LUMETRICS

OptiGauge Precision Thickness Measurement

Application Note: Glass Ampoule Testing

Summary

A medical products company contacted Lumetrics and discussed the possibility of measuring the thickness of the ampoule glass of their medical product. 20 sample sets of glass ampoules containing a fluid were provided by the customer to Lumetrics for measurement of glass thickness using the OptiGauge.

Each ampoule was measured at 30, 45, and 60 degree measurement locations along the "larger belled dome end" using a custom fixture assembled by Lumetrics to accommodate and position the ampoules below the OptiGauge probe in order to yield accurate and repeatable results. Figures 1 and 2 illustrate the ampoule measurement locations and a finished ampoule fixture used for positioning, respectively.

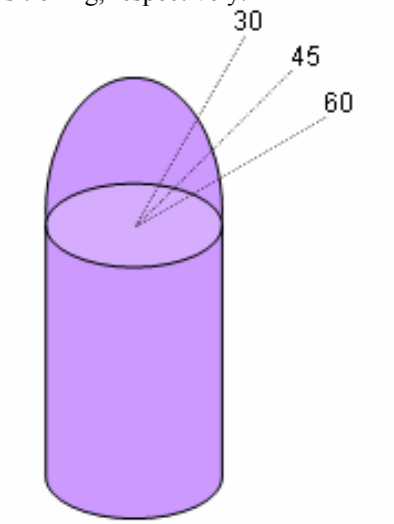

Figure 1: Glass Ampoule Thickness Measurement Locations

This series of measurements showed the viability of using the OptiGauge to measure the glass thickness along the larger dome end of the ampoule. Measurements showed that the thickness varied as the system measured from before the dome up to the tip of the dome.

Figure 2: Glass Ampoule Positioning Fixture and OptiGauge Probe Assembly

Technology

The OptiGauge is a new and highly advanced way of monitoring materials whether flat, round, or bubbled. It directs coherent light through translucent materials, even dyed, and measures the reflections coming back from each of the surfaces. It's so flexible that a single system can support multiple measurements kilometers away from each other. The OptiGauge is in use within four main industries; Ophthalmics, medical applications including, films, tubing, balloons, and packaging, precision optics and glass, and food packaging.

The OptiGauge has gathered strong support due to its inherent precision and reliability; accuracy to 100 nanometers. It is extremely flexible; can be used in any range of configurations whether on-line or off-line. Multiple probes can be mounted to a single control unit providing an efficient, cost effective solution. The OptiGauge can output data in many formats, integrate into a process control system or simply output data to excel or other data manipulation software.

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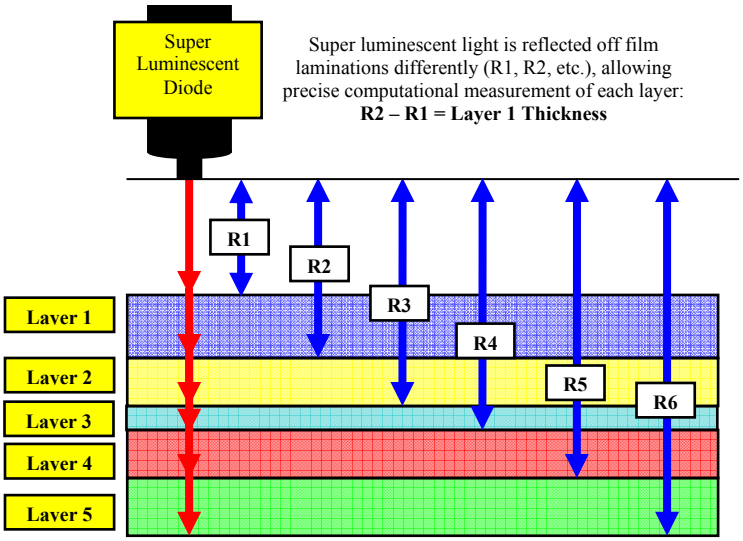

Analysis of five-Part Film

- Laser diode beam directed at target material will reflect and capture portion of light reflected from each layer in the film.
- Advanced processing algorithms calculate and display individual layer thickness on Lumetrics' graphical interface.
- 1310 nm wavelength laser is eye-safe for plant and lab use.

Procedure and Results

Before measuring each sample set, the ampoules were first positioned upright for several minutes to allow the fluid to drain sufficiently from the belled dome end to ensure that thickness measurements were not affected by the thin fluid layer. [It should be noted that during initial setup of the measurement fixture, it was observed that the OptiGauge measured the total thickness of the glass plus fluid as a single layer thickness. This indicates that this fluid probably has an index of refraction very similar to the borosilicate glass.]

After remaining upright, each ampoule was mounted into the fixture, and measured at 30, 45, and 60 degree positions as shown in Figure 2. The assumed material index of refraction was 1.5; however, the actual index may differ by several percent, which would shift the absolute measurement values for the entire data set.

By manually measuring the ampoule set Lumetrics determined the angle, for these products, that showed the thinnest points. This allowed the customer to move to the second phase of the project. By understanding the effectiveness of the manufacturing process the customer was able to predict the dome thickness least likely to break and yet meet all the manufacturing output criteria.

As a second stage the system was mounted on an ampoule manufacturing system to measure the ampoules as they were being made. The system consisted of a simple X/Y stage that the probe holder was mounted on. This holder had an angle block that held the probe at a specific angle respective to the ampoule. In the case of the customer, this angle was 45%. This fixturing allowed the probe to "read" the thickness of every ampoule after it was formed through the heating process. Measurements were taken as the ampoule was spinning in a position beside where the next ampoule was being made. A number of points were collected based on the dwell time of the ampoule. In this case the Lumetrics system was sampling at 50 measurements per second and the dwell time was less than one second. These data points were collected and then fed to a statistics program that evaluated the measurements.

The results of this testing exceeded the customers expectations. By measuring each ampoule the customer was able to determine the ideal process controls for each product being manufactured, independent of the batch ampoule variability. This allowed them to manage the variables of manufacturing including the correct speed of rotation and heat level. This information could then be fed back to the controls system. The feedback loop of this process is now underway. The ampoule measurement system provided the feedback to dramatically decrease breakage and improve production.

Specifications

Measurement Range	0.0005" to 0.35" 12 microns to 9 mm
Absolute Accuracy	0.000004" / 0.1 micron
Measurement rate	50 Hz

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