

# **Thermography in the paper mill; detecting moisture irregularities**

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## **ABSTRACT**

In growing numbers, paper companies are realizing the benefits of Infrared Thermography as a troubleshooting tool, especially as it relates to determining the source of cross direction moisture variations in the sheet. The detailed Infrared Analysis, in most cases, can quickly determine the origin of the process-related problem causing the moisture variation. The variations in sheet moisture at the reel are usually found to be occurring at the wet end, directly correlate with temperature differences. The application of this phenomenon to the paper making process is based on the fundamental temperature/moisture relationship in the sheet. Paper with a lower moisture content is relatively warmer than paper with a higher moisture content therefore, the darker thermographic images are "cooler" and represent areas of higher moisture content. Conversely, the brighter the area, the drier the sheet. The sheet temperature profile correlates very well with the moisture profile scans at the reel. No matter where they originate, the wet areas in the sheet remain cooler than the drier areas. This paper discusses the use of the Infrared Thermographic analysis to enable the mill to identify the source of irregularities in moisture without shutting down the machine or otherwise affecting production; thus making problem-solving both efficient and economical.

**Keywords:** infrared, thermography, paper machine, moisture profile

## **1. INTRODUCTION**

The application of Infrared Thermography as a diagnostic tool, to look at the entire paper making process allows a unique opportunity to literally "see" the affects of the various processes on a paper machine have on product quality and machine efficiency.

A detailed Infrared Analysis, in most cases, can quickly determine the origin of process related problems and facilitate improvements in sheet quality and machine performance. This technical analytical service is intended to be used to optimize total machine efficiency; and in most cases, reduce unit costs.

## **2. HERE'S HOW IT WORKS**

The principles of infrared imaging are based on the fact that all objects emit infrared radiation. This level of radiation increases directly as temperature increases. Infrared imaging equipment provides real time presentation of temperature patterns being emitted by an object. These patterns are displayed as standard video images in either black & white, or color. The darker colors represent "cooler" temperatures, while the lighter colors would be "hotter".

## **3. SHEET MOISTURE/TEMPERATURE RELATIONSHIP**

The advent of portable infrared imaging equipment has proven useful in determining the cause of cross-direction and machine direction moisture variations on paper machines. Variations in temperature of the sheet at the reel directly correlate with variations in sheet moisture. Areas with higher temperatures indicate dry conditions. Conversely, areas that are cooler contain higher moisture content. We found through the use of high-resolution thermography, that the sheet temperature profiles correlate very well with the moisture profile scans at the reel.

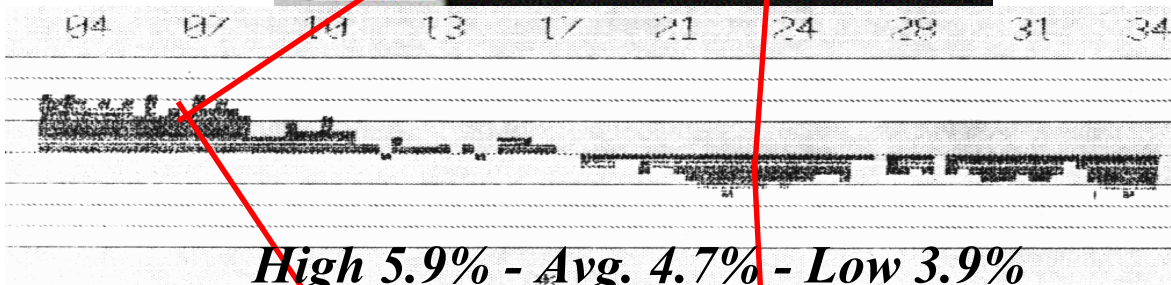
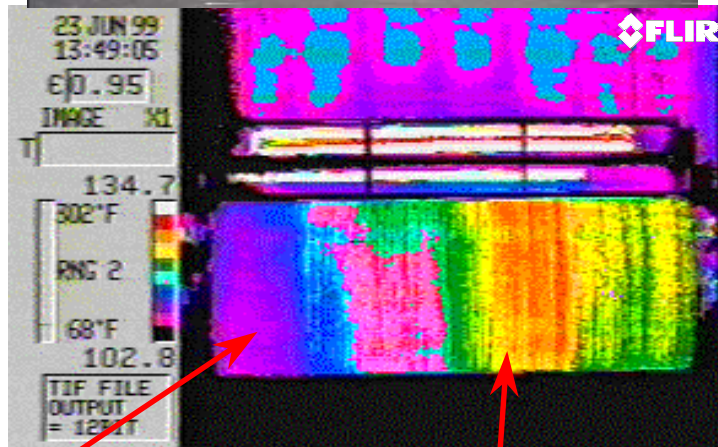
## **4. THE SURVEY**

