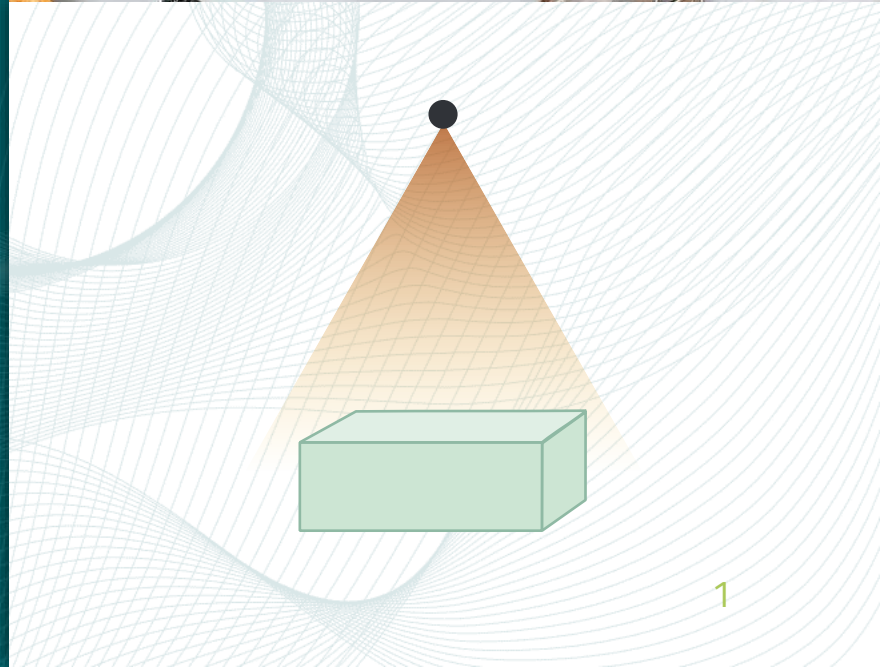
Introduction

The purpose of the Paper is to provide an overview of the application of XSpectra®, our proprietary inspection technology, in the food segment of frozen vegetables (the "**Product(s)**") to show on a preliminary basis the capacity of XSpectra® Detector to identify the presence of high-and low-density foreign bodies (also "**FBs**").

The tests were carried out at the Xnext Demo Center using a demo machine, equipped with XSpectra®, placed on a 6-metre conveyor loop, and the Products were inspected using a vertical system configuration, having the X-ray generator and the detector positioned respectively above and below the conveyor belt.



Background of the testing process

Compared to conventional X-ray inspection systems, which operate at energy levels above 25 keV, XSpectra® is able to operate even at low energies (up to 5 keV). This represents a significant competitive advantage since product non-conformities can become more visible at low energies.

The XNEXT proprietary inspection system, under normal operating conditions, performs the inspection analysis with the support of XInspector, a self-learning detection software trained for each specific application, which allows the automatic detection of foreign bodies and non-conformities.

Since these are preliminary tests, XInspector was not used, but instead the image analysis tool XSpectrum Analyzer was applied to process the data obtained from the inspection.

The results of the test and the relative images shown in this Report are therefore the result of simply exploiting the precision of the XSpectra® Detector.

Beside the above, as mentioned before, the **tests** were **executed using a standard demo machine available at XNEXT Lab**. Since the standard machine has fixed settings, in terms of geometric configuration (the distance between the X-ray generator and the detector, in relation to the size of the product packaging) the inspection system used is **obviously not optimized to inspect the Products**.

Tested Products

The Products used for preliminary tests are represented by 3 frozen ready meals of different types and packaging.

For each type of Product, tests were carried out to verify the capacity to detect the presence of foreign bodies.

