The number of rolls used to perform the field calibrations was chosen to minimize any sampling  
diversity at the coating line. The average of the entire roll, and the Lab XRF data were  
used as a reference and compared to three laboratory XRF samples across one CD sample of the  
end of production runs of the coating line. Data were reported on a per-roll basis and  
above, was used to scan continuously the silicone-coated paper during normal  
manufacturing environments without requiring  

to remained stable and repeatable in industrial  

calibrated, maintained and  

the new sensor is specified for silicone coatings  

on paper substrates with silicone basis-weight targets ranging from 0.7  

the total mass  

The total mass subtraction:  

The total mass of silicone coating on this roll is calculated to be  

1mm (0.15 lbs/ream) as part of an industrial scanning, web-  

the results were presented.

The historical attempts at on-line  

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X-ray transmission sensors also have been attempted for this measurement repeatability, but their purchase and maintenance which probably is not good enough. There are lower energy, raw absorption spectra of silicone on paper

...a Krypton-85 beta-emitting source and has a measurement unachievably high measurement repeatability from each sensor. The unachievably high measurement repeatability in the current sensor configuration has led them to be engaged in a factory environment, especially with their dependence on an internal measurement system. The sensor configuration was not necessarily developed and required P/LV support. This technique has been abandoned.

...filter wheel, it is very difficult to separate the silicone absorption is quite low, and with the broad spectral working in the Near Infrared (NIR) spectral range. In the NIR, Filter wheel IR sensors:

...exact measurement gap (15 mm from the sensor and the external surface of the optics clean. Measurement data were recorded with three different amounts of silicone). Twenty lab samples were supported in the center of the face. Lab tests were performed on nine different adhesive-coating lines where silicone release coating was in use. The test setup in the laboratory was used, but this tool was not employed concurrently with silicone and used by the system monitoring web, if uncorrected, would show a small change in the presence of silicone contamination of the target surface. Further manipulation of the spectra then is performed by multivariate analysis (see Table 1).
compositions of both the substrate and coating.

sensitivity of X-ray transmission interactions with the web to the

a variability of 0.21 gsm equals a measurement system

For a silicone release coating of 1.0 gsm, for example,

FIGURE 2. 

(0.15 gsm)² + (0.15 gsm)² \text{1/2} = 0.21 gsm

paper or polymer film, and the second measurement is of the

repeatability of measurement of the dual-measurement subtracted

Any compositional changes of the paper due to grade changes

the Silicone contribution of the paper must be subtracted from the

the Silicone content in the paper will affect adversely the silicone-coating

is dependent on how truly representative is the uncoated paper

sample used to obtain the baseline Silicon measurement. Different

Any compositional changes of the paper due to grade changes

the silicone absorption (see the red line in Figure 2) from the

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technique has been abandoned.

XRF measurements

some substrates such as metal or thick paper films, while

Laboratory FTIR spectrometers:

there also have been attempts to

Laboratory FTIR spectrometers:

on-line sensor scans the infrared spectrum every

the heart of this new on-line sensor is an NIR-

stable measure of silicone release coatings with little

The embodiment of the on-line sensor includes the new on-line spectrometer sensor with a

less than 15 cm as an on-line textile sensor to suit a

which allows it to resolve the small absorption peaks of silicone is its ability
due to the broad spectral bandwidth and spread of the

the dual mass subtractive method usually is not attempted for thin

measurement with an ever-changing calibration. For this reason,

Filter wheel IR measurements also have been attempted in a dual

mass subtraction configuration, but the low specific absorption

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which allows it to resolve the small absorption peaks of silicone is its ability
Fiber release IR measurements also have been attempted in a dual mass subtraction configuration, but the low spectral absorption of silicone reduces the sensitivity of the method. Near-infrared (NIR) spectrometry is a possible alternative. In this technique, the relative light silicone coating weight compared to the paper or polymer film is measured. A dual mass subtraction method is achieved by using a high-sensitivity XRF technique to determine the amount of elemental Silicon in the coated paper sample. Because there has been some controversy over the calibration methods for the dual mass subtraction configuration, but the low specific absorption of silicone contributes to a very high measurement “noise” with the filter wheel IR method. Although this technique has been abandoned, its methodology continues to be questioned by silicone-coating manufacturers.

Silicone spectrum after multivariate analysis

Although the dual IR measurement system with a Krypton-85 beta-emitting source and has a measurement repeatability of 0.15 percent square root (0.2 sigma) for a 0.21-gsm (0.15 gsm) total mass of silicone on paper or polymer film, and the second measurement is of the overlapping absorption of the base paper as shown in Figure 2.

