Temper Scanner 5D: The new complete metrology scanner after the furnace exit and its capabilities for furnace optimization and quality control

Technology

Since 2004 Viprotron has focused on line scan cameras and specialized illuminations for different optical problem areas in the architectural glass industry. The Quality Scanner 3D with the brightfield channel for defects according to the standards (EN 1279 I, ASTM C1036, etc.), the darkfield channel for low-contrast defects or „white haze“ and the reflection channel for coating defects, are the benchmark for the industry since 2012. In 2017, Viprotron was the first to launch an Anisotropy Scanner, and was presented an award for the „most innovative equipment“ by Glass Magazine.

With the new Temper Scanner 5D, Viprotron has launched a complete scanner with a missing function in our product range: the measurement of rollerwaves & edge kink at the exit of a tempering furnace. Together with the other existing proven functions, Viprotron now provides a modular scanner system, which can be equipped with up to five detection channels depending on the needs of the customer:

Figure 1 (Temper Scanner 5D)

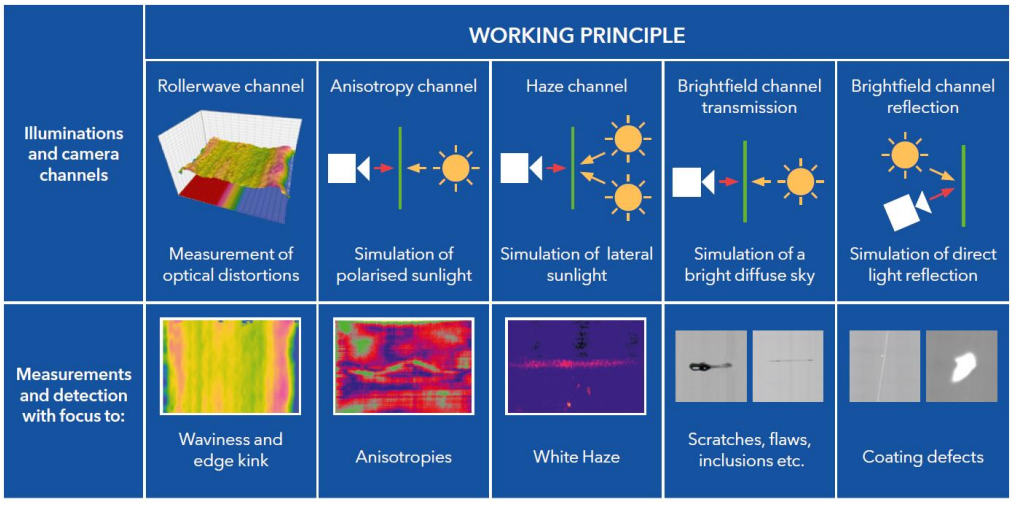

Figure 2 (Overview functions in Temper Scanner 5D)

While the channels 1 – 3 cover typical furnace-related issues and are the base for the optimization of furnace parameters, channels 4 & 5 look for typical glass defects, in case there is no earlier possibility for a quality control in the workflow. All channels can be combined or used as a single channel, depending on what the customer really wants to control after the furnace. All combinations are possible.

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Roller wave & edge kink measurement

It is no news: the more accurate the data are for making a decision, the better the result! That´s why equipment and machines have become more precise over the years. The Temper Scanner 5D is a good example for this. Developed by Viprotron as a modular scanner with a new level of roller wave measurement as a base, it combines smart, state of the art line scan camera technology with a continuous optical triangle light reflection pattern. This allows for the highest spatial resolution: In transport direction, every 0.5 mm there is a measurement of the local rollerwave with a resolution of up to 2mD. That provides a measurement accuracy which is on a new level and there is no real need to have an additional perpendicular measurement to verify or adjust the measurement values in the transport direction, as it is needed in older equipment setups.

As the measurement is very precise, all typical rollerwave patterns like hammer, pocket or saddle, as well as non typical patterns, are measured. The measurement results are shown in mD for the local bows and in mm as Peak/Valley values for the height of the distortions for the leading edge, the center and the trailing edge.

