On-Line Measurement for Gum Calender Profiles
Many tire makers are re-tooling their gum calender operations to take advantage of new cost-saving and product-improvement opportunities. Inner liners that have traditionally been produced as flat sheets are now being produced as complex contoured profiles. In many cases additional components are applied on the inner liner prior to spooling. These advancements have stimulated interest in on-line measurement due to three compelling reasons – cost savings, quality control, and tire safety.

Among these reasons, tire safety easily rises to the top. Inadequate inner liner thickness is a tire safety concern, and has been the cause for tire recalls. On August 15, 2012, the US National Highway Traffic Safety Administration announced a recall of one manufacturer’s radial truck tires due to insufficient inner liner gauge. The recall specified that insufficient gauge can cause voids to form causing a risk of sidewall separation. The announcement did not say whether there had been any accidents or injuries related to the problem.

Raw materials cost is a concern for all tire makers. With compound costs near record highs, continuous monitoring is an easy way to keep thickness near the optimum value in order to reduce excess compound consumption. On-line monitoring also has an added benefit because it provides a real-time alarm that alerts operators to intervene any time dimensions fall outside the allowable limits.

Although the inner liner is not ordinarily associated with cured-tire performance, the recent study Effect of Cured Liner Gauge on Tire Performance (R. Christopher Napier, Dirk F. Roukhout, and Walter H. Waddell, ExxonMobil Chemical Company) concluded that that tire performance parameters such as rolling resistance, treadwear, and handling are positively correlated to the cured inner liner thickness. On-line measurement provides an audit trail of dimensional measurement that can be associated to these performance parameters.

**NEW TECHNOLOGY FOR GUM PROFILE MEASUREMENTS**

In order to address these concerns, Starrett-Bytewise Measurement Systems has developed an on-line high-resolution profile measurement system customized for use in these gum calender applications. The system is based on the proven On-Line Profilometer (OLP) currently utilized in tread and sidewall extrusion monitoring. Both systems employ CrossCheck line laser sensors manufactured by Starrett-Bytewise. The Gum Calender OLP is configured as an O-Frame structure with line laser sensor arrays mounted across the top and bottom. A certified registration fixture is utilized to perform a virtual alignment of the sensors, and to stitch the individual sensor data sets into a single global coordinate system. This data set is then matched to a design template, where parameters such as width and thickness are measured. The entire cross-axis data set is acquired in an instantaneous snapshot, so any side-to-side movement in the inner liner stock has no effect on width measurements, as is the case with back-and-forth scanners. Unlike these scanners, the OLP System reliability and maintainability is inherently high because there are no moving parts in the system.

**HIGH-RESOLUTION OLP FOR GUM CALENDER PROFILE MEASUREMENT**

Sensors are built with a special high-resolution CCD detector to achieve higher accuracy. This results in a thickness accuracy of 20 µm or better. This is calculated as the average bias plus 3 standard deviations of a series of measurements made at multiple locations in the field-of-view. Width accuracy is specified as 100 µm or better.

Accuracies of this order require careful attention to thermal drift, which can be caused by seasonal ambient temperature changes as well as process heat, so the system has been fitted with a sealed, insulated cover, an internal temperature control system, and recirculating fans. The multi-channel thermo-electric system maintains the system internals to less than 1 degree Celsius total variation. This reduces thermal drift and assures a long sensor life.

The PSViewer software provides for test plan management, data viewing, and historical reporting. The software can be installed on any network PC for viewing any OLP instrument in real-time. Remote technical support is provided via Cisco WebEx Support Center, which hosts remote support sessions, integrated voice conferencing, video conferencing, remote software updates, system troubleshooting, and software training.
ABOUT STARRETT-BYTEWISE
Starrett-Bytewise Measurement Systems produces non-contact in-line measurement solutions specialized for profile manufacturing industries. Starrett-Bytewise is a complete solutions provider manufacturing line laser sensors, multi-sensor systems, application software, and turnkey measurement solutions. Products are found around the world among the largest global manufacturers as well as the smallest privately-owned companies. For these companies, Starrett-Bytewise technology is a core component of their quality and production management standards.

Starrett-Bytewise is a Division of The L.S. Starrett Company of Athol, Massachusetts, USA – a leader in metrology since 1880. Starrett is a manufacturing company with businesses in precision metrology tools, instruments, gages, optical comparators, vision systems, laser measurement systems, saw blades, granite plates, and lubricants. Starrett has five US manufacturing locations and three international manufacturing facilities located in the UK, China, and Brazil. The L.S. Starrett Company is listed on the New York Stock Exchange under the symbol SCX.

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