The conveyor belt speed used for these tests was:

- **30 cm/s** for samples #1 and #2
- **40 cm/s** for sample #3

Sample #1
Peas

Sample #2
Vegetables Soup

Sample #3
Spinach

FBs used for testing

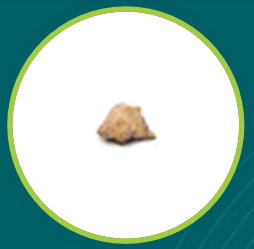
We used **12 different types of FBs**, to our knowledge, quite common for this type of production.

Also, we focused more on **low-density FBs which are difficult if not impossible to be detected with conventional inspection technologies**.

FB1
Orange plastic

FB2
Plastic fragments

FB3
Glass

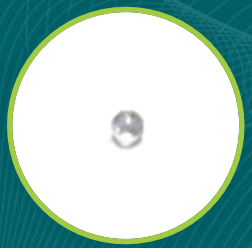


FB4
Stone

FB5
PTFE
Ø 6 mm

FB6
Ionx wire
0.5 x 5 mm

FB7
Ionx sphere
Ø 1 mm



FB8
Glass sphere
Ø 2 mm

FB9
Copper sphere
Ø 2 mm

FB10
insects

FB11
Wood
12 x 7 x 15 mm

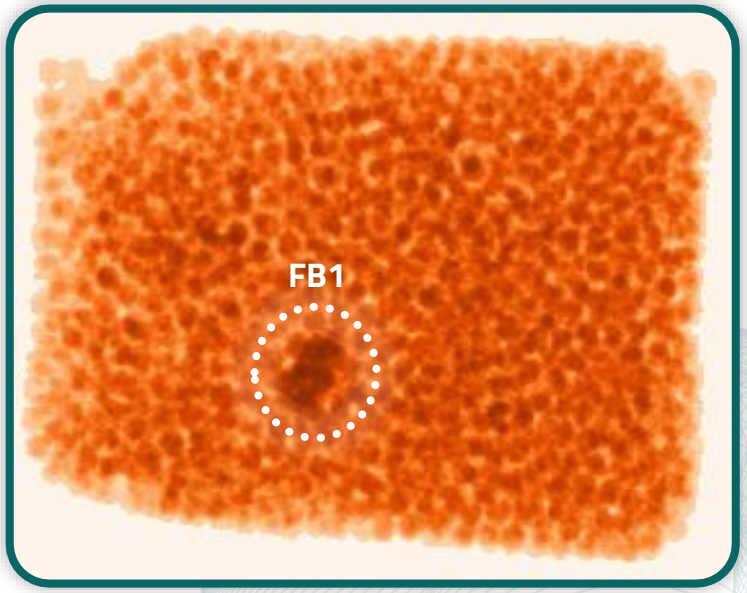
FB12
Blue plastic

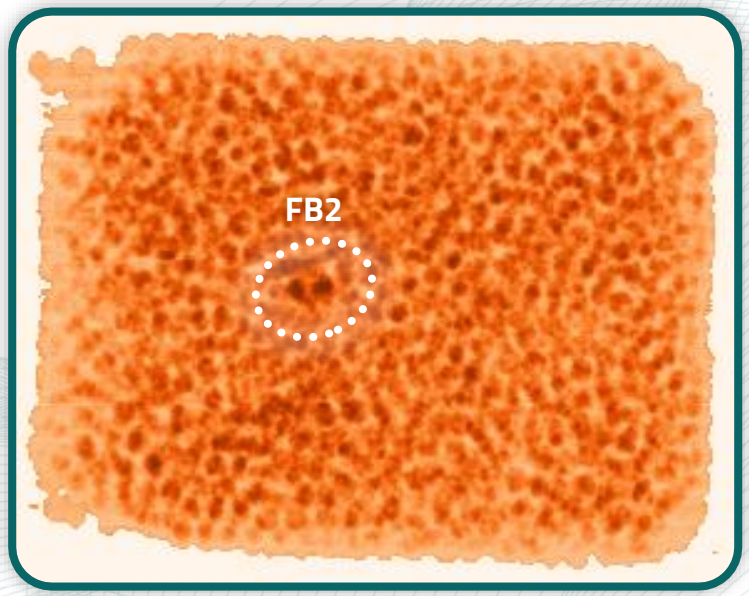
Main Test Findings

Sample #1

FB1
Orange palstic

FB2
Plastic fragments

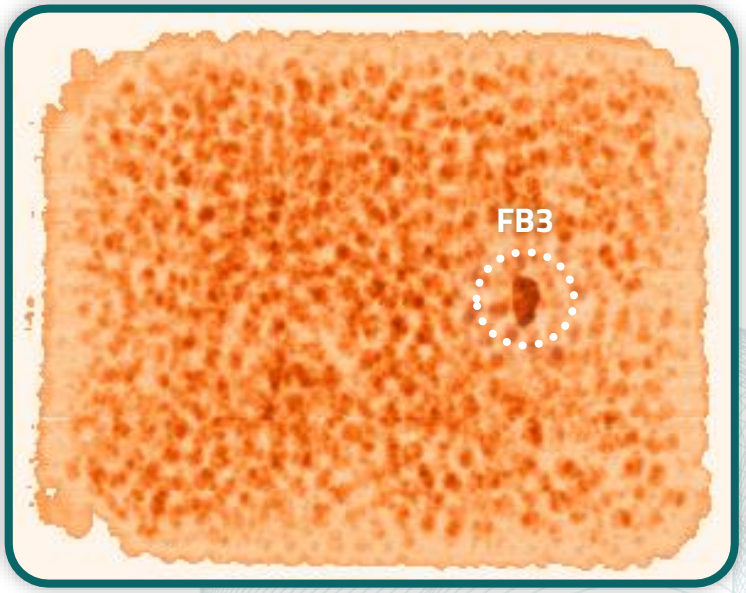