Viprotron has measured roller wave samples on a Temper Scanner and compared those samples to highly accurate tactile measurements performed on a precision table in a specialized lab, which is even used by the hyper-exacting automotive industry. It turns out that there were hardly any differences in the measurements as shown in Figure 3.

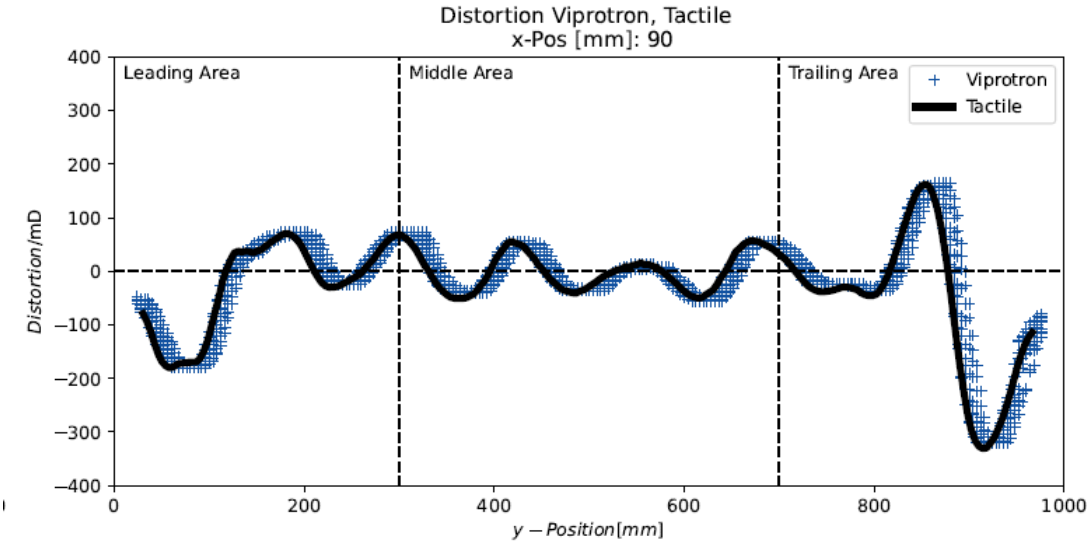

Figure 3 (Comparison Distorsion Tactile and Viprotron measurement)

In addition to the measurement accuracy, the Temper Scanner does not need a general or glass thickness-related calibration, which makes it easy to use. Nor does it require a special exit conveyor, which makes it easy to install even as a retrofit. The line scan cameras only need clean gaps between the rollers, which normally exist.

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Anisotropy measurement

As the first supplier in the architectural glass market in 2017, Viprotron realized an anisotropy measurement function in a completely new type of scanner. The need of such a scanner was obvious: Claims appeared because there were no standards in the industry and the quality level, in terms of anisotropies, was discussed only after the final customer saw the delivery quality in their façades. To be able to measure the anisotropies, define a certain quality level and gain a process stability to achieve this, an objective measurement tool was needed. Viprotron had such a tool and was part of the team helping to set up the meassurement standards. Since that time, the standards continue to be followed: (ASTM C1901 21 or DIN SPEC 18198). Now that there is a much better understanding of anisotropies themselves, the appropriate scanner equipment, and the quality levels that can be achieved.

The Viprotron Anisotropy Scanner function measures the light intensity differences in the glass which appear when glass contains anisotropies. With these values as a base, it calculates the optical retardation in nanometers (nm) according to special mathematical models. These models provide exact values with a tolerance of less that seven (7) nm, which is well within the standards that require less than ten (10) nm.

The results can be displayed in a percentage of the overall „good“ area according to a given threshold in nm, after which the anisotropies become visible to the human eye. A second display version can show the mean value results per lite, which can be defined without using a threshold.

