IK4 TEKNIKER
Research Alliance

Photonics

transfer quality control from the laboratory to the production line

The application of photonic technologies to the agri-food sector has meant a revolution in the field of food control, since it has enabled measurements to be taken and a multitude of data on its quality and properties to be recorded, in a precise, rapid and continuous way.

Thanks to these technologies, the industry operating in this sector can substitute the long manual processes used to collect spot samples for their subsequent submission to a laboratory for analysis, for non-destructive measurements capable of offering precise and varied information on food quality and safety throughout the entire value chain.

NEEDS AND TRENDS

This revolution has not only been preceded by the demands of consumers, but also by a series of needs and trends that have arisen in the agri-food sector, including:

- Increased quality and safety requirements in production entails the need to monitor increasingly more parameters online and preferably for all products, instead of sampling.
- A reduction in operating and maintenance costs, through preventive monitoring in real time.
- The growing interest towards a customised diet.
- The need to digitise the agri-food sector under quality, safety and traceability parameters.

From the Basque technology centre IK4-TEKNIKER, work has been combined in the field of sensor technology with the integration of photonic technologies to online measurement systems in various industrial sectors, including agri-food. In this sector, the focus has been on transferring the measurements from the analysis laboratory to the plants or production lines, facilitating their monitoring and quality control.

TECHNOLOGICAL CHALLENGE

The development of advanced sensors has been an important challenge in itself, because it requires the integration of heterogeneous technologies that become more complex the stricter the operating conditions and the regulations. This difficulty has been further exacerbated because the devices need connectivity, to be safe and cost effective, and to be able to operate autonomously and unattended.

Added to this is the complexity involved in transferring the principles of measurement to these devices that have traditionally been applied at the laboratory level, while maintaining the robustness, reliability and repeatability of measurements during the entire useful life of the equipment. Such requirements need the proper combination and integration of various technologies and areas of knowledge, from simulation elements to the principles of Mechanics, Fluidics, Op-

tics, Electronics and Communications. Finally, precise knowledge is needed concerning the requirements and applicable regulations in the operating environment in which the sensor will later be located.

APPLICATIONS AND EXAMPLES

The solutions developed by IK4-TEKNIKER for the monitoring of food quality include **in-line microscopy systems** that detect, quantify and classify particles in a fluid and are capable of detecting impurities or bubbles in products such as oil, beer and wine, as well as quantifying and typifying microorganisms or nutrients in water.

For their part, sensor solutions based on **Vis-NIR spectroscopy** enable, through fast, cost-efficient and non-destructive measures, the identification of many key parameters in solid and liquid foods, from the fat content in cow's milk or the alcoholic strength of a wine to the ripeness of a fruit (kiwi, tomato or avocado, among others) and the percentage of moisture in liquids such as oils, and in solids such as flour.

Colorimetry techniques also contribute to the development of appropriate solutions to measure parameters as diverse as the turbidity of a fluid or the presence of aromatic substances.

IK4-TEKNIKER is currently working on numerous photonic technology applications for the agri-food sector, such as the detection of allergens and pesticides by spectroscopy and electrochemical methods; the detection of pests in greenhouses through automated inspection via 2D/3D and multispectral vision; and the low-cost mass monitoring of environmental conditions in farms or processing plants, by means of self-powered IoT sensors, to guarantee the quality of the product, as well as animal welfare and projection towards a circular economy.

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