TECH KNOWLEDGE

By Timothy J. Walker

Tale of the Tape

Timothy Walker is the president of TJWalker + Associates Inc, an engineering services firm based in St. Paul, MN.

TJWalker+ Associates Inc can be reached by phone, (651) 686-5400, via email at tjwalker@tjwa.com, or through his web site www.webhandling.com.

The best wrinkle prevention costs pennies. Certainly you can spend more, but before you do, first try a simple approach.

Let's say you need a mousetrap. What do you envision? You are likely thinking about the old standard: a slat of wood, a coil spring, and some other simple components. Total costs? Pennies. There are more complicated designs, but this simple design is a great starting point.

In our industry, we don't fight mice we fight wrinkles. When I say "X removes wrinkles" what do you envision? A banana roller, a spiral roller, or something more complicated? I like to start simple. I first think about tape bands on a cylindrical roller. And the cost? As promised, pennies (assuming you have the roller already).

Tape vs. Wrinkle

A wrinkle, defined here, is a web that does not lay flat while in contact with a rotating roller. Quite commonly the wrinkles are rippling, forming at one end of a roller and walking across the roller some distance before disappearing, then another one forms, and on and on. We will save why the web wrinkles for another day.

With our tape bands, we will persuade each edge of the web to track away from the center. When a web wrinkles the edges are running too close together. We want to move them out laterally. This is done with an induced bending and the rule of normal entry.

Here is the mechanism. 1) The web tracking over the larger diameter taped bands will have increased strain and tension. 2) The laterally different tensions induce a moment (or torque) on the web. 3) The moment creates a slight inward bend in the web. 4) The web's bent shape conflicts with the rule of normal entry. The result: a slight lateral displacement; displacement enough to remove the wrinkle. Got it?

Some of you probably ran out to your machines after the third paragraph, but there are a few things to consider before applying wrinkle preventing tape bands to a roller. I'm sure many of you already know this trick, but let's see if I can even help even the experienced tape dispenser.

How much tape? Where? Consider three things: traction, web strain, and roller radius.

First, the tape must have good traction with the web. We are forcing the web (using friction) to do something it wasn't planning on doing. Good traction has two components, a reasonable friction coefficient (>0.25) and enough texture to prevent air lubrication.

The tape band at the edge creates a local tension increase. How much the tension increases is dependent on roller and web properties. The tape thickness divided by the roller radius will determine the strain change created by the tape band. How much tension increases is dependent on the web's spring constant (modulus times thickness). A typical starting point is to build up the roller similar to typical webs strains, around one tenth of one percent. For a three-inch radius roller we are starting with 0.003 inches of tape buildup. Not much. Add more as needed, cautiously.

The non-uniform tension at the roller's entrance causes the web to bend subtly inward. This angled web violates the rule of normal entry (A turning roller, with good traction, will displace a tensioned web to enter perpendicular to its rotational axis). The bent web is displaced toward the larger diameter tape band.

Let's jump to the conclusions: 1.Use good traction tape. 2. Use more tape for stretchier webs. 3. Use more tape on larger rollers. 4. Only apply tape to the non-rotating roller. 5. Spiral patterns are not better. (The web does not fall for optical illusions.)

Lastly, if you like the results you get with tape, but want a more permanent solution, a similar radial change can be machined into the roller's metal or elastomeric surface with the same benefits.

Is there room for a better mousetrap, a better wrinkle fighter? Yes. Tape bands are width specific, may fall off, and won't stop all wrinkle forms. There may be better, but not simpler.