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Troubleshooting cross-machine direction moisture profile problems

Scope

Poor cross-machine direction (CD) moisture profiles result in non-uniform paper end-use properties, converting problems, and poor runnability in the form of wrinkles and breaks. Fiber costs (such as heavy edges) and energy consumption can be higher than when moisture is more uniform.

Final moisture profiles reflect complex interactions between the forming, pressing, drying, and gauging and control systems. Many CD moisture profile problems originate in the press section, although they can also be caused by dry weight profile, forming, or drying problems.

This TIP discusses steps to take and tools available to troubleshoot CD profile problems. Steps to identify the source of the problem include:

1. Evaluate information from the machine gauging and CD control system.
2. Determine where poor profile originates.
3. Pinpoint the cause to get an effective solution.

Additional Technical Information Papers provide more information on troubleshooting issues in the forming (TIP 0502-14 “Forming section monitoring”), pressing (TIP 0404-19 “Press section monitoring”), and drying TIP (0404-33 “Dryer section performance monitoring”) sections.

Safety precautions

Follow normal safety precautions when working around paper machinery. Do not allow loose clothing or equipment to contact rotating machinery. Beware of thermal and slip hazards around the dryer section operating floor and basement. Tag, disconnect, and lock out all dryer drives and steam systems before entering dryers.

Discussion

Keys to good moisture profiles include:

- Uniform weight profile
- Proper roll crowns, covers, and cover conditions
- Effective fabric cleaning, conditioning, and tensioning
- Good condensate evacuation
- Full-width dryer bars
- Effective pocket ventilation

Preferred methods to correct CD moisture profile are remoisturizing showers and steam showers. Infrared is used in some applications where sheet contact would be detrimental, but is a last resort because of high energy cost.

TIP Category: Automatically Periodically Reviewed (Five-year review)



Documents

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In some cases it is easier to troubleshoot moisture profile problems by turning off the CD moisture profile control system or setting all control positions at the same level. Some control methods used but not recommended include biasing weight profile, partial-width dryer bars, profiling pocket ventilators, size press blade or rod pressure, variable-permeability fabrics, biasing nip load with zone-controlled press rolls, and cocking press loads.

Gauging system

The machine gauging system can provide valuable information as to the nature and severity of profile problems. Tips for beginning troubleshooting efforts follow:

Characterize the profile. Is it a frown, a smile, edges only, sine waves at a defined spacing across the width, grade dependent, etc. Characterizing the profile is an important first step toward identifying which operations are the most likely to contain the root cause. For example, if the profile is a sine wave on 12" spacing, the press section is probably not the first place to look,

Do not accept the problem as described. The symptom is often not the cause of sheet profile problems. Check the weight profile first when moisture problems are presented to you. If the moisture profile is highly correlated to base sheet bone-dry weight profile, there is no use doing an infrared survey. Caliper, smoothness, and wrinkling problems can also be caused by poor moisture profiles. Poor moisture profiles can also be caused by poor ash or coating profiles. Also do not overlook the obvious. A quick inspection of the machine may find things like exhaust fans not running or missing ductwork that can affect CD moisture profiles.

Determine if the problem is in the machine direction or cross-direction. Check the trend pages of the supervisory control system. Is the system doing a reasonable job? Are there any trends of cyclic disturbance? Is the re-moisturizer tuned too aggressively? It may be necessary to single-point the sensors to observe machine-direction (MD) trends. One way to check this is by gathering 20 scans and comparing the average composite profile of the first ten scans with the second ten scans. If the two composite profiles are highly correlated, then variability is CD. If not, it is time-dependent (MD) and not CD.

Observe the reel. The reel may tell a MD or CD story. Observe the side of the reel. Is the edge of the sheet moving in and out? Is it uniform in appearance or random? Look at and feel the face of the reel for soft and hard areas. Wet areas calender more easily than dry areas and can cause soft or hard spots.

Utilize the supervisory control system. Begin on the profile pages, go to the trend pages, and then look at the CD control pages. Actuator profiles can be helpful in pointing to the right area of the machine. It is also important to look at the system in the field instead of just looking at the computer screen. Is the full sheet being scanned? A remoisturizing shower does not work if the water pump is not on. Bump testing of control system actuators and nip loading can be another valuable diagnostic tool. Leveling actuators or shutting off spray water and profiling steam can help reveal the true profile. In some cases this exercise can be extended to different unit operations such as taking each coater off-line, taking a water box off-line, shutting down the size press, etc.

