APPLICATION NOTE - 03

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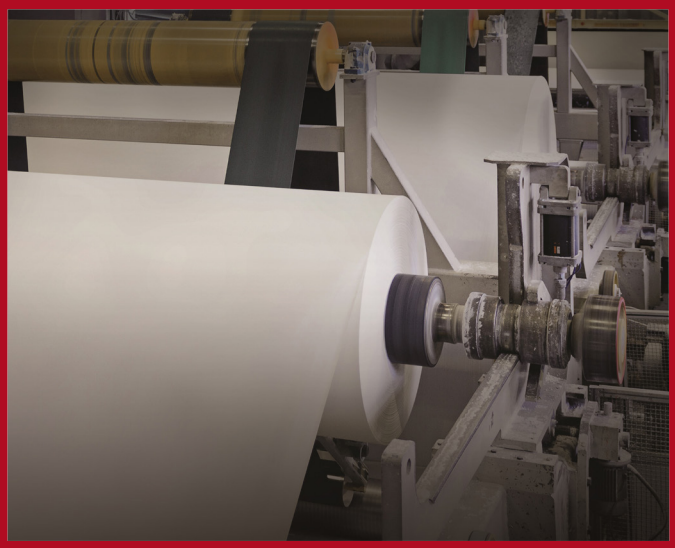
LAB-X5000



The LAB-X5000 benchtop analyzers provide many benefits:

- **Compact and robust:** ideally suited close to the production line
- **Easy to use:** reliable results with minimum operator training
- **Results in seconds:** fast analysis for quick decision making and process adjustments, ensuring consistent product quality
- **Outstanding stability:** results you can trust day after day

LAB-X5000 for the rapid analysis of silicone coat weight on paper (including clay-coated and clay-filled) and film

INTRODUCTION

Silicone is applied to a wide variety of papers such as glassine (supercalendered kraft, SCK), clay-coated kraft paper (CCK, which uses a layer of clay (kaolin) to fill the gaps between the fibres in the paper to smooth its surface), and clay-filled paper (for which clay is mixed with the wood pulp to reduce production costs).

Silicone-coated papers are widely used as release liners, with the major application being stick-on labels of all types. Other uses include double-sided tapes, polymer films and decorative trims. Release liners are also used in the electronics industry, in the design of flexible printed circuit boards and RFID tags. In all cases the silicone-coated substrate protects a pressure-sensitive adhesive layer until it is needed, at which time the backing is peeled away. It is important to closely control the amount of silicone applied because too little will prevent the protective paper or film from being removed cleanly and too much is a waste of expensive material. Benchtop XRF analysers have been used for over twenty years to provide a cost-effective solution to this problem, offering rapid, precise analysis with minimal sample preparation and operation by non-laboratory staff.

As the industry looks to increase yield and reduce costs, production facilities need to take more measurements from side-to-side and start-to-finish. This requires analytical equipment to be faster to improve sample throughput. New substrates are being introduced for specialty applications and new market segments, requiring the testing equipment to be more flexible and future-proof. The LAB-X5000 achieves both of these improvements as a result of numerous improvements made to the leading line of LAB-X analyzers.

SILICONE COAT WEIGHT ANALYSIS MADE EASY

Including Hitachi's high-resolution silicon drift detector SDD, the LAB-X5000 delivers results fast. With the optimized "blank correction", users can measure all types of paper with one single calibration, correcting for the "baseline" under the silicone X-ray signal. All the operator has to do is measure a blank sample (i.e. not coated with silicone) before measuring production samples of the same type, and repeat this step every time the paper type changes. It's that simple!

Preliminary results are displayed within seconds on the analyzer's large, industrial LCD touchscreen. Pass/Fail messages can be setup for fast product acceptance/rejection decision, and clear assurance that the final product meets specification.

The LAB-X5000 is calibrated by measuring a series of well-characterized samples. Setting-up samples (drift correction monitors) are measured at the time of the calibration, and again in the unlikely event that the analyzer drifts, so there is no need to re-measure calibration standards again.

For this application, the LAB-X is equipped with a sample spinner to compensate for potential sample heterogeneity and deliver repeatable results. Built-in atmospheric compensation delivers reliable analysis without the need for helium, minimizing the cost per analysis while retaining optimum measurement stability.

Advanced data handling capabilities include connectivity to ExTOPE Connect, a cloud-based service for storing and managing analysis data anytime, anywhere. Up to 100,000 results and spectra are stored on-board the analyser. Results can be printed on the optional integrated printer and transferred via USB.

