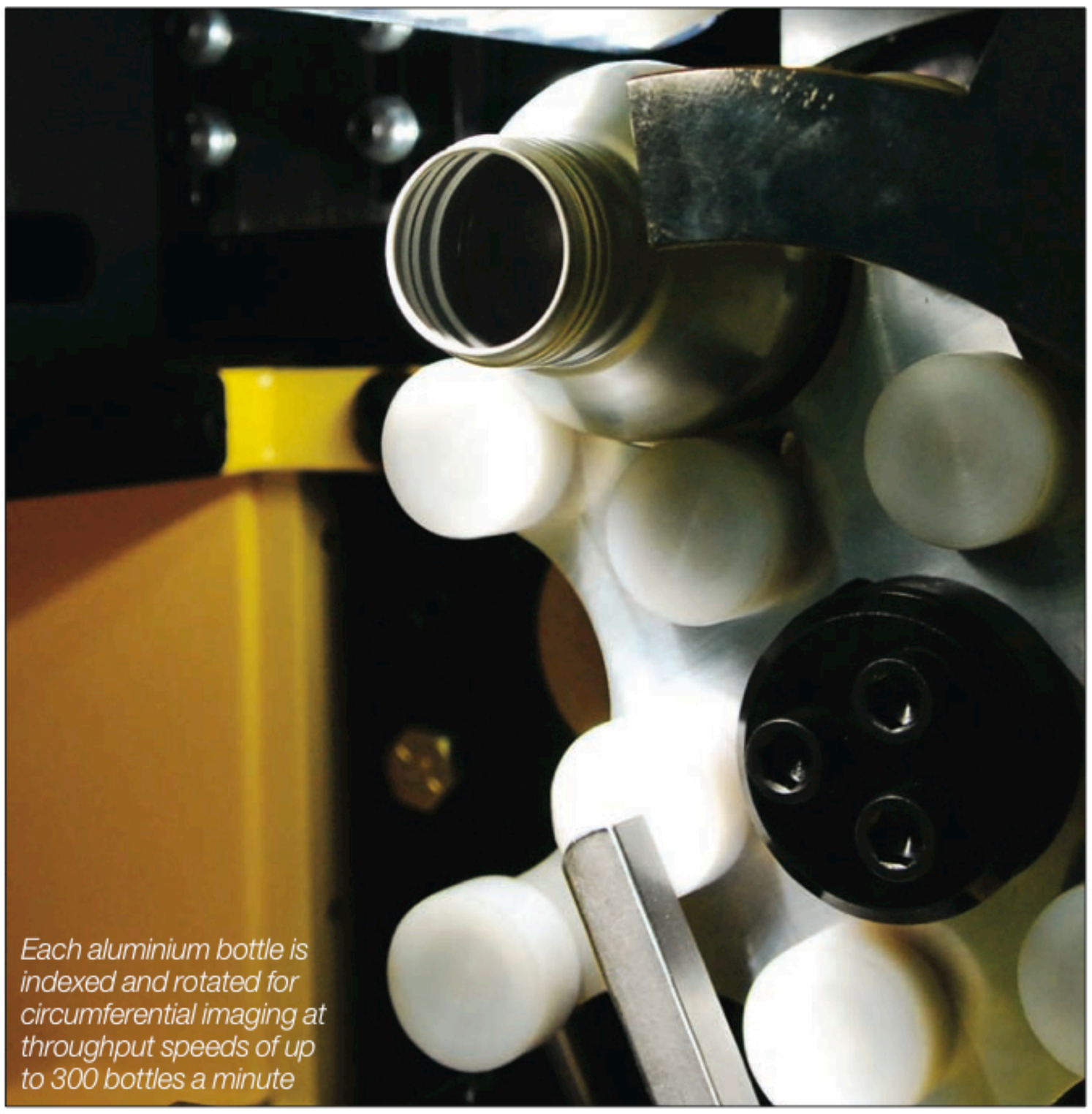
Close scrutiny

*Manufacturing screw-threads into the necks of aluminium bottles is a challenge and requires sophisticated inspection systems, says Amir Novini**



Each aluminium bottle is indexed and rotated for circumferential imaging at throughput speeds of up to 300 bottles a minute

The Alumi-Tek aluminium bottles produced by Ball Corporation in the US feature a screw-thread formed in the neck, making the containers resealable and easily recycled – two key benefits for today's beverage consumers.

The lightweight DWI bottles are produced by Ball at its plant in Monticello, Indiana. The manufacturing process is licensed from Japan's Universal Can, and the bottles have been used in North America since 2007 by ready-to-drink Caribou Iced Coffee, beer brand Miller Lite and vitamin-enhanced water LYF Citrus.

However, the complexity of the manufacturing process can create defects, particularly when necking the can body down to a much smaller diameter and forming the screw thread. The sealing integrity of the bottle may be affected by cracks or other metal deformations, and the coating previously applied to the aluminium is vulnerable to wrinkling and cracking.

Left undetected, such defects can compromise the integrity of the contents or produce unsightly defects that could erode customer confidence. Some of the defects can be subtle in appearance and be buried amongst acceptable process variations and complex features such as the thread pattern.

To address this problem, Applied Vision has created an inspection system which consists of two consecutive imaging stations – one to inspect the upper-neck, thread and curl areas through a side view, and the other to inspect the sealing-surface area from a top view.

Relative to material handling, the top-view area-scan imaging station is adapted directly to the vacuum conveyor immediately after the light tester. The side-view line-scan camera and its lighting system are mounted inside a special handling system developed by Stolle Machinery. This system indexes the aluminium bottles via a star-wheel that rotates each one slightly more than a full revolution per index at throughput speeds of up to 300 bottles per minute. The circular rotation allows the line-scan camera to acquire a complete unwrapped image around the circumference of the bottle from the neck up.

For lighting, high-intensity solid-state white LEDs were chosen for their reliability and light-intensity stability. The upper neck, the thread and the curl areas are illuminated by a continuous LED light source, and the top sealing-surface is illuminated by a pulsed LED light source.

Two different camera technologies are used: a mega-pixel gigabit Ethernet (Gig E) area-scan for imaging of the top sealing-surface, and a two-mega-pixel color line-scan for the upper-neck and thread area.

The top-view imaging system, using an area-scan camera and pulsed LED lighting right after the light-testing station, utilizes Applied Vision's standard Genius algorithms developed for sealing-surface on glass and plastic containers. This is because, although the inspections are performed on aluminium, there are striking similarities to its glass and plastic counterparts with regards to defect characteristics. Any anomaly that can potentially affect the integrity of the sealing area such as splits, cracks and burrs are detected and the defective bottles are blown from the manufacturing line by a rejection station.

The defects which are most challenging to detect are on the thread and curl areas, and include lacquer defects, de-lamination, splits, cracks, dents and scratches. These areas are scanned by the high-resolution colour line-scan camera in the Stolle handler. The lighting geometries and image processing algorithms are critically important in this process, to allow the detection of tiny defects. The image processing learns the thread area patterns and is able to lock on the randomly oriented top and thread area of the aluminium bottle. The normal part features along with acceptable process variations are then suppressed, leaving the defects and the anomalies to be detected with high-level accuracy.

The inspection system was installed at Ball's Monticello plant at the beginning of 2009, and has been operating successfully since.

** Amir Novini is chief executive at US-based vision inspection equipment specialist Applied Vision.*