Call for the Cavalry. Once it is determined that the gauging system is indicating accurately and responding appropriately, it is often necessary to utilize additional resources to identify the source of profile problems.

Infrared thermography

Infrared thermography provides an excellent tool for narrowing the search for cause of profile problems. The objective is to determine where the profile can first be seen. Areas of the sheet indicated as cooler are generally wetter at the dry end of the machine so infrared temperature profile corresponds to sheet moisture profile. However, the relationship between temperature and moisture may be the opposite at the wet end of the machine. Troubleshooting efforts should start at the reel by relating the temperature profile to sheet moisture indicated by the gauging system. Then work towards the wet end to determine where problems develop. Thermography can be used to look at the sheet at open draws, under unrun and single-tier dryers, and wherever the camera can see the full width of the sheet. Dryer fabric temperatures can indicate what is happening to the sheet where there is not good access to the sheet.

Draws out of the press section are a key place to look at the sheet to determine whether the problem is occurring at the wet or dry end of the machine. Infrared can also be used to troubleshoot operation of profiling steam showers and rewet showers.

Infrared thermography can be extremely sensitive. It is important to make sure the "problem" is real. Different scales are needed to evaluate temperature differences down the machine. Temperature differences less

than 0.5 degrees F can indicate problems in the forming section, 2-3 degrees F can be significant in the press section, and variations greater than 10 degrees F indicate problems at the reel.

Sheet moisture profiles

Sheet moisture profiles out of the press section are another tool that can be used to identify the source of the problem. Portable moisture scanners can be installed in an open draw, in an area where the sheet is supported by a fabric, or under one of the first dryer cans. Figure 1 shows an example of a profile out of the press section compared to the reel moisture profile. The scanner can also be placed in a stationary position to determine if there is MD moisture variation. The scanner can be used to provide immediate feedback on the effects of adjusting nip loads, variable-crown roll settings, felt conditioning, steam box adjustment, and shoe press tilt. The scanner can also be installed before the press section to look at the effects of suction roll or former vacuum, deflector loading, and showering. These scanners are again being offered as permanent installations.

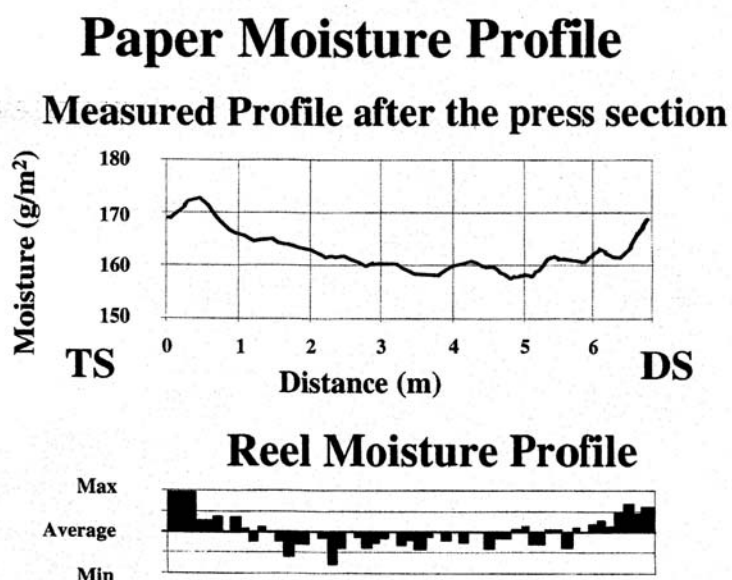


Fig. 1. Comparison of press section and reel moisture profiles.

Dryer surface temperature profiles

Dryer surface temperatures can identify if poor profiles are caused by non-uniform heat transfer through the dryer condensate layer or by non-uniform sheet-to-dryer contact. Sheet moisture profiles are typically the inverse of surface temperature profiles when there are condensate removal issues, and the same as temperature profiles when there are contact issues. Figure 2 compares sheet moisture profile to an inverted dryer surface temperature profile. Typical dryer temperature profile with no dryer bars is a “smile,” with the edges hotter than the center. Profile problems that can be identified with surface temperature profiles include:

- Lack of dryer bars
- Partial-width dryer bars
- Dryer bar/syphon interface
- Non-uniform dryer casting