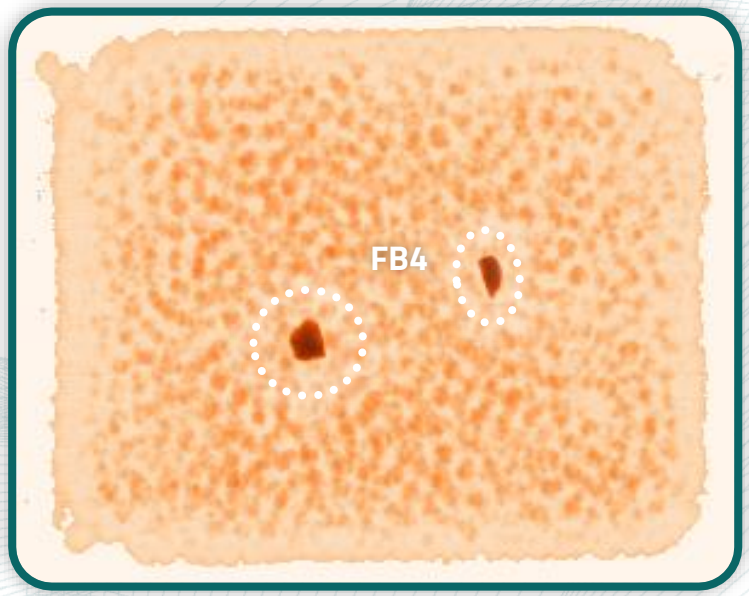


Sample 1

FB3
Glass

FB4
Stones





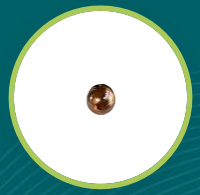
Sample #1

FB5
PTFE

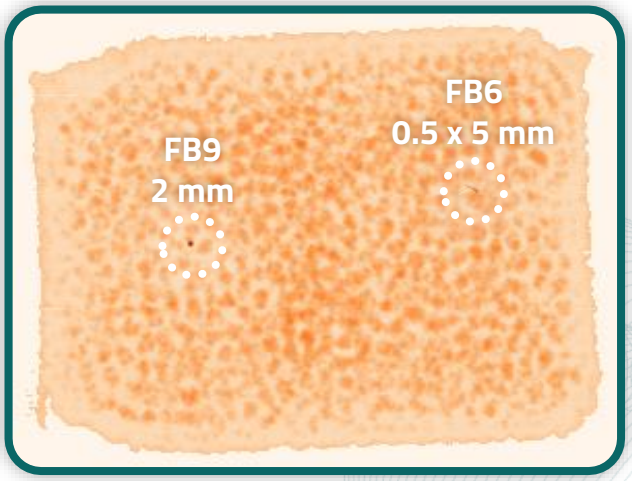
FB6
Inox wire

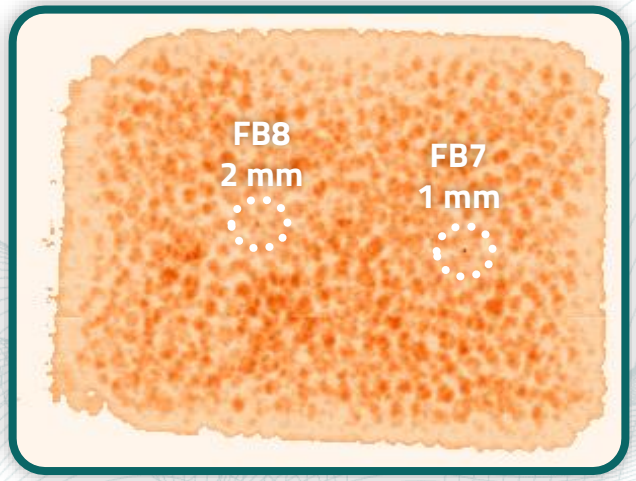
FB7
Inox sphere

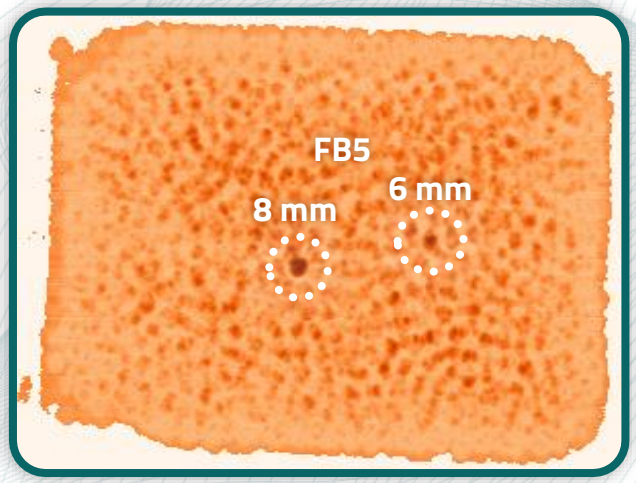
FB8
Glass sphere



FB9
Copper sphere



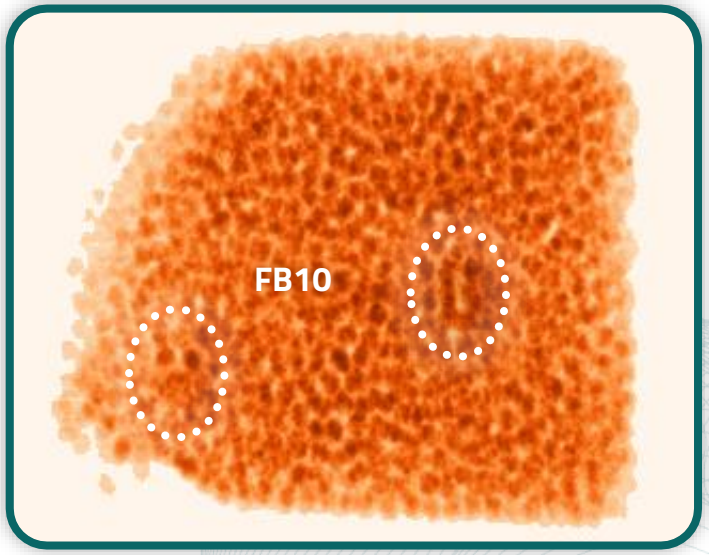


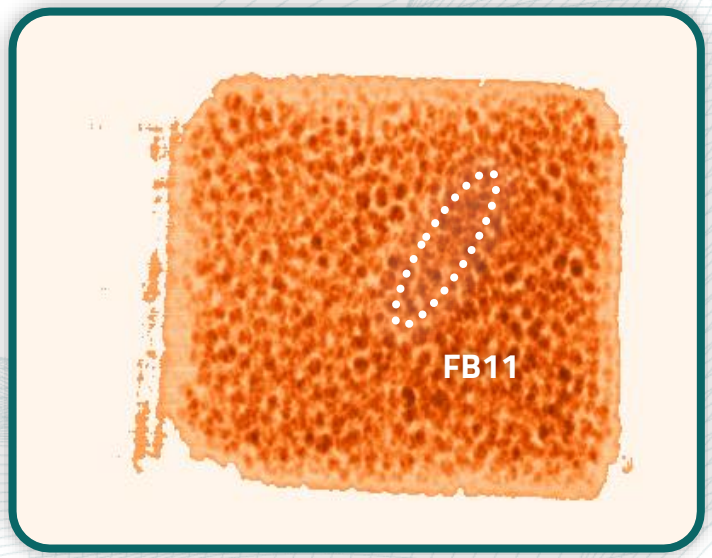


Sample #1

FB10
Insects

FB11
Wood



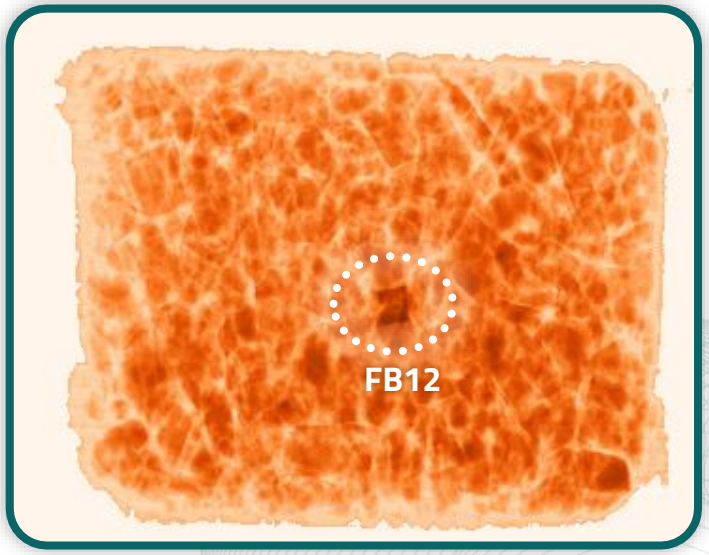


