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Roll Cleaning and Web Cleaning to Reduce Defects in Film Production

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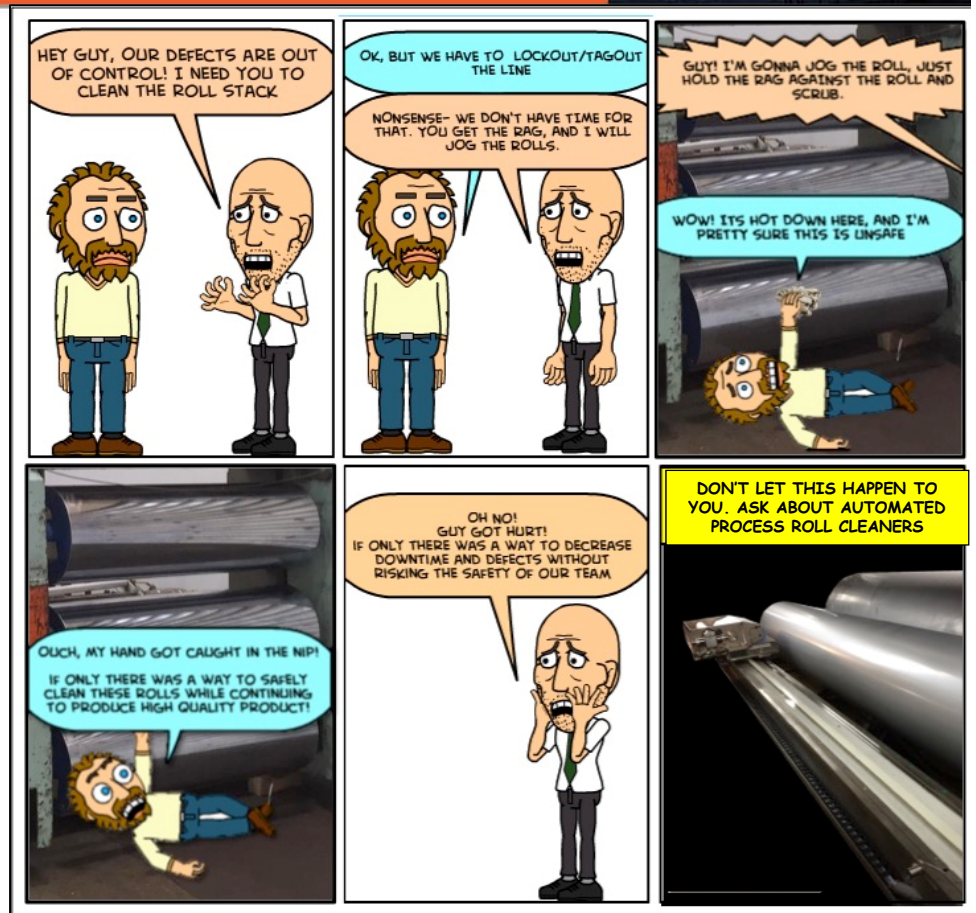
Cleaning Technology for Process Rolls and Substrates

- Safety, Quality and Productivity are paramount.
- Plate-out, condensate and buildup on rolls cause defects.
- Contamination on the substrate can impact product quality.

In this presentation we will explore the options for reducing downtime, defects and safety concerns by utilizing existing technology to cost effectively clean process rolls and substrates.

Why Clean Process Rolls?

- Defects from Buildup
- Equipment cleanliness
- Customer Specification
- SAFETY!


HEY GUY, OUR DEFECTS ARE OUT OF CONTROL! I NEED YOU TO CLEAN THE ROLL STACK
OK, BUT WE HAVE TO LOCKOUT/TAGOUT THE LINE
NONSENSE- WE DON'T HAVE TIME FOR THAT. YOU GET THE RAG, AND I WILL JOG THE ROLLS.
GUY! I'M GONNA JOG THE ROLL, JUST HOLD THE RAG AGAINST THE ROLL AND SCRUB.
WOW! ITS HOT DOWN HERE, AND I'M PRETTY SURE THIS IS UNSAFE
OUCH, MY HAND GOT CAUGHT IN THE NIP!
IF ONLY THERE WAS A WAY TO SAFELY CLEAN THESE ROLLS WHILE CONTINUING TO PRODUCE HIGH QUALITY PRODUCT!
OH NO!
GUY GOT HURT!
IF ONLY THERE WAS A WAY TO DECREASE DOWNTIME AND DEFECTS WITHOUT RISKING THE SAFETY OF OUR TEAM
DON'T LET THIS HAPPEN TO YOU. ASK ABOUT AUTOMATED PROCESS ROLL CLEANERS