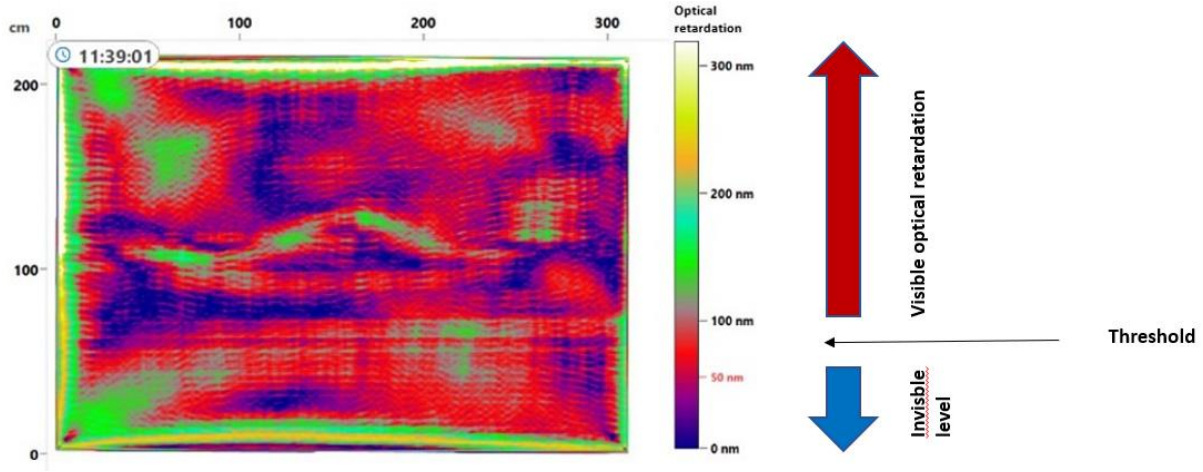

Figure 4 (Display of anisotropies using a threshold for „good/bad“ evaluation)

As the intensity of anisotropies is normally high at the edges, corners and possible holes, those areas can be faded out when evaluating the quality, because when finally framed, the corner and edge values are of little interest.
The anisotropy function comes with several further analysis tools, that are described in more detail in our eBook available on Viprotron.com.

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White Haze detection

Known as „Skunk Marks“, or other descriptive names, the „White Haze“ effect comes from uneven rollers or from glass that bowed in the furnace. The Haze can be found either in the middle or at the edge areas of a lite, when traveling through a flat glass furnace. Depending on whether the bowed glass is concave or convex, the weight of the glass lies on these areas of the glass and leaves behind surface contamination. Under normal production conditions this is difficult to detect and normally will only later be seen on a scanner of an IG line or finally at the construction site.

The typical way of finding low contrasted area defects like roller marks, white haze, etc. is with a darkfield channel. Viprotron has used this technology since 2004 to detect fine hairline scratches and all other low contraste defects in architectural glass. Our Haze Scanner reveals the areas of white haze just after the glass exits the furnace, alerting the operators who can easily find these contaminated areas and polish them out.

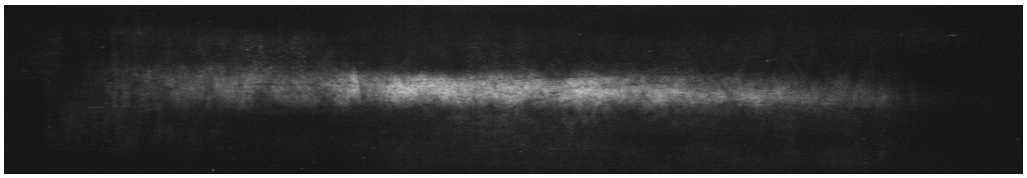

Figure 5 (Display of „White Haze“ in black & white)

Depending on the complete setup of the planned Temper Scanner, this option can be added as darkfield in transmission (illumination underneath the conveyor) or as darkfield in reflection (illumination above the conveyor).

Brightfield in transmission

In some production workflows, there is no good location to control the glass for quality issues. In these cases, where the furnaces are the focal point, glass comes together from many different processes to be checked against the quality standards (like EN 1279). The concept is not to spend money for scanners on the many individual processes, but to concentrate on scanning the glass at the furnace exit. Although the ideal place to check glass for quality is after a washer, to avoid pseudo defects, the brightfield channel can be very effective after tempering. Typically, high-contrast defects with a clear contour will easily be detected even after a furnace. Examples are scratches, or raw glass defects like inclusions or bubbles.

