Selecting the Proper Web Handling Equipment

The following is a presentation given by New Era Converting Machinery's Bob Pasquale at a AIMCAL R2R Conference. The presentation is titled "Selecting the Proper Web Handling Equipment."

OVERVIEW

A key requirement of every web processing line is the ability to properly handle and convey the web among the various machine sections.

Though much time is typically spent focusing on the unwinding, winding, coating, drying, laminating and embossing sections, typically very little time is spent on the equipment sections that are required to allow for the proper handling and conveying of the web from section to section.

The proper handling and conveying of the web covers many areas including:

- assuring that proper web tension is provided and maintained into, out of and between the various equipment sections
- assuring that the web is provided to the next section and removed from the previous section at the proper speed/rate
- assuring that the web is delivered to the next section at the required temperature

Additionally, in certain web processing lines there is the need to change the orientation of the web, whether by:

- turning it at right angles to the main web direction
- inverting it during processing

In this presentation we will discuss the equipment that is required to allow for the above to occur. We will break the equipment into four major categories which are:

- Pull Rolls
- Heating and Cooling Rolls
- Accumulators
- Web Turns and Web Flips

For each of the above equipment categories we will discuss:

- the need for it
- the uses of it
- the factors and considerations that go into the design and selection it
- the pros and cons associated with the selection

TENSION CONTROL OF THE UNWINDING MATERIAL

The two major areas to address regarding unwind tension control are:

- The need for constant tension control
- The method of generating the tension
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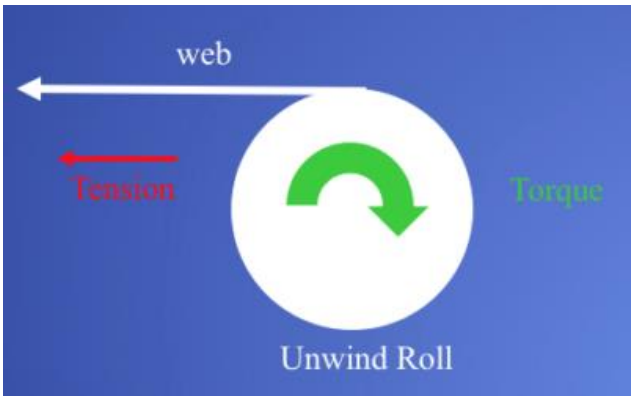
The Need for Constant Tension Control



On a center unwind web tension is applied by using a device to impart a drag on the shaft/spindle that holds the web roll. This drag force results in a torque on the unwind roll.

The torque is related to web tension through the following formula:
Torque = Force X Radius
Where:

- Force = the web tension
- Radius = the radius of the unwinding roll

Therefore, in order to keep the web tension constant, the torque needs to be adjusted as the roll size changes.

Non-Constant Tension System

A system where no adjustments are made to the drag force, resulting in a system where the web tension varies as the unwind roll diameter changes.

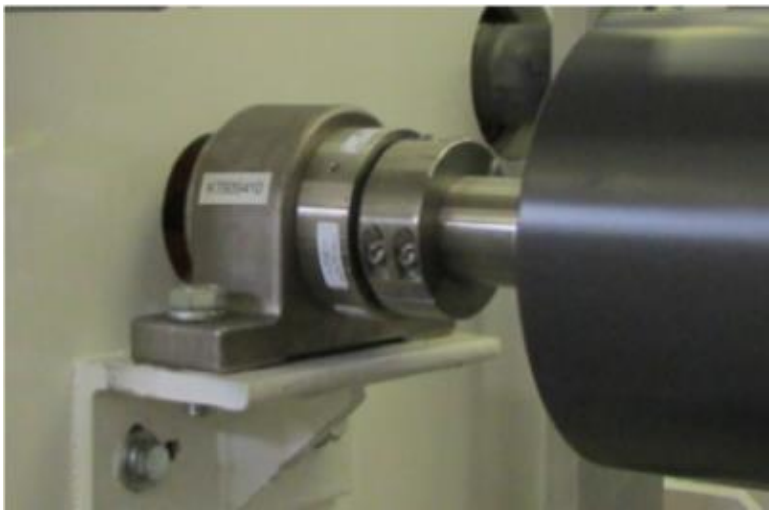
Advantages:

- Minimal cost
- Minimal maintenance

Disadvantages:

