

Greener greens through Laser processing of food and vegetables

Recent years have seen the development of a greater sensibility towards the environmental impact of the production processes. Manufacturers are trying to streamline the use of resources and materials, switching to greener ways of producing goods.

For the packaging sector this meant an overall reduction of the materials employed. Cardboard boxes, wrapping paper or plastic films, just to name the most common, are being supplanted by their biodegradable equivalents or simply being discarded.

Labels, one of the simplest and most traditional forms of packaging, are also undergoing a similar trend.

Traditionally, printed labels containing various information, were placed on the surface of fruit and vegetables. Labeling is used for marketing information such as logos and pay-offs to logistical information such as identification codes or barcodes. It is key to keep track of the value chain.

The simple actions of labeling requires a whole infrastructure: companies must produce or buy their labels from a supplier, install an industrial printer and finally include machinery to apply them to the surface of the produce to the production line.

Though this is the standard procedure, it has many drawbacks.

First of all, it influences the final price of the product. Producing labels implies having a supplier who make them or just having to print them out and stick them on the product. Secondly, it has an impact on the ecological sustainability of the production process, since the label isn't reused and is wasted. More labels means more plastic and this equation goes against the general trend of reducing plastic use. Third of all, labels mean using some form of glue to stick them on the products. Not only does this require the consumption of chemicals, it also means having a less organic fruit since it has come into contact with chemical adhesives. Finally, the use of printed labels does not comply with a fast-paced market, where flexibility is the key to success.

But what if one could print information directly on the surface of the product?

Today one can do it thanks to CO₂ laser marking. The process has been called "natural branding".

Natural branding

Simply put, natural branding is the replacement of standard physical labels, stuck on the surface of produce, with laser marked labels.

The unstoppable growth of organic food sales seems to suggest that consumers are increasingly aware of genuine, natural, and environmentally friendly fresh products. The leading vegetable wholesalers are already moving toward implementing natural branding. Just look at ICA Gruppen, one of the world's leading fruit and vegetable producers, who has adopted laser-labelling on their products. This transition translates into saving hundreds of kilos of paper and glue, resulting in an eco-friendly product. Moreover, it allows for greater flexibility thanks to the intrinsic features of laser material processing.

The laser marking of fruit and vegetable in detail

Laser labeling of food goes under the wider umbrella of laser marking, a process with multiple fields of application. It consists in the removal of a thin layer from the surface of a material.

When the laser beam reaches the surface, it makes the temperature of the material rise until it causes its sublimation (the instant passage from solid state to gaseous state) or other visible effects.

The removed material creates a well defined contrast between the untouched surface and the one marked by the laser beam. This process is well-known and used in many sectors on materials that aren't destined for food consumption.

The process of labeling through CO₂ laser marking is applicable to any sort of fruit and vegetables. Nevertheless, the best results are obtained with fruit and vegetables having a wooden or thin skin e.g. tomatoes, apples, grapefruits, walnuts, chestnuts, coconuts, pumpkins, etc. Besides fruit and vegetables, laser food labeling can be also applied to products such as cheese and cured meat, as we will see below.

Laser food labeling makes it possible to mark different pieces of information. Food products make large use of codes, labels and other symbols. They serve many purposes: guarantee the safety of consumers, trace products through the various steps of the supply chain and fight the counterfeiting of products. Here is some of the information that can be found on products:

- alphanumeric codes like expiry date, batch code or PLU codes
- barcode or QR code
- logos and commercial brands
- controlled origin symbol

Traditionally, this information can be applied to the product in different ways:

- fire branding for products such as cheese or cured meats
- ink printing for products with non edible shells like eggs
- adhesive labels for fresh produce

The laser labeling of fruit and vegetables through laser marking replaces all those techniques with a faster, more flexible tool.

- **Speed:** laser's most renowned characteristic is speed of execution. A laser source integrated in a system with a conveyor belt can mark batches of tens of items a minute or more.
- **Precision and cleanliness:** thanks to numeric control, it is possible to etch characters, codes and images in high resolution on the surface of products without leaving any type of residue. This characteristic makes it easy to 'print' QR codes, barcodes or complex logos.
- **Flexibility:** laser technology's innovative characteristic is its versatility. A simple reprogramming of the laser control software is all that is needed during production to switch from one application to another.
- **Environmentally friendly process:** laser marking can replace the use of many potentially polluting materials. Plastic or paper labels, glue and ink can all be eliminated through the use of laser labeling. This would generate an important reduction of the ecological footprint. The products would then become less harmful for the environment or for the people that consume them.
- **Permanence:** laser markings are applied directly to the surface of the product and are therefore impossible to erase and difficult to counterfeit. This technique is perfect for products with symbols that guarantee their origin or quality.

The technology used in laser food labeling

A laser system for food labeling is mostly identical to any other laser marking system. The fundamental components are:

- a CO2 laser source
- a scanning head
- a software for numeric control and automation

The design of the machine layout can't be defined in advance. The final implementation will depend on the type of plant, processes and product used. A company that distributes and markets apples will need a different configuration than a company that does laser markings on cured meats.

Nonetheless, all machines will need a CO2 laser source, a scanning head which moves and focuses the beam on the surface of the object and a software connected to the control unit that interfaces the user and the system.

Let's go over the characteristics these components need to efficiently carry out laser food labeling through laser marking.

Laser food labeling: choosing the right laser source

Among the laser sources available on the market (fiber, Nd:YAG), CO2 lasers give the best results in terms of process efficiency. This is due to various reasons.

Organic materials achieve high absorptivity in the infrared wavelength. Now the CO2 lasers fundamental wavelength corresponds to 10.6 micrometers, which places them fully in the infrared portion of the spectrum.