Considerations for Choosing the Right Cleaner

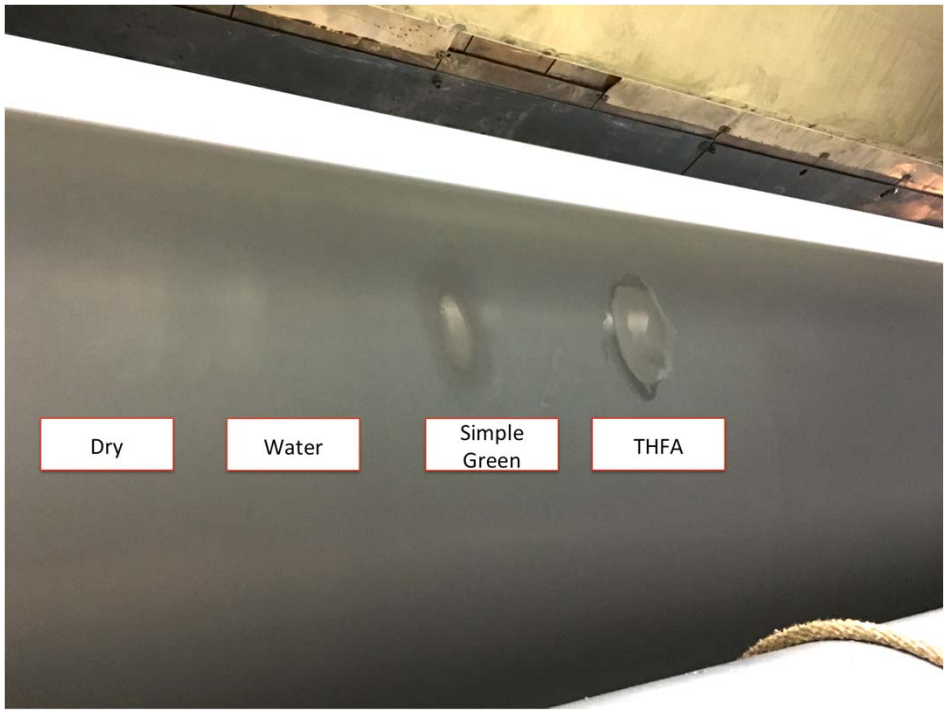
- What are you trying to remove
- How wide is roll
- Space Available
- How fast is roll
- Roll surface makeup
- How often to clean
- Wet or Dry Clean
- Temperature
- Clean Room
- Solvent Environment
- Budget

Roll Cleaning Methods

- Hand Clean
- Doctor Blade
- Contact Cleaning Roll (Tacky Roll)
- Automated Cloth Wipe
- Automated Wet Clean

Hand Clean

- Many manufacturers wait until buildup causes defects, then they shut down and hand clean with a solvent