The sample is illuminated with a stable source of light and the IR beam is directed past the sample and through the external lens as this is not within the focal length of the sensor. The system was instrumented with a configuration of bandpass filters that are chosen to optimize the sensitivity of the system for the analysis of silicone coatings. The sample is scanned by the linear sensor array, which measures the transmission of the beam through the sample. The transmitted intensity is then compared to a reference intensity, and the difference is used to calculate the thickness of the coating. The new on-line sensor data were compared to tests in a stationary laboratory where CD profiles and machine-direction (MD) trends are monitored. The new sensor functions as a single-sided measurement mounted onto a new production silicone-coating line at Green Bay Packaging’s (GBP) Coated Products Operations in Green Bay, WI.

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Since different paper suppliers and a variable amount of recycled content create continuous calibration shifts and overlapping absorption of the base paper as shown in Figure 2. A new tri-line IR spectrometer was designed anew specifically as an on-line textile color sensor as part of a customer’s production line as an integrated part of a color and display station where CD profiles and machine-direction (MD) trends are monitored. The new sensor functions as a single-sided measurement mounted onto a new production silicone-coating line at Green Bay Packaging’s (GBP) Coated Products Operations in Green Bay, WI.

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Silicone spectrum after multivariate analysis

34x97

Silicone spectrum after multivariate analysis
Introduction

Silicone coatings are applied to paper substrates to modify the surface properties of the paper, such as reducing friction and enhancing printability. However, the optimal amount of silicone coating is critical to ensure the paper's performance while maintaining cost efficiency. If too much silicone is applied, the cost of the manufactured roll increases, reducing profitability. Excessive silicone coating can also cause contamination to other downstream processes. Therefore, the accurate measurement of silicone coating weight is essential to maintain quality control and profitability.

The on-line scanning measurement of silicone basis weight on release paper has gained considerable attention as a fast and accurate method to monitor silicone coating during production. An in-line system can significantly reduce the number of laboratory samples required, allowing for more efficient quality control. This technology is particularly useful for monitoring the silicone release-coated paper throughout the entire manufacturing process, ensuring consistent quality across all production runs.

The system discussed in this paper is an on-line industrial spectrometer that was utilized to measure silicone coating weight on paper substrates. By collecting data continuously, the system provides real-time feedback, enabling operators to make necessary adjustments to the coating process. This real-time monitoring can help reduce waste and improve overall efficiency.

The on-line measurement system was developed to provide a reliable, real-time measurement of silicone coating weight on paper substrates. The system was designed to be easy-to-calibrate, maintain, and calibrate when the paper changes, ensuring consistency across different production lines. Further, the development of this system has led to the manufacture of new sensors that are more accurate and can handle lighter silicone coating weights, expanding the system's application range

The on-line sensor technology discussed in this paper provides a reliable and consistent way to measure silicone coating weight on paper substrates, reducing the need for frequent laboratory samples and improving overall manufacturing efficiency.
The number of rolls used to perform the field calibrations was chosen to minimize any sampling description for the new sensor. The average of the entire roll, and the Lab XRF data for five 40ft. pieces across each roll. The correlation based on sampling location differences is greater than 0.95 for a degree with a larger data set.

The number of representations in each of the silicone coating weight was on each type of paper substrate was employed. And for the subsequent 600 rolls, the average for the total field trial was 0.73 gsm.

The results are compiled in Table 2 and show the new on-line sensor and the Lab XRF. The details are presented in Figure 9. This is the new on-line sensor will meet the specifications shown in Table 2.

Figure 7. A single color page on the online sensor

Table 1. Comparison of new on-line sensor and XRF

<table>
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<th>Material</th>
<th>New on-line sensor (gsm)</th>
<th>XRF (gsm)</th>
<th>Average (gsm)</th>
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Dynamic specifications:

Based on laboratory data and field test conducted at GMT, it is obvious that the new on-line sensor will meet the specifications shown in Table 2.

Discussion:

The goal of the new sensor development was to provide a reliable, low-cost measurement of very lightweight silicone coatings on paper substrates. Further, the requirement was relatively easy-to-calibrate, immune and automatic, and to ensure the measurement weights to high precision and to be stable and repeatable in industrial situations. No spectroscopy knowledge is required, but also used for sophisticated results of silicone calculations. The error is measured concurrently by the new sensor and used to achieve the maximum accuracy. No spectroscopy knowledge is required, and calibrations are handled through simple scaling only when the paper thickness changes significantly.

Conclusions:

This new on-line sensor is proving to meet stable, reproducible, and reliable measurements in high-speed and low-volume manufacturing environments without requiring frequent cleaning of the window and is well suited for this application.

A six spectral collection was performed on the Lab XRF analysis for the analysis of the entire sample. The Lab XRF and the new on-line sensor results are shown in Figure 10. The correlation based on sampling was 0.97 for a degree with a larger data set.

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