Improving the measurement of non-round containers

JOCHEN SCHULZE OUTLINES RECENT IMPROVEMENTS MADE FOR THE CONTACT-FREE THICKNESS MEASUREMENT OF CONTAINER GLASS

THE FLAT PROBES

At Glasstec 2006, Precitec Optronik presented its optical probes to the glass industry; these probes enable the customer to have accurate and fast contact-free measurement of glass thickness from just one side.

The CHRocodile M4 sensor boasts a high measuring rate, a small compact size and a modular design. Glass of between 0.1-35 mm in thickness can be measured, and the high sensitivity of the electronic device means that coloured glass containers, such as brown beer bottles or green liquor bottles, can be measured.

The optical probes are very good at measuring round container glass, but their high aperture also enables them to measure non-round containers, even when the probe may not be measuring perpendicular to the surface during rotation.

HOW IT WORKS

The wall thickness of container glass is measured using the chromatic length aberration of a special lens system. To do this, white light is launched into an optical fibre and directed into the measuring head. The optical probe consists of a lens with a well-defined colour length error; it focuses the light leaving the fibre onto the glass surface being measured, according to the wavelength. This means that there is always only one wavelength in focus on the surface. The spectrometer analyses the reflected light. The spectrum shows a sharp peak for the wavelength focussed on the glass surface.

The calibration performed at the factory calculates the distance from the optical probe to the glass surface from the wavelength found. In wall thickness measurement, the front and rear sides of the bottle glass are in the measuring range. Correspondingly, two peaks can also be observed in the spectrum, from which the distances to the front and rear sides of the glass are determined. The glass thickness is calculated from the difference. Here, the sensor automatically makes allowance for the refraction index of the glass.

THE CHROCODILE M4

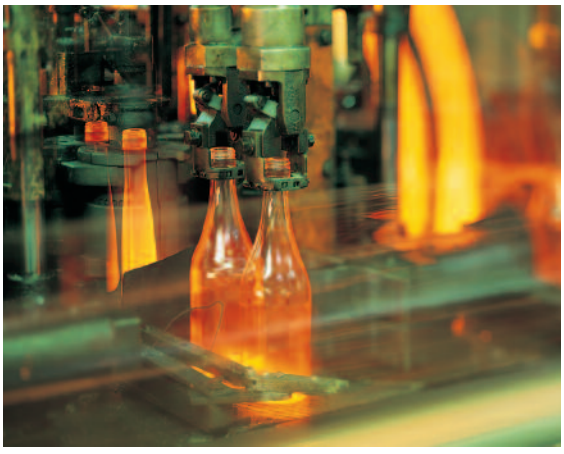
USE IN THE GLASS INDUSTRY

The CHRocodile M4 supplies the distance from the outside and the inside, as well as the glass thickness, 4000 times per second. Since the measuring spot has a diameter of only a few hundredths of a millimetre, even the smallest flaws do not remain undetected. In an inline thickness measurement, a new independent measured value for distance and thickness is obtained for every millimetre at a glass speed of 4 m/s. With the special design of the measuring heads it is possible, for example, to measure slanted surfaces in an angle range of ± 20° to the optical axis.

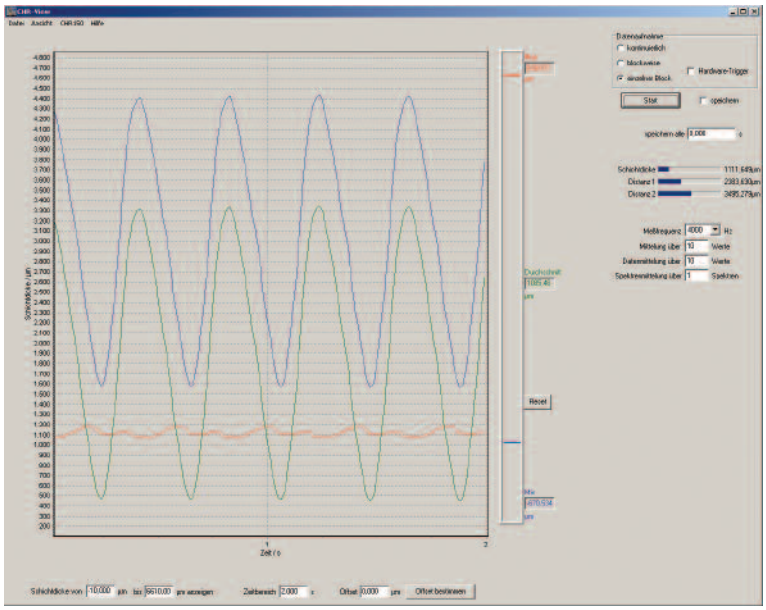
In measurements performed on glowing glass surfaces, the hot ambient air causes wavy effects as a result of density fluctuations, which in turn cause major measuring errors in other optical methods, such as laser triangulation. With the chromatic sensor, the streaking effect is negligible thanks to the high numerical aperture of the measuring heads.