When conducting an infrared survey of a paper machine looking for moisture irregularities, I begin by looking at the sheet being wound at the reel and follow the sheet to the wet end. The sequence of images shown in Fig. 1 show how the cool (wet) area can be followed down the machine to determine its source. Fig. 1 shows (from top to bottom) a real time photograph of the sheet being wound at the reel and infrared thermograms (in color and black & white) of the reel, A copy of the mill's moisture scan of the reel appears between the color and black-and-white thermograms. The thermograms correlate quite well with the poor moisture profile.



Tending Side

Drive Side



*High 5.9% - Avg. 4.7% - Low 3.9%*

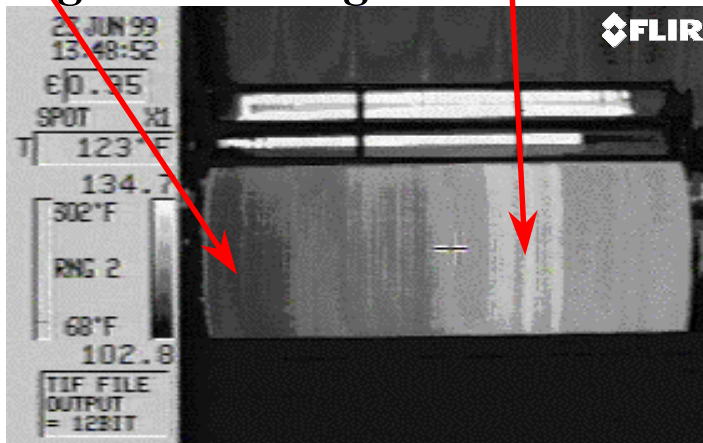


Figure 1. Photograph of the sheet being wound at the reel and infrared thermograms (in color and black & white) of the reel. A copy of the mill's moisture scan of the reel appears between the color and black-and-white thermograms

The survey continues toward the wet end looking at the sheet anywhere there is a clear unobstructed view. Fig. 2 shows the top side of the sheet exiting the 3<sup>rd</sup> press, it still shows to be cooler (wetter) on the tending side, same as what was noted at the reel.