SAMPLE PREPARATION

To prepare the sample for analysis, operators cut a disc of paper or film with the cutter provided, and place it in our unique sample holder. After introducing the holder in the LAB-X5000's analysis port, they simply press the Start button to initiate the analysis.

PERFORMANCE AND RESULTS

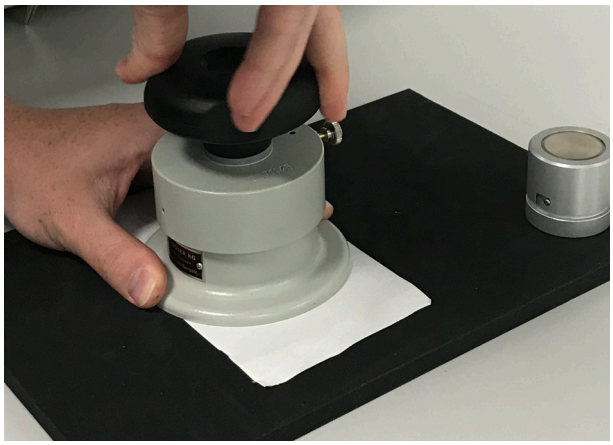
For this application, the LAB-X5000 was calibrated by measuring a series of glassine paper with known silicone coat weight to establish the relationship between the Si coat weight and its X-ray signal. A blank correction was applied to correct for Si baseline.

Table 1 and Graph 1 show the typical calibration performance the LAB-X delivers for this application.

The limit of detection (LOD) was calculated from the results of 10 repeat measurements of an uncoated glassine paper, and the precision from 10 repeats of a sample with 0.85 g/m^2 Si. The analysis time was set at 40 seconds per reading.

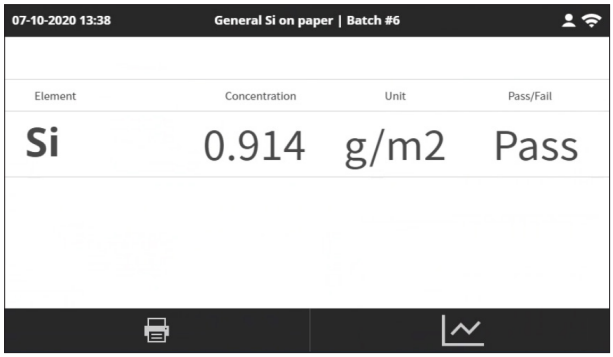
To demonstrate how the blank correction adjusts the baseline for different types of paper, a series of well-characterised clay-coated samples were analyzed using a glassine paper calibration, after a silicone-free clay-coated sample was first measured as a blank. Results are shown in Table 2.

Finally, Graph 2 and Table 3 show the superb stability of the LAB-X5000. For this test, a sample was measured periodically over a period of 6 months, with no restandardization or other adjustments. During that time, the LAB-X was switched off during a 2-week holiday period, it was exposed to varying ambient temperatures (15 to 25 deg C), and taken off-site for several demonstrations.



Preparing the sample for analysis

Starting the analysis



Results screen

Table 1: Typical calibration performance for the determination of Si on paper

Analyte	Calibration range (g/m^2)	Standard error of calibration (g/m^2)	Guaranteed limit of detection (3σ) (g/m^2)	Limit of quantification (10σ) (g/m^2)	Mid-range precision (95% confidence) (g/m^2)
Si	0 – 1.4	0.01	0.003	0.010	0.006

Graph 1: Calibration graph for Si on paper

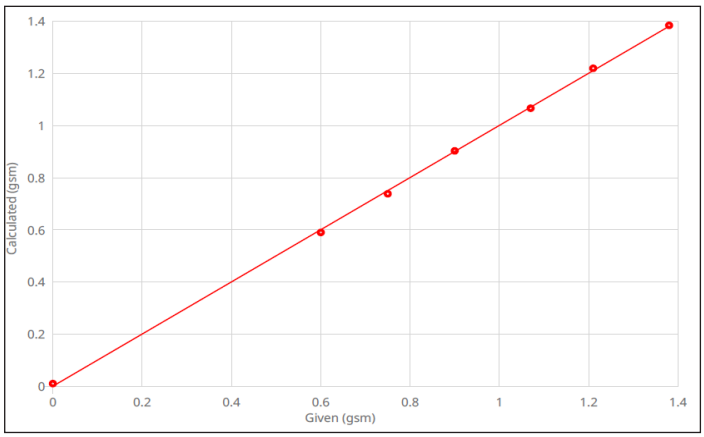


Table 2: Accuracy data for a set of clay-coated samples

Given Si coat weight (g/m^2)	LAB-X5000 result (g/m^2)
0.38	0.32
0.59	0.52
0.73	0.66
0.92	0.90
1.15	1.12
1.34	1.34
1.43	1.39