The CHRocodile M4 has a wide optical dynamic range. Since a reflection from the rear wall is also evaluated in thickness measurements, the absorption of the wall material can prevent the use of optical sensors with a narrow dynamic range in the case of dark or tinted glass. The CHRocodile M4 is therefore suitable for measurements on dark sunglasses, brown beer bottles and almost opaque small cosmetics bottles.

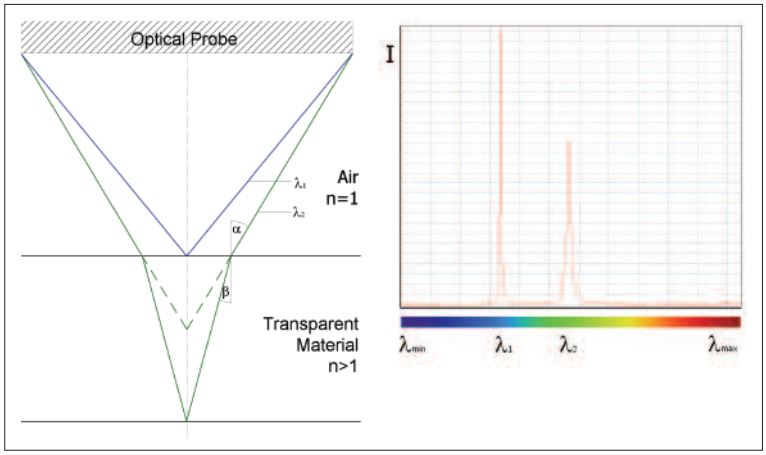
At the same time as the thickness measurement, the distance values for the surfaces are also obtained. This >



STREAKING EFFECTS ON GLOWING GLASS BOTTLES DO NOT AFFECT MEASUREMENT



SIMULTANEOUS EVALUATION OF WALL THICKNESS AND ROUNDNESS ON A GLASS BOTTLE



BEAM PATH AND SPECTRUM IN A GLASS THICKNESS MEASUREMENT

> means that the rotation measurement of symmetrical objects also calculates the object's ovality. The only prerequisite is that it is fixed concentrically to the axis of rotation. The wobble error is also determined at the same time.

A RANGE OF MEASUREMENTS

The CHRocodile M4 is ideal for calculating the following measurements:

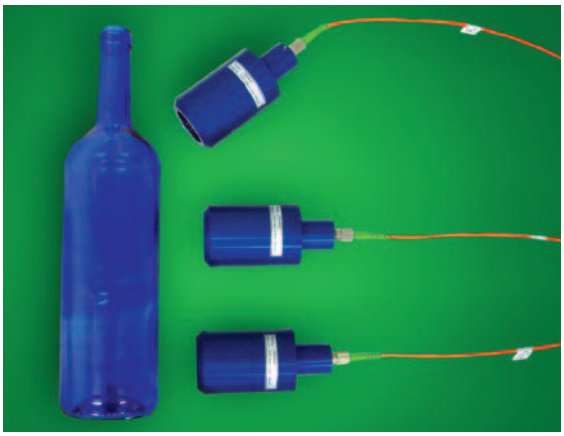
- wall thickness and shape (e.g. ovality) on round bottles, including around engravings and textures
- determining the wobble error (eccentricity) when measuring the bottle neck
- the shape and wall thickness of the side surfaces on rectangular bottles, as well as the thicknesses of the corners
- thickness and evenness deviation on flat glass.

These measurements can be taken inline during production or on a random sample basis in the testing laboratory.

Customers want to use this design to measure container glass thickness at different heights at the same time, such as on a stop-rotate machine, however the big aperture of the probes requires a big diameter, so it was not possible to put several of the classic probes on top of each other. This meant that measurements at different heights could not be simultaneously undertaken, or the optical probes would have to be situated around the bottle, which is not always possible because very often the space is not available.

FLAT PROBES

The solution to this problem is to flatten the optical probes, so that these flat probes can enable the simultaneous measurement of the thickness of glass containers of different heights when they are stacked on top of each other.



ARRANGEMENT OF THE MEASURING HEADS FOR A WALL THICKNESS MEASUREMENT

The advantage of this new probe is that the high aperture still remains for the horizontal dimension, which means that both round and non-round containers can be measured in the same way as before. Cutting does not have any influence on the measurement because in the vertical dimension, the aperture is reduced but not needed, because no tipping of the bottle in that direction occurs when it is turned. This means that several optical probes can be stacked on top of each other and the thickness of round and non-round containers can be measured simultaneously at different height positions when they are stacked on top of each other.

UPGRADING TO FLAT PROBES

Customers who have already a CHRocodile sensor with optical probes can easily use the new flat probes as they can be connected to all CHRocodile control units in the same way as the classic probes are. The new flat probes are passive elements with no electrical connection to the control unit and are therefore very robust. This means that the control unit (CHRocodile M4) and the existing software can be used with all round and flat Precitec Optronik optical probes.

It is Precitec Optronik's company policy to undertake developments according to customer requirements. The new flat optical probes are available for a measuring range of between 10 and 25 mm and will be demonstrated on the Precitec Optronik booth at Glasstec 2008, which is in hall 13, stand 13B72. ■

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