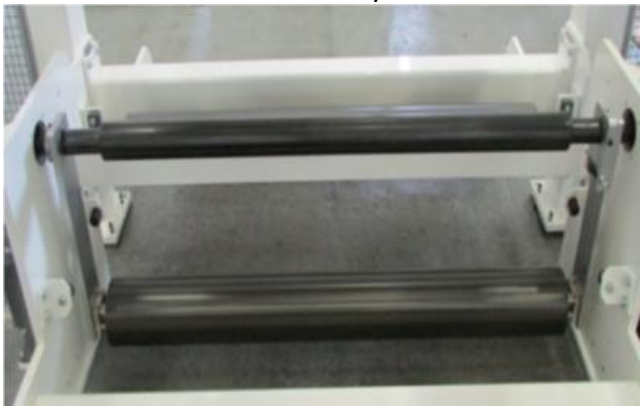
- Web tension varies as the unwind roll diameter changes

Constant Tension System*:*



Force Transducer Roll

A system where adjustments are made to the drag force as the unwind roll diameter changes, resulting in a constant web tension. This can be with no web feedback such as sonic sensor to measure the unwind roll diameter and adjust the drag force accordingly or with web feedback such as a force transducer or dancer to automatically maintain constant tension.



Dancer Roll

Advantages:

- Allows for the web to be delivered to the process under constant tension

Disadvantages:

- Costly
- Requires extra space
- Higher maintenance

Braked Unwind

The Method of Generating the Tension

One must decide on what type of device should be used to generate the web tension. Typically this is done through the use of either a brake or a motor/drive set.

Braked System

Advantages:

- Less costly to purchase, install and operate
- Easier to operate
- Minimal maintenance
- Pneumatic brakes are excellent for use in a hazardous environment

Disadvantages:

- Limited total tension range
- May be difficult to use at low tensions
- Not good for use with damaged rolls
- May not work well during roll acceleration where the acceleration force is greater than the required web tension
- Not good for applications where the web roll needs to be accelerated prior to unwinding

Driven Unwind

Motor/Drive System

Advantages:

- Greater total tension range
- Good for use at low tensions
- Good for use with damaged rolls
- Works well during roll acceleration where the required acceleration force is greater than the web tension
- Good for applications where the web roll needs to be accelerated prior to unwinding

Disadvantages:

- More costly to purchase and install, especially in a hazardous environment
- Higher maintenance
- Not good a low speeds, where reflected inertia is an issue

GUIDING OF THE WEB AS IT EXITS THE UNWIND

An important consideration is the need to guide the web as it exits the unwind. Though some unwinds are provided without the means of adjusting the web's cross machine position, most include some form of adjustment, either as a manual or automatic system.

Manual Unwind

Manual System

A manual system is where either the roll of web or entire unwind is manually shifted in the cross machine direction.

Advantages:

- Low cost
- Minimal maintenance

Disadvantages:

- No method for precision adjustment of the web location
- No method for continuous adjustment

Automatic System

An automatic system is one where the web location is continuously sensed and automatically corrected.

Automatic Unwind

This can be edge, line or center guiding and uses an actuating device to adjust the web's position by moving the unwinding roll or entire unwind in the cross machine direction, or by pivoting a roll or pair of rolls that the web passes over upon exiting the unwind to steer it to the desired position.

Advantages:

- The web is automatically guided to a precise location
- Guiding of the web is continuous

Disadvantages:

- Higher cost of equipment
- Higher maintenance

SPLICING THE EXPIRING ROLL ONTO THE NEW ROLL'S WEB

The method of joining the end of the expiring roll's web to the beginning of the new roll's web is typically dependent on:

- The web materials
- The process that the web is entering

To be considered are:

- The method of joining the webs
- The type of splice to be formed

The Method of Joining the Webs

There are several methods available to join the webs together such as:

- Pressure sensitive tapes or adhesives
- Heat and pressure activated tapes or adhesives
- Sewn splices
- Welded splices

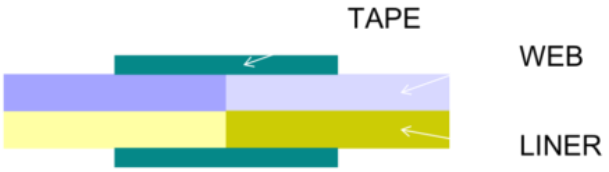
The selection of the method of joining the webs is typically dependent on:

- **The web material** – what methods of joining the webs works with the particular web material
- **The process** – what methods of joining the webs allows for the splice to survive the process conditions such as:
    - Tension
    - Moisture
    - Heat

The Type of Splice to Be Formed

The most common types of splices are:

- **Lap splice** – the expiring web's end overlapping the new web's leading edge; this is the easiest splice to perform
- **Butt splice** – the expiring web's end butts up against the new web's leading edge; this splice is more difficult to form, requiring more work and time to prepare/perform