Graph 2: Stability test results over a 6-month period

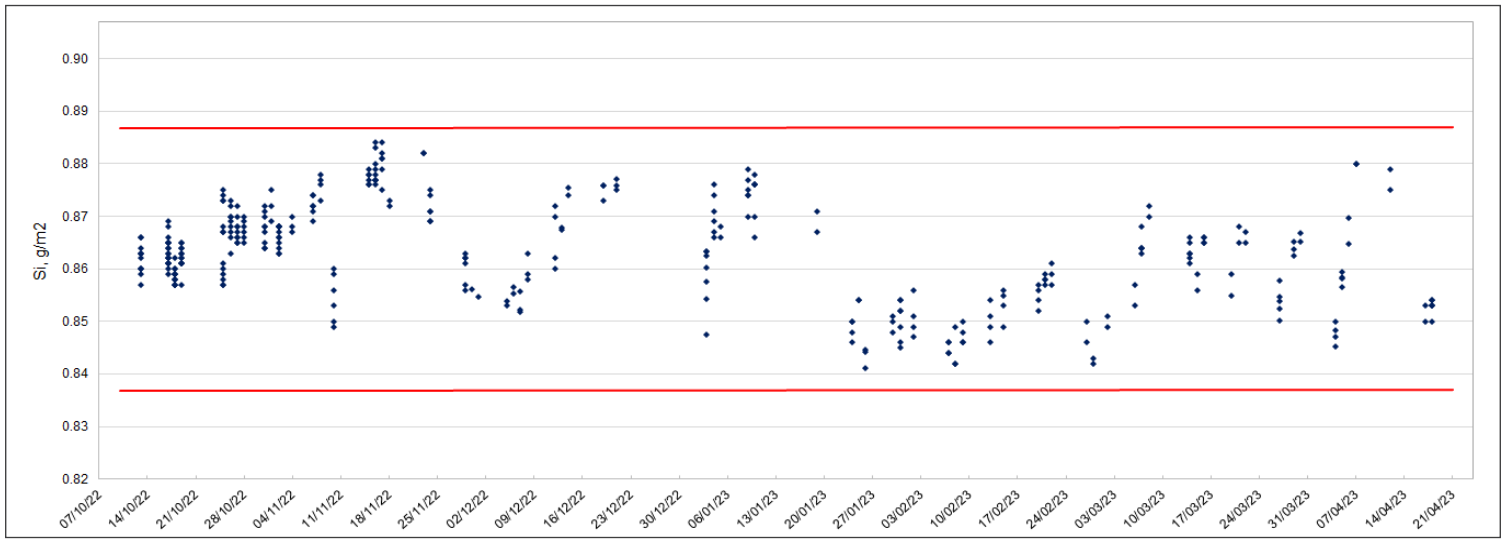


Table 3: Stability test results statistics

Average (g/m^2)	Standard deviation (1σ) (g/m^2)	Relative standard deviation (%)	Minimum reading (g/m^2)	Maximum reading (g/m^2)
0.864	0.010	1.1	0.841	0.884

SUMMARY

Once calibrated, Hitachi High-Tech's LAB-X5000 provides cost-effective, rapid and accurate determination of silicone coat weight on a wide variety of paper and film, enabling operators to ajust the coating process quickly and ensure a consistent final product quality.

The LAB-X brand has been trusted by the release liner manufacturing industry for decades for its reliability, ease of use, stability and ruggedness. With these same benefits and more, the LAB-X5000 is an ideal quality control tool close to the production line or in the plant's laboratory, delivering results within seconds for maximum productivity.

ORDERING INFORMATION

The instrument configuration and accessories used to produce the data in this application note are included in the following packages:

- LAB-X5000 "Silicone coat weight (with integrated printer)" package
  (P/No. 10010089)
- LAB-X5000 "Silicone coat weight (no integrated printer)" package
  (P/No. 10027113)

Visit **www.hitachi-hightech.com/hha** for more information.