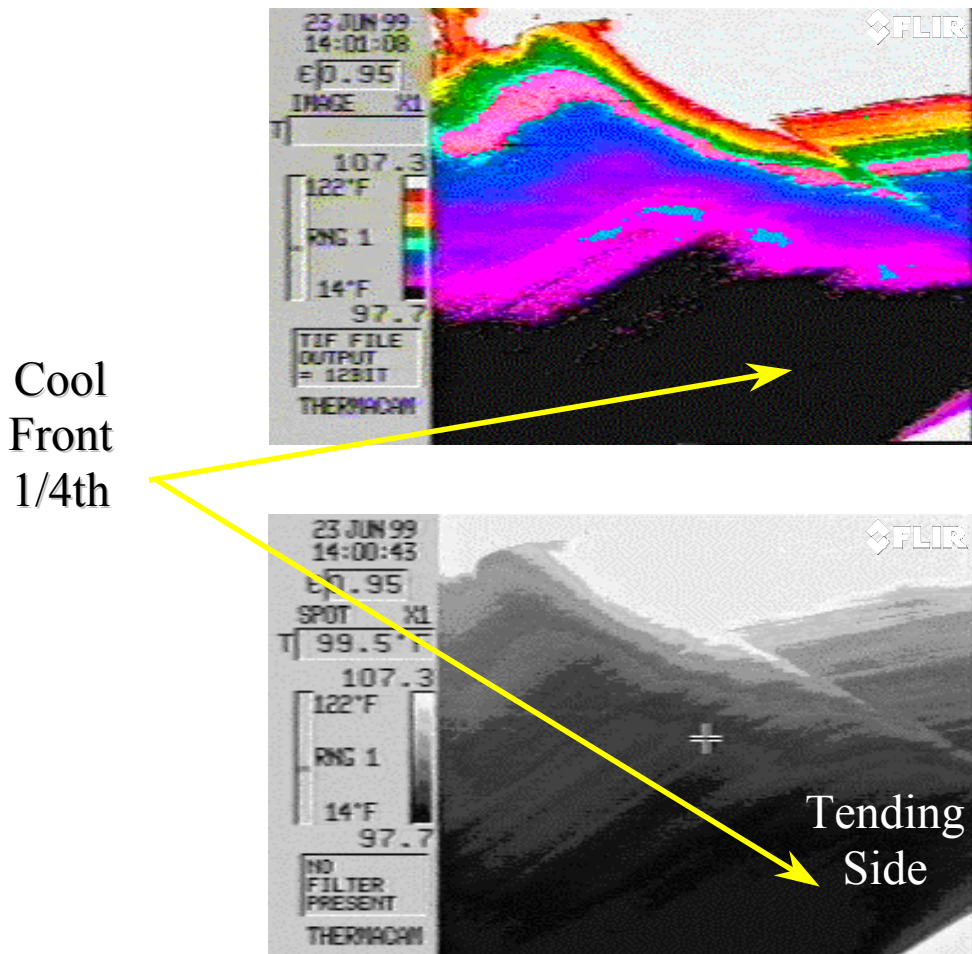
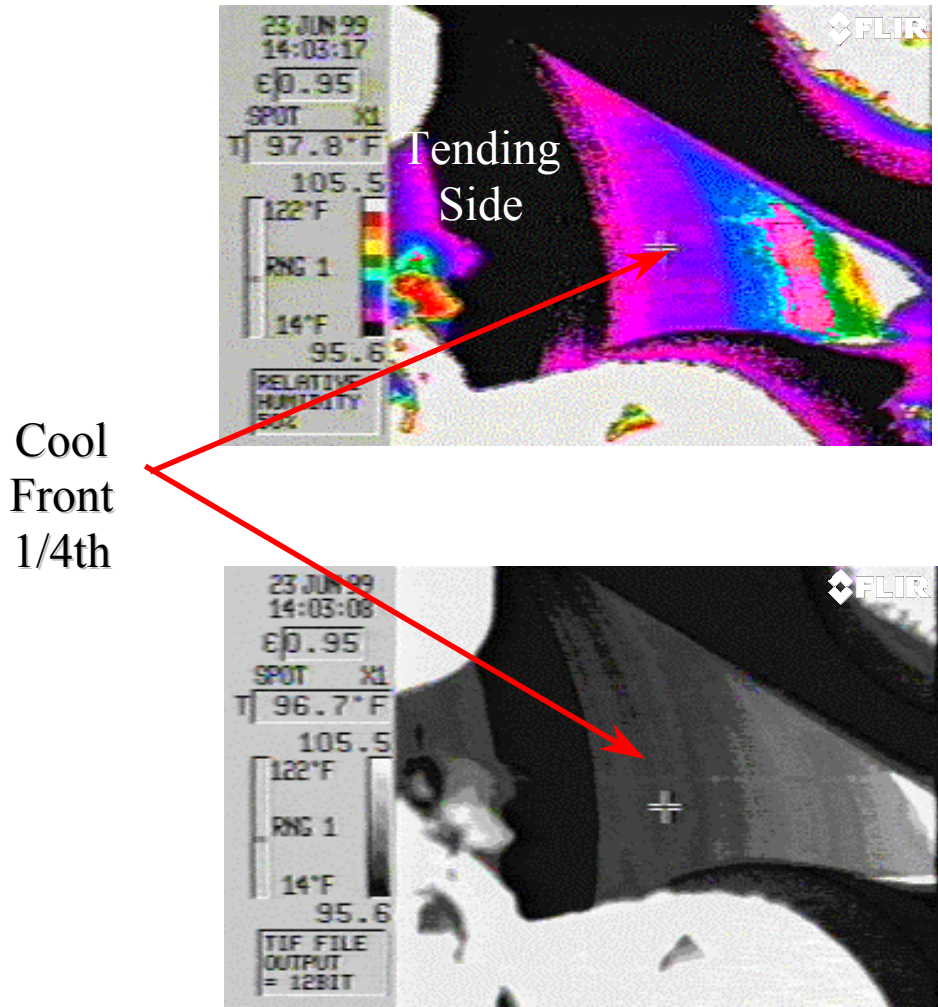


Figure. 2. Top side of the sheet exiting the 3<sup>rd</sup> press shows to be cooler (wetter) on the tending side

The sheet passing over the center press roll is looked at next, ( Fig. 3) this shows the same cool (wet) front ¼ th of the sheet, the same as at the reel.