The selection of the type of splice to be formed is typically dependent on:

- **The web material** – what type of splice works with the particular web material; an example is a web with a liner that will later be peeled on a continuous basis, requiring a two sided butt splice

The selection of the type of splice to be formed is typically dependent on:

- **The process** – what type of splice allows for the web to make it through the process; examples of this are conditions such as:
    - the double thickness of web from a lap splice will not make it through the machine
    - a hanging tail from a lap splice may result in problems

The design of the unwind should allow for the required splice to be formed.
This could range from no hardware required for the operator to form a manual zero speed splice on the roll of web to the inclusion of a special splice assembly like shown below:

Welded Splice System

Sewn Splice System

Butt Splice System

Simple Splice Table

HOW THE EXPIRING ROLL'S WEB WILL BE CUT

During normal operation it is typical that the end of the expiring roll's web, the beginning of the new roll's web or both need to be cut as part of the splicing procedure. Several factors dictate the method of cutting and cutting hardware required including:

- the web material that needs to be cut
- if the web will be moving or stationary during cutting
- if the cutting will be manual or automatic

Manual System

For some applications cutting of the web may be a simple task, performed manually by an operator using a handheld knife or scissors.

Advantages:

- Extremely inexpensive equipment

Disadvantages:

- Safety is a concern
- Web must be stopped

Automated System:

An automated cutting assembly can be integrated into the unwind system. The design of the assembly can vary greatly as shown in the examples below.


Traversing Driven Cutter


Shear System


Rupture Type Blade


Traversing Razor

Advantages:

- Allows for cutting with minimal to no operator intervention
- Minimal safety concern
- Allows for repeatable cuts
- Certain methods allow for clean cuts

Disadvantages:

- Costly to install
- Take up space in the equipment line
- Requires higher maintenance
- Certain methods can generate debris
- Certain methods can result in unclean edges
- Certain methods can result in a biased edge if the web is moving during cutting

NUMBER OF UNWIND POSITIONS

Of major consideration is the number of unwind positions that are included with the unwind. The unwind can be provided as a:

Single Position Unwind

Single Position Unwind:

An unwind designed to include a single assembly for holding rolls of web material

Advantages:

- Lower initial purchase cost
- Minimal space requirements

Disadvantages:

- Requires the process line to be stopped for roll changes
- Requires the process line to be stopped for splicing

Multi Position Unwind:

Multi Position Unwind

An unwind designed to include two or more assemblies for holding rolls of web material.
Advantages:

- Allows for new rolls of web to be loaded into an unwind position and prepared for splicing without stopping the process

Disadvantages:

- Still requires the process to be stopped to safely splice the leading edge of the new roll to the end of the expiring roll

ROLL TO ROLL VS. CONTINUOUS UNWINDING

For many operations it is not practical to stop the process line for splicing. In these applications the unwind system is designed to allow for the continuous feeding of web to the process by one of two methods:

- allowing for the web to be fed to the process continuously while the unwind is stopped
- providing a system that allows for the splicing of the new web to the old without stopping the unwind

Allowing for the web to be fed to the process continuously while the unwind is stopped:

Web Accumulator

Here a section such as a “J” box, conveyor or web accumulator is incorporated into the process line. This section is designed so excess web can been stored in it for feeding to the process while the unwind is stopped for splicing.

Advantages:

- Allows for continuous operation of the process while splices are being made at the unwind. Particularly useful when time consuming splices such as sewn or welded ones need to be made without stopping the process

Disadvantages:

- Takes up floor space
- May require a significant number of rolls to contact the web, creating scratches, static, stretching, etc.
- Does not work well with high speed operations where significant storage time is required

Providing a system that allows for the splicing of the new web to the old without stopping the unwind:

Continuous Unwind

Here the unwind is designed to allow for splicing of the leading end of the new roll to the tail end of the expiring roll without stopping the unwind. This type of system can take one of several forms but most typically features a turret unwind with an automatic splicing and cutting system.

Advantages:

- Allows for the automatic splicing of new rolls at high speeds with minimal operator intervention

Disadvantages:

- Limited to lap type splices
- Only applies to splices that are performed using tapes or adhesives

CONCLUSION

There are many different design considerations and decisions that need to be made when matching an unwind to a web process. Care needs to be taken to assure that the system is designed to maximize the operation of the process.

BIOGRAPHY

Bob Pasquale is one of the founders and principals of New Era Converting Machinery, where he serves as President. He holds a degree in Mechanical Engineering from Stevens Institute of Technology and has worked in the web converting industry since 1985. He is the holder of several patents in the industry. Bob can be reached at bob.pasquale@neweraconverting.com.