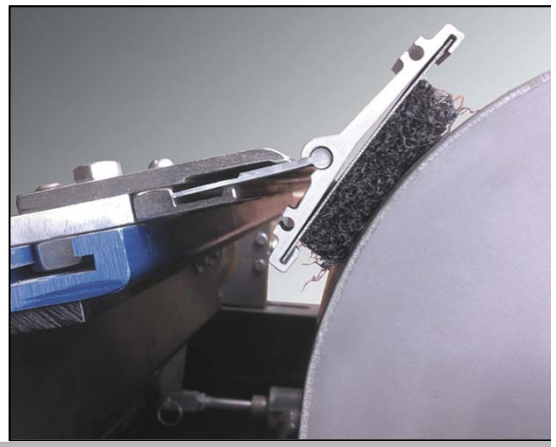


Doctor Blade

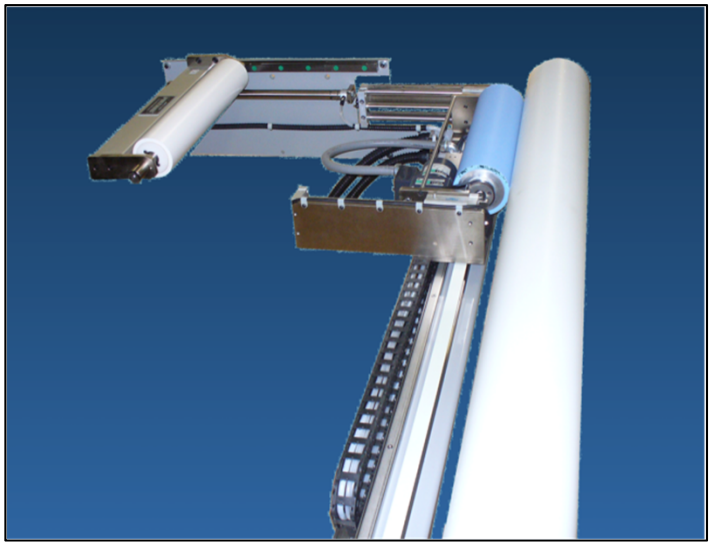
Doctor blades can be a very effective way to clean your rolls. It all depends on what you are trying to remove and how much there is.

- Doctor blade engages against the full surface of the roll and creates a collection point for contamination
- Relatively low cost
- Still need to find a way to collect buildup/ contamination
- Can sometimes smear the buildup depending on viscosity
- Some offer oscillation or change outs for roll polisher

Courtesy of Kadant



Contact Cleaning Roll



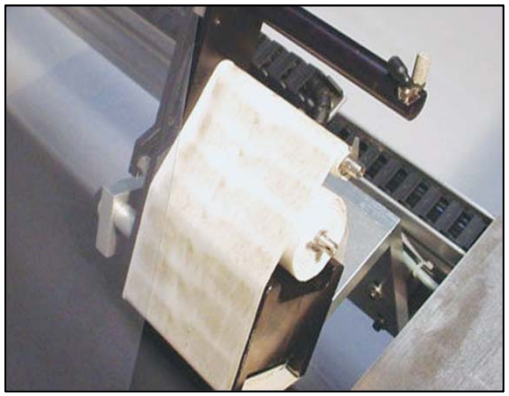
- If contamination is loose and dry, a polymer CCR can be used to remove the contamination.
- Typically uses an adhesive tape roll to collect contamination for final removal
- Can use full width or traversing
- Often used prior to lamination or coating or for backing roll cleaning

Automated Cloth Wipe

- A cloth cover touch surface engages against the roll surface and wipes and collects buildup
- Intended to be used while running
- Programmable
- Use a cloth that is durable but absorbent
- Wet clean is possible but with restraints
- Most are traversing or multi-position machines

Automated Cloth Wipe: Traversing

- Usually smaller cleaning head
- Used when buildup collects quickly or space is a constraint
- There are some drawbacks



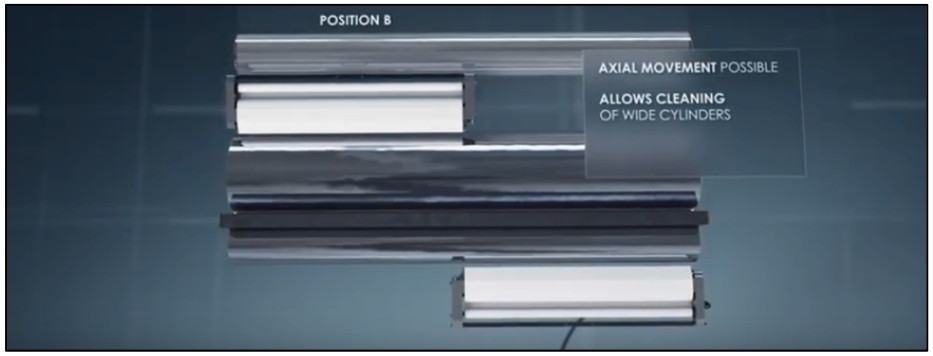
Courtesy of RG Egan

Automated Cloth Wipe: Step Traversing

- Cleans in zones while producing film
- 18” cleaning head
- Larger footprint

Automated Cloth Wipe: Multi Position

- Cleans in 2 zones roughly ½ the width of the roll
- Wider cleaning head
- Shuttles between positions