**Figure 3. The sheet passing over the center press roll shows the same cool (wet) front ¼ th**

The stock passing down the wire and over the couch roll (Fig. 4) shows the temperature to be quite even ahead of the couch roll, but as the stock passes over the couch roll it becomes cool on the front 1/4<sup>th</sup>

Cool  
Front  
1/4th

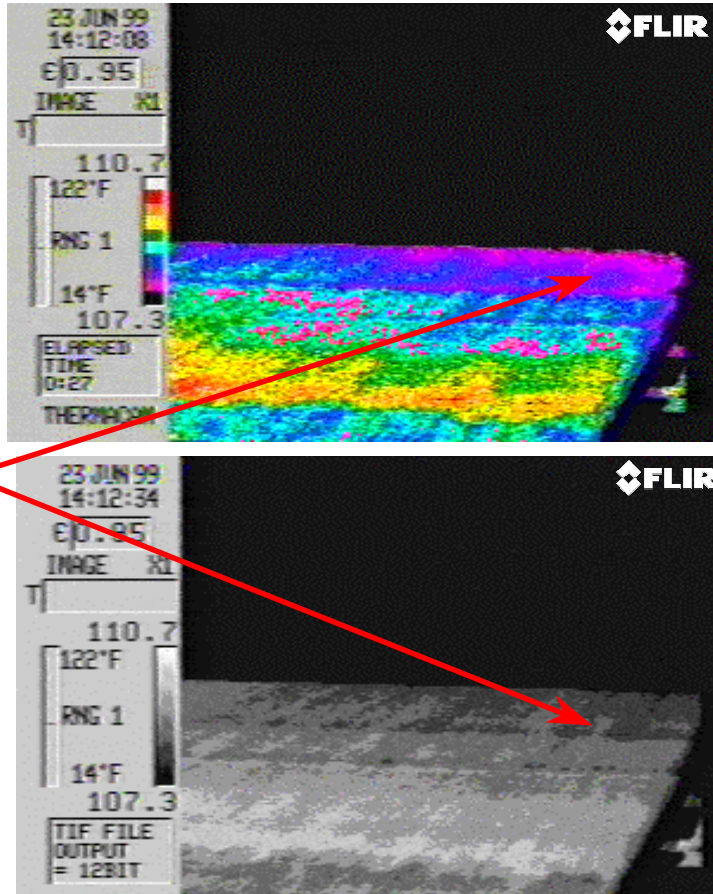


Figure 4. The temperature is shown to be quite even ahead of the couch roll but becomes cool on the front 1/4<sup>th</sup>

## 5. CONCLUSION

The Cool (wet) front 1/4<sup>th</sup> of the sheet we followed from the reel to the former was being caused by a worn wipe on the couch roll.

## 6. SUMMARY

Typical problem areas where infrared thermography has proven to be an invaluable troubleshooting tool include the following:

Wet/Dry Streaks (Cd And Md)	Steam Leaks, Over Heated Bearings, And Electrical P/Pm
Barring Problems	Uneven Steambox Distribution
Slice Irregularities	Plugged Uhle And Suction Boxes
Plugged Felts, Showers, And Drilled Rolls	Uneven Felt Construction
Defective Roll Covers	Steam Condensate Problems
Incorrect Roll Cambers	Press Roll And Calender Stack Vibration
General Machine Maintenance:	

While infrared thermography does not replace good paper making know-how, it does provide information that can help pinpoint complicated or persistent moisture imbalance problems.

Thermographic analysis enables the mill to identify the source of irregularities without shutting down the machine or otherwise affecting production; thus making problem-solving both efficient and economical.