

X-Ray in Food Inspection

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Increasing regulatory and consumer demands have intensified the pressure on the food industry to implement reliable methods of food inspection to ensure product safety and quality. X-ray technology can be used in food inspection to detect physical contaminants and to study the internal structure of food products for quality purposes.

Food inspection

The operation of food safety management systems incorporates the principles of Hazard Analysis and Critical Control Points (HACCP); inspection forms a key part of procedures designed to control potential hazards. The role of technology for inspection purposes has become increasingly important due to the ever-increasing emphasis by consumers and regulatory authorities on food safety and quality.¹ Emerging issues such as fraud and the intentional contamination of food have also highlighted the importance of food inspection technology.

Many different methods and technologies are available for the inspection of food, including metal detectors, optical camera systems, magnetic resonance imaging, ultrasound, and X-rays.² The application of a specific inspection technology is related to the nature of the food and the specific purpose of that inspection.

X-ray inspection

X-rays are a form of invisible electromagnetic energy with short wavelengths and high energies. The use of X-ray technology is most familiar to people through its use in medical imaging. However, X-rays can also penetrate food products and allow the imaging of the internal features of the food to detect physical defects or contaminants without damaging the food product.^{2,3}

As an X-ray enters a food it loses some of its electromagnetic energy. If the X-ray encounters a dense area in the food, such as a metal contaminant this will reduce the X-ray energy further. As the X-ray leaves the food a sensor in the inspection equipment converts the X-ray into a greyscale image of the foods interior. The denser a contaminant, the darker it will appear in the image, which helps in its identification.^{2,3}

Uses of x-ray inspection

Depending on the type of X-ray inspection equipment and the nature of the food product, X-ray inspection can identify a variety of physical contaminants including metal, glass, rubber, stone and some plastics.³ Because X-ray inspection provides non-destructive imaging, its use has become more widespread for packaged, processed foods, particularly those in bottles, cans, jars and pouches.² Increasingly, as the technology advances X-ray inspection is being used for in-line production control and verification.

Considerable research has highlighted the potential of X-ray inspection for the grading of fruits, vegetables and grains, and detection of bones in chicken and fish.^{2,4} Some advanced X-ray inspection systems can simultaneously perform in-line quality checks detecting physical defects, measuring mass, counting components, identifying missing or broken products, monitoring fill levels and inspecting the seal integrity of packaging. As such X-ray inspection systems may help reduce inspection costs for some food businesses.²

Disadvantages of x-ray inspection

X-ray inspection has a number of distinct disadvantages including its relatively high cost and the need for high voltage power supplies to generate X-rays.² X-ray inspection also has a number of perceived disadvantages, e.g. the perception that X-ray inspection irradiates food. However, the X-ray dose used for inspection purposes is significantly lower than that for irradiation and does not affect the safety, quality or nutritional value of foods.⁵

Concern has been expressed that operators may be exposed to harmful levels of radiation from X-ray inspection systems. However, under normal circumstances the level of radiation that an operator in direct contact with an X-ray system will receive is less than that received in a year from natural background radiation.

As the capability of X-ray inspection to detect contaminants is directly related to the density of the product and the contaminant, there are some contaminants which X-ray inspection systems have difficulty in detecting and imaging. These include hair, paper/cardboard, low density plastics and stone, string, wood and soft bone tissue such as cartilage.^{2,3} Other inspection technologies and controls are often used to identify these low density contaminants. However, advances in X-ray inspection technology and particularly coupling of other technologies to improve imaging are addressing some of these limitations.²⁻⁴

Conclusions

The detection of physical defects and contaminants using X-ray technology is an important part of quality control for specific food businesses. While technological advances have made X-ray inspection systems more affordable, reliable, and easier to use, with improved image quality and detection capabilities, they still remain costly.² However, continuing advances in X-ray inspection should ensure that use of this technology expands within the food industry.²

References

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