) angles, and severe lateral vibration.

CANT ANGLES

Aggressive cant angles will cause chipping between the blades and displace metal in the form of a burr around the perimeter of upper and lower slitter edges. In some instances, excessive cant angle may cause a thin curl of metal to peel from a newly installed slitter blade. Harder steels are more prone to chipping. Softer steels tend to roll over, forming a burr. Angles substantially greater than 1° are especially prone to chipping and burring of the upper blade. The edge of the lower slitter may be rapidly radiused. These unnecessarily high angles greater than 1° concentrate the sideloading forces onto an extremely small "footprint" at the perimeter of the blade. The resultant stresses can be sufficiently high to

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exceed the ultimate yield strength of the metal. Chipping then results.

OVERLAP

As blade overlap increases, the blade edges cross at increasingly steep angles. Blade-to-blade abrasion accelerates. This occurs even when both blades are driven synchronously. The effect is more pronounced with smaller blades and increased overlap. This angular crossover is responsible for the typical wear band seen on the contact face of slitter blades. It forms slowly as a smooth, uniform bevel. Strictly controlling overlap to about 0.8 mm (0.03 in.), limiting overlap to 1.0 mm (0.40 in.), and using the largest slitter blades can possibly delay the formation of wear bands.

RUNOUT AND VIBRATION

All slitter blades have some oscillation or run-out that accelerates the abrasive movement between the two blades. At slow speeds, the wear may be tolerable. At high speeds, even a small amount can be troublesome and costly. Accelerated wear from run-out may be evident as a concave wear band. With extreme run-out, the wear band may also be elliptical.

Vibration in the shear system is very destructive. If the vibration has a low frequency, high energy form, severe abrasion marks may be visible on the blade wear bands. If the vibration has a high frequency, low energy form, the blades may display highly polished, concave wear bands.

GRIND ANGLE

Highly acute grind angles are vulnerable to blade chipping and impact damage against the lower slitter. In some cases, the blade edge can roll over to form a small "burr" or ridge around the blade perimeter. This occurs because less metal is present at the extreme tip edge and the contact pressures between the slitters cannot be supported without the metal yielding.

In traction-driven slitter systems, where contact pressure must be sufficiently high to ensure blade rotation, ultra-thin blades are very vulnerable. In twin-arbor slitter systems—where both arbors are actively driven—the contact pressures between blades can be much lower, and ultra-thin profiles are practical.

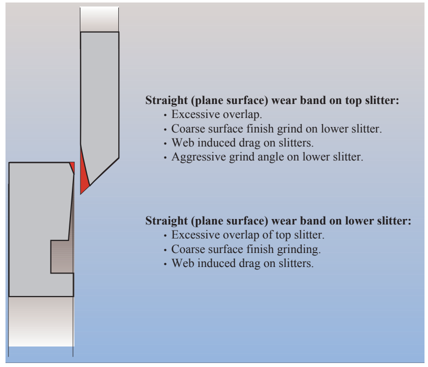

Figure 2: Slitter blade wear. Straight (plane surface) wear bands.

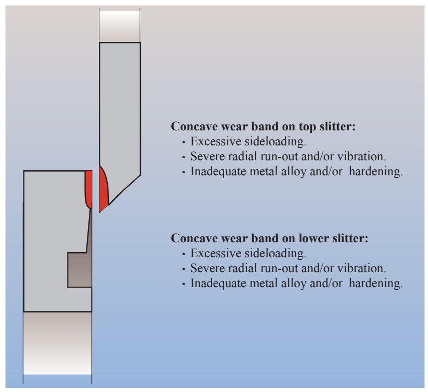

Figure 3: Slitter blade wear. Concave wear bands.

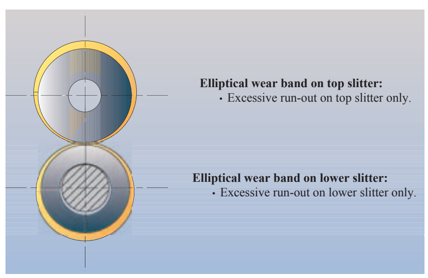

Figure 4: Slitter blade wear. Elliptical wear bands.

BLADE ALLOY

Metal hardness and alloy influence the rate of blade-to-blade wear. As hardness increases, metal strength increases and wear resistance improves. Steel blade hardness reaches practical limits at approximately 62–64 Rockwell C.

Low alloy or hardness results in rapid formation of wear bands that are concave. Under severe conditions, the edges of the blades may roll over to form a ridge or "burr." This indicates that the yield strength of the metal has been exceeded.

To improve wear resistance, the steel is usually alloyed with chromium, tungsten, or vanadium. A 12% chrome (D-2) steel typifies an economical, enhanced wear resistant steel. For even greater wear resistance, higher alloys such as tungsten or vanadium steels are best. These "tool grade" steels can better tolerate the abrasive pressures found between rotating slitter blades.

Tungsten carbide lower slitter edges have a proven history. If properly ground, they contribute to improved wearability of even the upper slitter blade. A hard coating of the upper slitter is effective in controlling blade-to-blade wear, but it is less effective for web-to-blade wear, as Part II will discuss.

GRIND FINISH

Smoother finishes have less pronounced surface variables, which distribute initial blade-to-blade contact stress over a broader surface. This reduces the rate of initial wear. Generally, a micro finish of 16 is the coarsest allowable for general converting slitting. As blade hardness or alloy increases, the surface finish should improve to 8 or better. Carbide and ceramic slitters demand glassy smooth surfaces to avoid eroding mating steel blades with alarming speed.

PROBLEM SOLVING

To determine the cause of blade-to-blade wear, look for tell-tale wear patterns that differentiate between the forms of wear. The accompanying graphics will help identify the patterns and their probable causes. After classification of the distinctive patterns, solutions will be easier to recognize and implement without resorting to "taking a stab in the dark" or applying an unnecessarily costly solution to a relatively simple problem. **S!**