

Non-destructive testing in the dairy industry

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Non-destructive testing (NDT) refers to a range of techniques and methods used to inspect, test, or evaluate milk and milk products for defects or impurities without causing damage to the sample. The primary objective of NDT is to assess the quality of the milk and milk products while allowing it to remain intact for its intended use.

1. Key characteristics of non-destructive testing:

- **Non-Damaging:** NDT methods do not alter the physical, chemical, or mechanical properties of the material or component being tested.
- **Detection of Defects:** NDT techniques are used to detect and locate surface and subsurface defects, flaws, cracks, discontinuities, and other imperfections that could compromise the performance or safety of the item under inspection.
- **Techniques and Methods:** Common NDT methods include visual inspection, ultrasonic testing (UT), radiographic testing (RT), magnetic particle testing (MPT), liquid penetrant testing (PT), eddy current testing (ECT), and infrared thermography (IRT), among others.
- **Quality Assurance:** NDT plays a critical role in quality control and assurance by ensuring that products meet specified standards, regulatory requirements, and safety criteria.

Overall, non-destructive testing enables manufacturers, inspectors, analysts and engineers to assess the integrity and reliability of materials and components efficiently and effectively, and to

assess the quality and safety of milk and milk products thus contributing to improved safety, reduced costs, and enhanced product performance. Non-destructive testing (NDT) plays a crucial role in ensuring the quality and safety of dairy products throughout various stages of production and processing.

2. Applications of NDT in the dairy industry:

2.1 Ultrasonic Testing (UT):

- **Quality of Dairy Products:** Ultrasonic waves can be used to assess the internal structure, textural properties and quality of dairy products such as yogurt, cream, ice-cream and cheese. Besides changes in density or voids within the product can be detected, and by assessing these properties, manufacturers can optimize production processes, monitor product consistency, and ensure desired sensory attributes.
- **Equipment Integrity:** It is also used to inspect the integrity of dairy processing equipment such as tanks, pipes, and fittings. It helps in detecting cracks, leaks, and other defects without damaging the equipment.

2.2 X-ray and Gamma-ray Testing:

- **Detection of Contaminants:** X-ray and gamma-ray imaging are used to detect foreign objects or contaminants in dairy products. This ensures that only safe products reach consumers.
- **Packaging Integrity:** These methods can also be employed to check the integrity of packaging materials to prevent leakage or contamination during transportation and storage.

2.3 Infrared (IR) Thermography:

- **Temperature Monitoring:** IR thermography is used to monitor temperature distribution in dairy processing equipment such as heat exchangers, pasteurizers, and cooling systems. This helps in ensuring proper heat treatment and maintenance of hygiene standards.

2.4 Spectroscopic methods:

- Spectroscopic techniques, such as infrared spectroscopy and near-infrared spectroscopy (NIRS), have gained popularity in dairy testing due to their non-destructive nature and rapid analysis capabilities. These methods utilize the interaction of light with dairy product samples to obtain information about their chemical composition, including protein, fat, moisture, and sugar content. NIRS, in particular, is widely used for process control, quality assessment, and authentication of dairy products, allowing for real-time monitoring and ensuring consistent product quality.

2.5 Magnetic Particle Testing (MPT):

- **Detection of Surface Defects:** MPT is used for detecting surface defects in ferromagnetic materials such as stainless steel used in dairy processing equipment. It helps in identifying cracks, corrosion, and other defects that could compromise product safety.

2.6 Visual Inspection:

- **General Quality Control:** Visual inspection remains a fundamental NDT method in the dairy industry. It includes checking for abnormalities in product appearance, texture, and consistency, as well as inspecting equipment for cleanliness and wear.

2.7 Acoustic Emission Testing:

- **Monitoring Equipment Under Stress:** Acoustic emission testing can be used to monitor dairy processing equipment under stress conditions, such as during high-pressure operations. It helps in detecting any signs of mechanical failure or structural weaknesses.

3. Specialized instruments used in NDT:

Besides these, Milkoscreens and Milkoscans are specialized instruments used for non-destructive testing (NDT) of milk and dairy products. Here's how they are typically utilized:

3.1 Milkoscreens:

- **Purpose:** Milkoscreens are devices used for rapid analysis of milk composition, particularly for fat, protein, lactose, and other components.
- **Non-Destructive Nature:** They operate on the principle of light absorption or transmission through the milk sample, which allows for non-destructive measurement. This means the milk remains intact and can still be used for further processing or consumption.
- **Applications:** Milkoscreens are commonly used in dairy farms, milk collection centers, and processing plants to quickly assess the quality of incoming milk batches. They help in ensuring that milk meets specified standards before it undergoes further processing.

3.2 Milkoscans:

- **Purpose:** Milkoscans are advanced instruments used for comprehensive analysis of milk composition and properties.
- **Non-Destructive Nature:** Similar to Milkoscreens, Milkoscans use technologies such as infrared spectroscopy to analyze the chemical composition of milk without altering its physical state.
- **Applications:** Milkoscans provide detailed information on fat content, protein content, lactose content, and other parameters of milk. This data is crucial for dairy processors to optimize production processes, ensure product consistency, and meet regulatory requirements.

3.3 Advantages of Milkoscreens and Milkoscans in the Dairy Industry:

- **Efficiency:** These instruments provide rapid results, allowing dairy operators to make quick decisions about milk quality and processing.
- **Accuracy:** They offer precise measurements of milk composition, helping to maintain product consistency and quality.
- **Non-Destructive Testing:** Milkoscreens and Milkoscans analyze milk without altering its physical properties, ensuring that the milk can still be used for its intended purposes after testing.
- **Quality Control:** They contribute to stringent quality control measures in dairy production, ensuring that only high-quality milk is processed into dairy products.



Overall, Milkoscreens and Milkoscans are integral tools in modern dairy operations, facilitating efficient and accurate testing of milk composition while preserving the integrity of the dairy products. In summary, Non-destructive testing methods have revolutionized the dairy industry by preserving sample integrity and providing accurate analysis without compromising the quality of dairy products. All these NDT techniques collectively contribute to ensuring that dairy products meet regulatory standards for safety, quality, and consumer satisfaction. By identifying defects early and non-destructively, these methods help minimize waste, improve efficiency, and maintain the integrity of dairy production processes. As technology continues to advance, non-destructive testing methods are expected to become even more sophisticated, providing valuable insights into the dairy products' composition, structure, and safety.

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