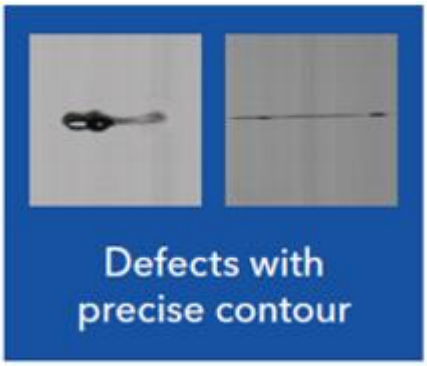

Figure 6 (Defects with a clear contour)

Brightfield in reflection

As the number of temperable coatings keeps increasing, typical coating defects, like scratches, pinholes or voids, can be detected after a furnace as well. That´s why Viprotron decided to make this channel available at that place of control. The reflection channel is not only good for detecting coating defects, but to improve the data volume for better defect classifications. The more data from different channels are available for a certain area, the better the classification can be, base on precise repeatable objective measurements, and not on undefined data collected from different sources.

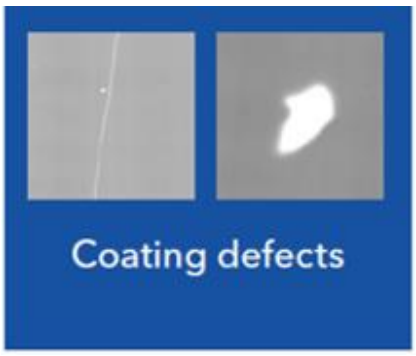

Figure 7 (Coating defects)

Base for process optimization

Using all available channels, the Temper Scanner 5D is the most complete scanner in the architectural glass industry. It not only provides the opportunity to collect as much precise data as possible, e.g. for accurate classification, but even at this stage in product development, the 5D already provides tools for analyzing the data and tools for using the data with relation to the furnace structure / setup. The components of the heating zone and the quench can be displayed over the furnace bed as a separate layer, to help point out the reasons for certain issues in or on the glass. The analysis tools and additional views provided by the separate channels then allow a quicker optimization of the furnace parameters.

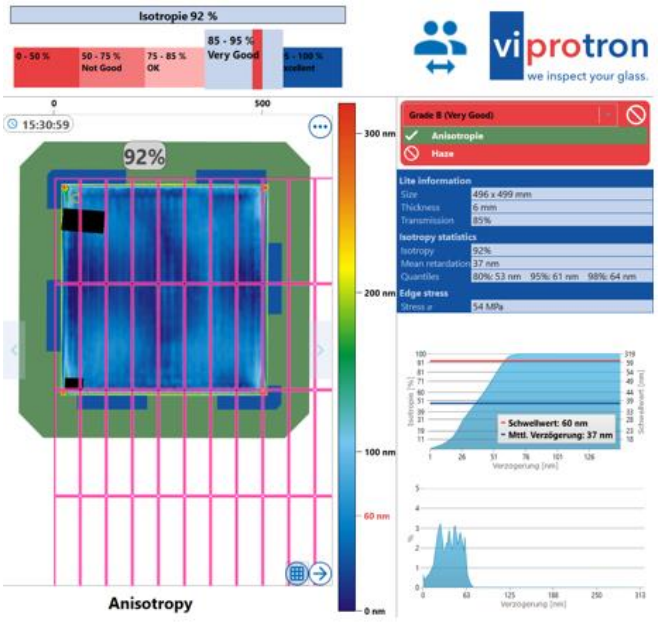

Figure 8 (furnace bed layer)

While the first three channels / functions of the Temper Scanner 5D target the improvement of the furnace parameters, the last two provide a base to find the root cause for defects in the processes before tempering. As mentioned before, a complete scanner to help in all areas of glass quality including tempering.

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