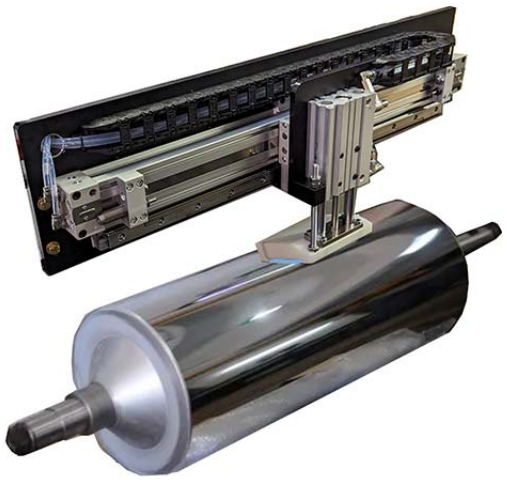
Courtesy of Baldwin Tech

Automated Wet Clean

Courtesy of Kadant

- Traverses across the face of the roll and uses a fluid/brush to clean
- Collects/Reclaims fluid
- Vacuum and air knife
- Uncommon, but the only way to clean some rolls

Oscillating Wipe



- Oscillates across the face of the roll using a pneumatic rodless cylinder simulating a back and forth wipe
- Can be wet or dry wipe
- Good for smaller rolls

Tips, tricks and lessons learned

- Using a fluid while running can change the temperature of the roll and impact film quality
- For most applications a dry wipe will work
- Start Clean, Stay Clean
- Some buildup may be good- provides release
- Textured rolls are hard to clean
- Most available cleaners are programmable. It will not work the first time. You have to find the right recipe of cleaning frequency, engagement time, number of engagement, pressure, speed, etc.

Roll Cleaner Manufacturers

- Polymag Tek
- Baldwin Technology
- RG Egan Equipment
- Kadant
- ProJet B.V.

Web Cleaning

Selection Criteria
and how they fare

Why Web Cleaning?

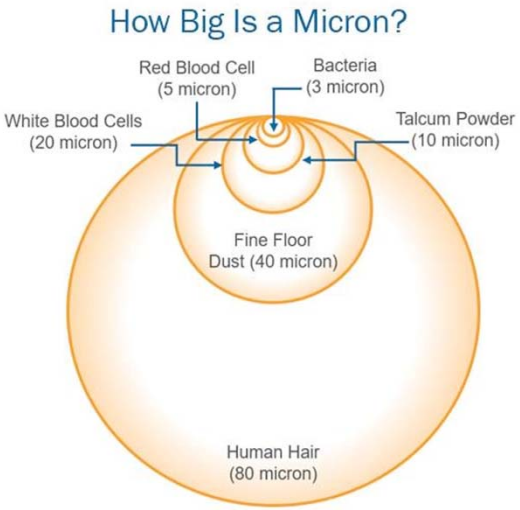
- Reduce Defects in Printing, Laminating, Coating
- Customer Requirement
  - Food, Medical, Pharma, Photovoltaic, Electronics, Aerospace
- Keep Equipment Clean

Where does Contamination come from?