Also organic materials, as opposed to metals for example, have a very low thermal conductivity that doesn't disperse the heat generated by CO2 laser.

For that reason CO2 laser are the right choice for laser labeling of food products.

But not all CO2 lasers are made equal. In laser marking applications, the stability of laser parameters is key. They guarantee markings with high levels of precision, definition and consistency. The best processing output is achieved when the laser medium remains in optimal conditions.

Sadly, this ideal state is seldom - if ever - obtained with gas based lasers. As the name suggests, in CO2 lasers the medium is made of a gas mixture, a fraction of which is represented by carbon dioxide. Over time, the natural contamination of gas molecules changes the composition of the medium, producing a gradual degradation of the laser beam parameters, resulting in a downgrading of the processing output. In other words, signs of the laser beam mutation will show through the deterioration of the quality of the laser markings.

Maintenance from the producing company of the laser source is crucial, and it is usually the only way to restore the laser's original parameters. However, it means putting the production on hold and therefore increasing costs.

In order to avoid this inconvenience - which is typical of all gas lasers - El.En has created a self refilling laser source that can be restored autonomously.

But which output power must one choose for laser labeling applications? The answer is: it depends on the specific application and production process. Laser sources come in many output power options. From low to high power, there is a wide range of options to choose from. Laser marking applications on fresh produce doesn't require such a great power. Nonetheless, keep in mind that the power of the laser source will have a direct influence on

the speed of production. Thus, unless one have specific needs, a rule of thumb is that the more powerful the laser source, the faster the processing time.

Laser scanning head

Every laser marking application needs a scanning head to operate. A laser scanning head has the function of moving the laser beam on a defined path determined by the output provided by the control software, in other words, the operator.

But why is a scanning necessary? A laser beam is just a beam of light which originates from a source and travels in a straight line until it reaches an obstacle. In order to create a mark, a laser must be deflected and focused where needed.

The function of galvo mirrors is to move the laser beam along the X and Y axes of a work area. The z-axis len's task is to focus the laser beam on the working area by dynamically increasing and decreasing its focal length.

The laser source and scanning head have to work in tandem. The laser's position, focus, power and the duration of the beam emission have to be decided according to production requirements. This goal is achieved by the software and control unit which are responsible for the coordination of all these devices. The software is the interface between the machine and the operator. It translates the patterns needed for production into coordinates and parameters that the control unit sends to the scanning head and laser source.

This system of production allows for great flexibility. To change the operation being performed, all that is needed is a change of the software's parameters or the insertion of a new CAD file.

Some applications

Let's see two applications of laser food labeling through marking. We have chosen two of the most representative among the many we have implemented over the years.

A case study: marking traceability codes on apples

One of our customers asked us to integrate a CO2 laser labeling system in an industrial line for the selection and sorting of apples.

We created a system composed of a laser scanning head, a low power CO2 laser source with a wavelength of 10.6 micrometers and a computer with the software that controlled the process.

The system was able to determine the position and the speed of each apple passing on the conveyor belt, thus synchronizing the behaviour of the laser beam with the position of the apples on the belt. It proved to be extremely fast: up to 6 apples were marked per second.

As we said this speed is not fixed but depends on the complexity of the results that need to be achieved.

The energy consumption of the system extremely low: only 0,3 kW.

Although it was designed for apples, this configurations of a laser labeling system can be extended to any typology of fresh fruit and vegetable and seamlessly integrated in existing production lines.

A case study: marking official signs on Italian seasoned cheese

The marking of food products such as seasoned cheese and cured meat is a key phase of their production process. The marked information includes brand and codes that establishes the batch of production, identify the producer, allow to trace back the origin of the product.

Seasoned and semi-seasoned cheese has always been marked through heat. This traditional method, while being inexpensive, is incredibly slow and inflexible. In order to change any small piece of information , the marking tool has to be modified or redone.

A more efficient way of imprinting information on food is to use the CO2 laser application. The laser makes it possible to mark faster and with higher precision. Compared to traditional ways of marking food, laser marking is an extremely precise process: the parameters are highly adaptable and can suit the characteristics of most products.

A cheese producer asked us to create a laser marking system for cheese to speed up and optimize its production process.

The machine we designed had this configuration:

- Completely washable stainless steel structure
- Conveyer belt
- CO2 laser source
- High performance laser scanning head
- Controlling software

The process is semi-automated. The system involves the presence of an operator placing the products to be marked on the conveyor belt. The conveyor belt transports the products to the laser processing space which is isolated from the environment with doors that can be opened for inspection and cleaning operations. The laser scanning head, controlled by a software, guides the laser beam on the surface of the product, completing the laser marking in a few seconds. In a few minutes only, a single operator is able to mark dozens of wheel of cheese.

The advantage of such a system is its flexibility. First of all, the machine is designed to be modular: each module can be replicated and adapted according to the needs of the manufacturer. For example, one can install different laser sources for different applications.

Also, the system allows to change the information to mark very quickly . One just have to modify the parameters inserted in the control software to perform a different process.

A world to explore

The laser labeling of produce is an application yet to be explored. It offers many possibilities and greatly reduces companies environmental footprint. Each product has different qualities and the parameters used should change accordingly. It is therefore fundamental to study a tailor made solution with the help of a laser producer.

Here at EI.En. we have gained a wide experience in designing CO2 laser system for food labeling. If you have an application in mind, contact us at marketing@elengroup.com and we will be happy to help you find the right laser solution and not just labeling ones, with the help of the EEn. lasers you can automatize a bounce of processes on food and relevant packaging!