It has to be LASER

This is the first of what will hopefully be many examples submitted by members of where laser technology provides the only practical means of manufacturing an item or feature.

This issue's winner is Frank Gaebler of Coherent Inc for the use of lasers to solve a high speed package precision perforation problem for an ice cream cone manufacturer.

CO_2 lasers enable high speed package perforation

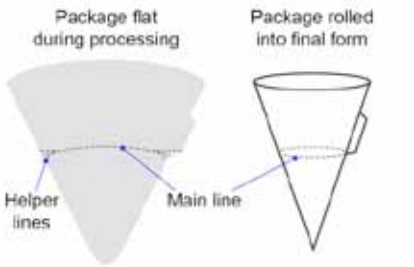
Perforation of food packaging is often required for ease of removal. In this particular application, filled ice cream cones were packaged in a material that is made of 70-80 µm thick paper, coated with an approximately 20 µm thick layer of aluminium; and to facilitate opening of the package, the cone manufacturer needed to perforate through the paper layer while leaving the aluminium layer totally untouched. Preserving the aluminium layer was necessary to maintain the mechanical stability of the package and avoid compromising its function as a barrier to entry for moisture and oxygen.

When first developing the perforation process the manufacturer specified that any new method must meet 3 important criteria. First, it must integrate into the existing production line, in which the packages pass by on a conveyor belt at a rate of three per second. Next, it must add very little unit cost to the product. Finally, the new process must not discolour the paper or produce any noticeable debris, since this would produce a negative customer perception of a food product.

The packaging producer concluded that no existing mechanical method could meet all these constraints. In particular, traditional paper cutting tooling could not operate at the required level of precision on a high speed conveyor belt. The company turned to laser systems developer Clean-Lasersysteme to create a solution.

The laser solution

CO_2 lasers have now become a critical enabling technology in performing high speed, precision package perforation for the packaging industry. The system developed for the ice cream cone manufacturer by Clean-Lasersysteme interfaced a Coherent GEM-100 laser with focusing optics and a two dimensional, galvanometer mirror based scanning system. The GEM-100 is normally run as a 100 W CW laser, but for this application it was pulse width modulated with a 60 - 80% duty cycle in order to produce a dashed, rather than a continuous scribe on the product.



Main and helper perforation lines in ice cream cone packaging

Referring to the diagram, at the point of processing the paper is flat and triangular in shape. The laser cuts a smooth curved line, with two additional “help” lines at each end (to help start the tear in the right spot). The curved perforation then becomes a straight line after the paper is rolled into its final cone shape and glued.

The conveyor belt speed was approximately 1 m/s and held constant. The scanners compensate for this motion and cut while the product is moving. Since laser power is fixed (only the duty cycle, and not the peak power of the laser is varied), scanning speed is really the only process variable. If cuts are too deep or too shallow, then scan speed is altered to re-optimize the process.

Laser considerations

Clean-Lasersysteme selected a CO_2 laser source for this application because its 10.6 µm output is readily absorbed by paper and highly reflected by aluminium. This makes it simpler to cut completely through the paper layer while leaving the aluminium layer untouched.

The additional laser requirements for this application, all of which the GEM-100 laser satisfied, include: compact size to meet space considerations; power stability (±3%) within the process window; good mode quality and rapid pulse rise and fall times to eliminate side lobes and a long power tail, which would lead to charred edges.

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