- Air, Substrates, Equipment, People
- Processes
  - Slitting, Shearing, Die or Laser Cutting , Stamping

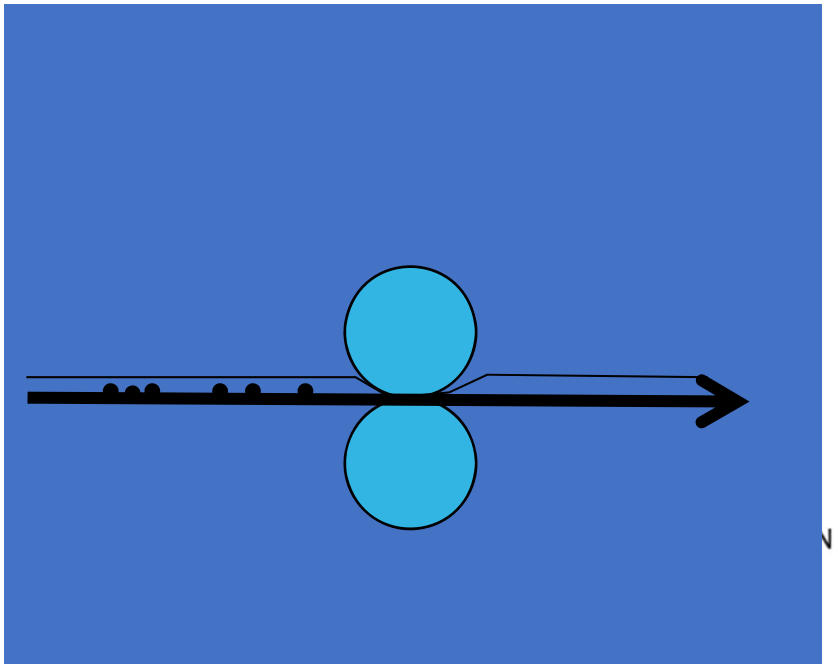
Considerations for Choosing the Right Cleaner

- Industry of use
- Web substrate makeup
- Size of contamination particles
- Amount of contamination
- Substrate width
- Processing speed/ Boundary layer air
- Tension



The Boundary Layer Air

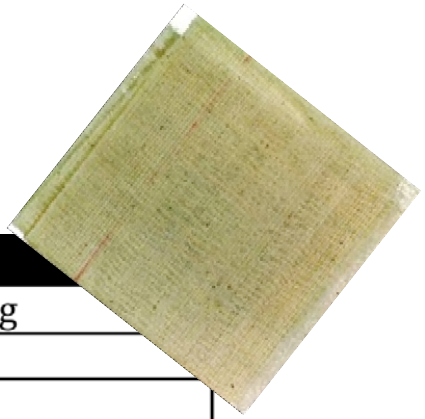
- Laminar Flow Boundary Layer Air
- Need a method to “break” the Boundary Layer
- Web disruption from contact
- Flutter



Web Cleaning Methods

- Non-Contact Cleaning
  - Vacuum
- Contact Cleaning
  - Tack Cloth
  - Vacuum
  - Moving Brush
  - Polymer Roll + Tape
  - Polymer Roll- Water Wash

Tack Cloth



Parameter	Notes/ Usage
Industry of Use	Industries without strict quality standards, converting
Substrate	Papers, non-sensitive films.
Particle Size	Large, Greater than 50um
Particle Amount	Particles can quickly saturate the surface, so lower levels of contamination preferred
Web Width	Narrow web; generally hard to make a wide web tack cloth apparatus with consistent contact
Web Speed	Slow; even at 200fpm, webs cut into cloth creating more debris
Web Tension	Higher tension works better
Total Cost of Ownership	Very low. Cost is approximately $0.66/SF, but if you use new cloth every changeover, you might spend $5-$10/Day

Pros and Cons – Tack Cloth

Pros

- No Capital Investment Required
- Good for Large Contamination Particulate Removal

Cons

- If Changed Regularly, the Tack Cloth can Become a Costly Consumable
- Must be Changed Regularly (every 3-4 hours) Minimum
- Dependent Upon Operator Remembering to Change It
- Irregular Surface of the Cloth can Mean Intermittent Surface Contact with the Substrate

Non-Contact Vacuum

Parameter	Notes/ Usage
Industry of Use	Almost all. Does not work well in removing particles less than 40um, so medical and optical films may not be the best fit.
Substrate	Papers, Films, Foams, good for sensitive substrates
Particle Size	Large, Greater than 40um ideally
Particle Amount	Vacuums work well with large concentrations of contamination as long as the particle size is large enough and the speed is slow.
Web Width	Up to 10 meter width
Web Speed	Speeds up to 2500m/min but may see particles carried past by boundary layer air. Less than 20m/min is ideal.
Web Tension	No tension loss. High tension better to reduce web flutter to keep web at consistent distance from vacuum
Total Cost of Ownership	Low to Moderate initial investment, filter and collection consumables and electricity

Pros and Cons of Vacuum Systems: *'Non-Contact'*

Pros

- Industry choice for contact sensitive substrates.
- Non-Contact Vacuums can be used as a "Pre-Clean" for other web cleaning methods, possibly forming the "ultimate solution", for challenging contamination conditions on non-sensitive substrates.

Cons

- Investment price.
- Utilization of vacuum pumps and compressed air can make the cost of operation expensive.
- Other systems' efficiencies can be negatively affected by web speed.
- These systems can be negatively affected by a small amount of web flutter.
- Little to no testing documentation available.

Contact Vacuum

Parameter	Notes/ Usage
Industry of Use	Almost all. Does not work well in removing particles less than 40um, so medical and optical films may not be the best fit.
Substrate	Papers, Films, Foams, nonwovens. Brush contacts substrate, so not great for sensitive substrates
Particle Size	Some suppliers claim down to sub micron level at speeds up to 1600m/min. Verifiable data from other suppliers indicate 92% removal of particles greater than 30um at 20ft/min
Particle Amount	Vacuums work well with large concentrations of contamination as long as the particle size is large enough and the speed is slow.
Web Width	Up to 10 meter width
Web Speed	Speeds up to 2500m/min but may see particles carried past by boundary layer air. Less than 20m/min is ideal.
Web Tension	No tension loss
Total Cost of Ownership	Moderate initial investment, filter and collection consumables and electricity

Pros and Cons of Vacuum Systems: *'Contact'*

Pros

- Most commonly accepted industry choice for web cleaning.
- Moderate investment price.
- Low maintenance costs associated with these systems over years of use.
- Excellent "Pre-Clean", when used with contact web cleaning systems, forming the "ultimate solution", for challenging contamination conditions on all substrates.

Cons

- Utilization of vacuum pumps and compressed air can make the cost of operation more expensive than is usually realized. Beware the Hidden Costs!
- How are the brushes cleaned?
- Can web flutter upset the vacuum?
- No industry reports that can verify effectiveness claims at web speeds stated.

Moving Brush

Parameter	Notes/ Usage
Industry of Use	Automotive, Furniture, Metals, Converting
Substrate	Papers, Films, Foils, Metal Coils, Thermoformed Blanks (Sheets), 3D surfaces. Sensitive thin films may not be a good fit due to potential abrasion from brush.
Particle Size	Large, Greater than 40um ideally
Particle Amount	Brush can loosen adhered particles. Vacuums work well with large concentrations of contamination as long as the particle size is large enough and the speed is slow.
Web Width	Up to 3200mm(126in) width
Web Speed	Speeds up to 600m/min
Web Tension	Unknown
Total Cost of Ownership	High-brushes, vacuum, controls and pneumatics, filter, collection consumables and electricity

Pros and Cons of... 'Moving Brush' Systems

Pros

- Good on substrates suffering from a large volume of large-size particulate contamination.
- Can be utilized on some irregular (convex or concave) surfaces.

Cons

- Use of vacuum pumps and compressed air increase operational costs. Beware the Hidden Costs!
- Effectiveness of removing contaminants from brushes.
- Possible cross-contamination.
- Edge cleaning of thinner substrates are a question mark.
- Micro clean claims need to be defined and verified. No documentation to substantiate.

Contact Cleaning (Tape)

Parameter	Notes/ Usage
Industry of Use	Converting, Flexible Packaging, Medical, Nonwovens, Electronics
Substrate	Papers, Films, Foils, foams, non-wovens, plastics
Particle Size	Down to sub micron level (documented)
Particle Amount	Moderate contamination levels acceptable, as long as amount of contamination does not overwhelm adhesive tape collection in determined time period. .
Web Width	Generally up to 180 inches
Web Speed	Speeds up to 800 ft/min, >800 ft/min with speed match
Web Tension	Usually not critical. Nip tension loss is minimal. Configurations vary. Higher tensions preferred.
Total Cost of Ownership	Low initial investment. Consumables cost vary by contamination level.

Pros and Cons of Contact Web Systems: *'Tape'*

Pros

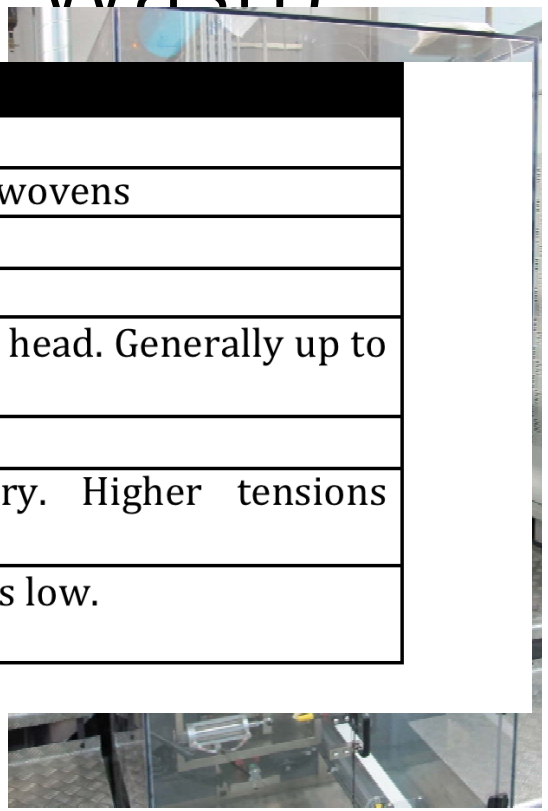
- 96.9 % loose particulate contamination removal in a single "nip" configuration.
- 99.9% loose particulate contamination removal to < 1µ in a double "nip" configuration.
- Moderate investment price.
- ROI is less than one year (usually just months).
- CCRs will perform effectively for years
- Nip configuration cleaning effectiveness is not effected by web speed or tension.

Cons

- Tape change needs to be manually checked and maintained.
- Contact cleaning creates static, thereby requiring static elimination after cleaning is complete.
- Depending upon the process and contamination levels, the tape consumable cost may become prohibitive.

Contact Cleaning (Water Wash)

Parameter	Notes/ Usage
Industry of Use	Paperboard Converting, Nonwovens
Substrate	Papers/Paperboard (recycled), Films, non-wovens
Particle Size	Down to sub micron level (documented)
Particle Amount	Very high contamination levels acceptable
Web Width	Theoretically infinite with traversing wash head. Generally up to 180 inches
Web Speed	Speeds up 2500 ft/min with speed match
Web Tension	Usually not critical. Configurations vary. Higher tensions preferred.
Total Cost of Ownership	High initial investment. Consumables cost is low.



Pros and Cons of Contact Web Systems: *'Water Wash'*

Pros

- Best web cleaning solution for 100% recycled CRB or URB board stocks.
- Best solution for high speed (up to 3000 fpm), high contamination processes.
- ROI generally within 1 year.
- Low annual consumables cost.
- Swap out clean CCRs every 4-6 minutes, for highest average cleaning effectiveness.

Cons

- High investment price.

Tips, tricks and lessons learned

- Only works for dry and loose contamination
- Static elimination goes hand in hand with cleaning
- Speed and particle size play an important roll
- If you have a run over 4 hours long, a continuous cleaner is a better option
- It is more expensive to clean the bottom side of the web
- Thin films under 100um convey better in a nip to roll configuration.
- The majority of contamination tends to be along edges

Web Cleaning Manufacturers

- Non-Contact
  - Static Clean International
  - Weducon
  - Kelva
  - Hildebrand
  - Meech
  - Teknek
  - Doyle
- Contact
  - Polymag Tek
  - Static Clean International
  - Teknek
  - Meech
  - Kelva
  - Vetaphone
  - Doyle
  - SDI
  - Jemmco

Questions?

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