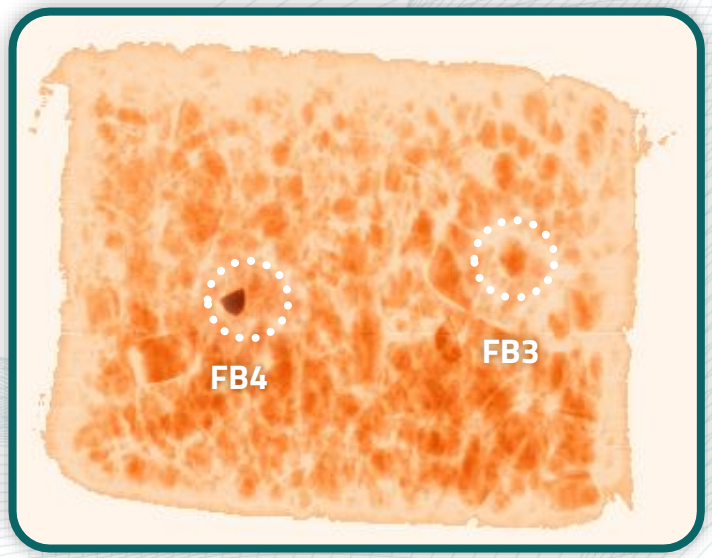
Sample #2

FB3
Glass

FB12
Blue plastic

FB4
Stone





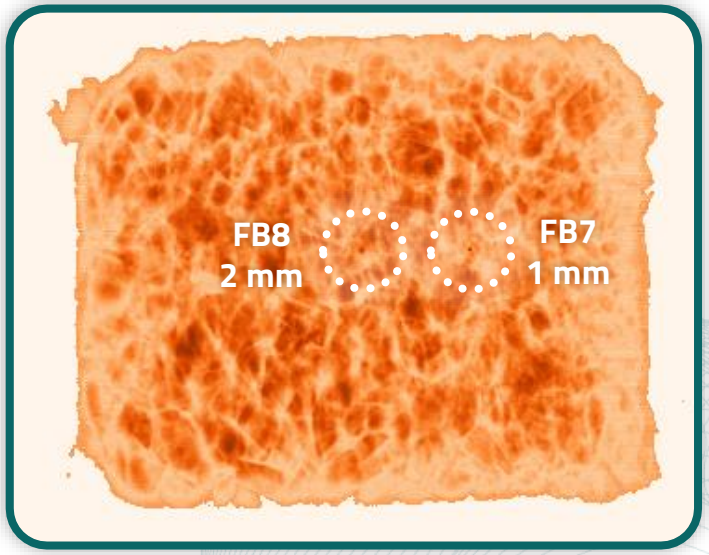
Sample #2

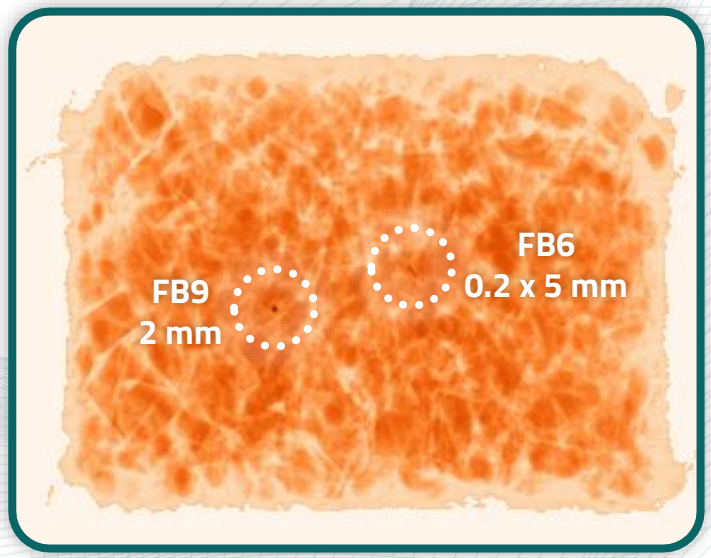
FB6
Inox wire

FB7
Inox sphere

FB8
Glass sphere

FB9
Copper sphere



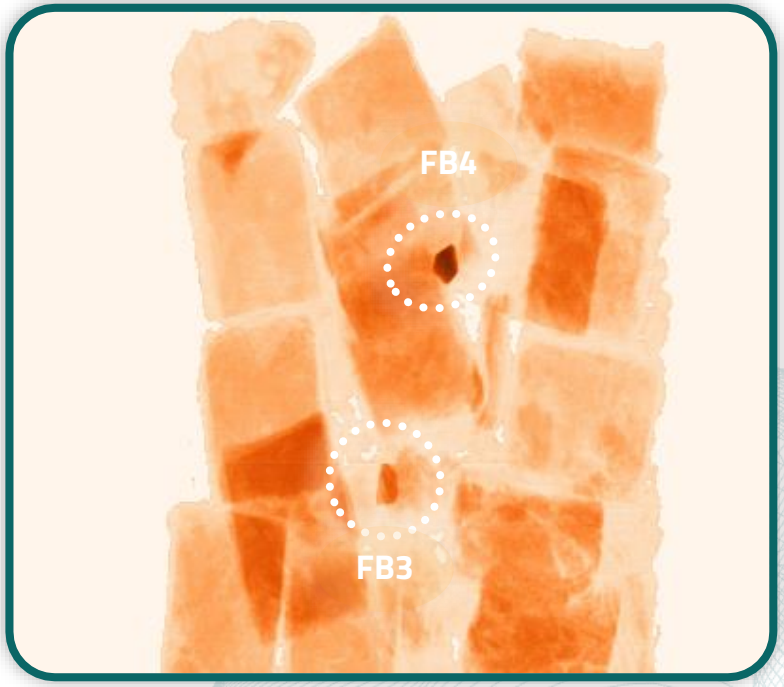


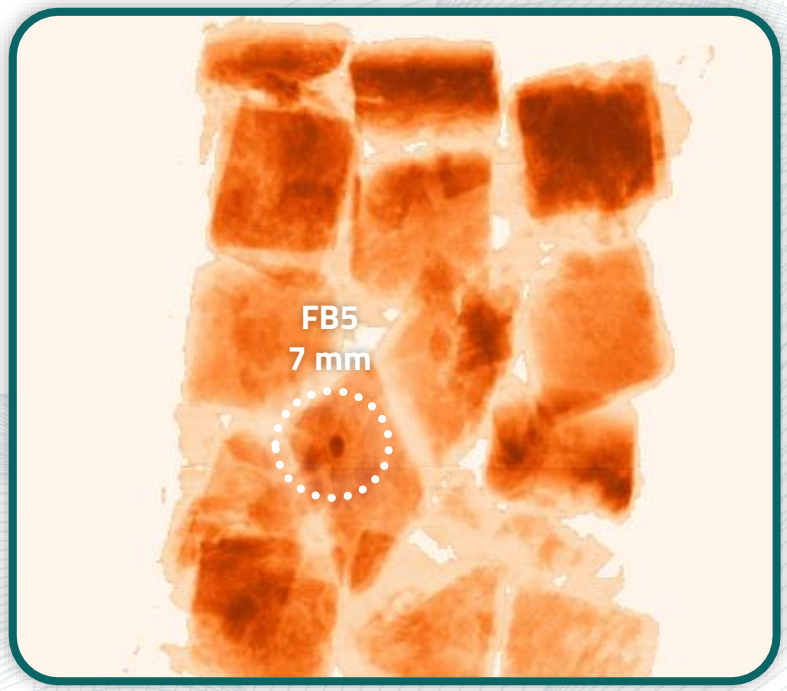
Sample #3

FB3
Glass

FB4
Stones

FB5
PTFE





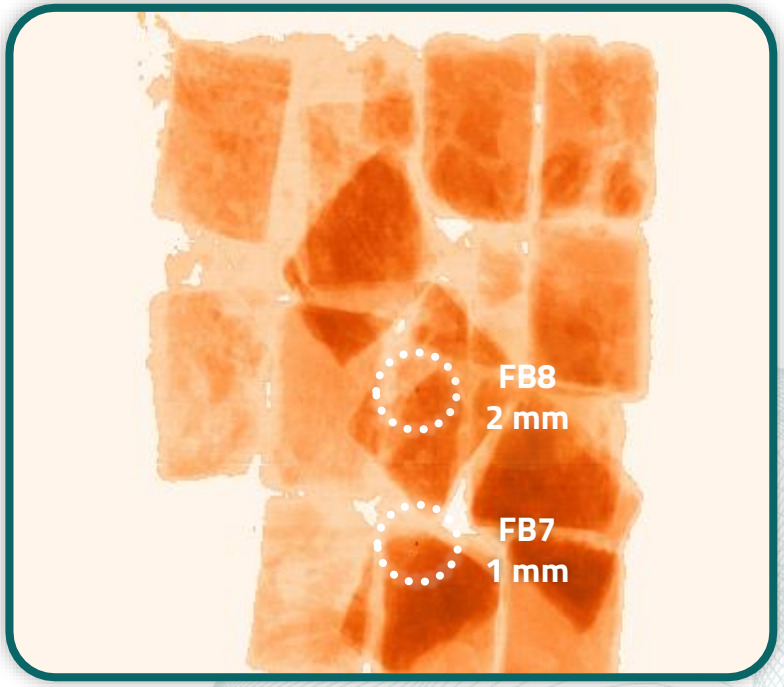
Sample #3

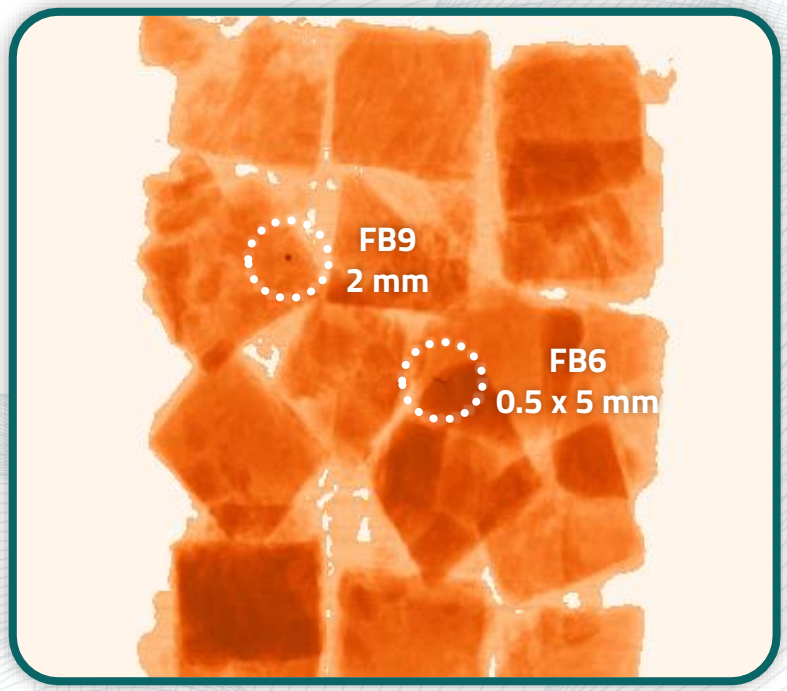
FB6
Inox wire

FB7
Inox sphere

FB8
Glass sphere

FB9
Copper sphere





Final remarks

Although the results achieved are already remarkable, when compared to the performance of a conventional X-ray inspection system, there is room for further improvement that could be achieved through:

- the use of XInspector automatic detection software, developed for this specific application;
- a geometric configuration of the system optimized for the product features.

In order to make all the main contaminants always clearly detectable by the system, **it is necessary to integrate the performance of the detector with a set of dedicated detection algorithms, which take into account the specific features of the combination Product-FB**.

XInspector is a self-learning software, which means that the performance and efficiency increase as the statistical data acquired during the inspection of contaminated/non-conforming products increase. Like any AI software, the more it learns to recognize product non-conformities, the more efficient it becomes.

In relation to the above, once installed on the processing line, XInspector can achieve a continuous improvement of its accuracy. In addition, the practical application of the technology on production lines is providing evidence that the system can also detect FBs the customer was unaware of.

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About Xnext

who we are

Xnext is high-tech SME, a technology innovator with the ambition to revolutionize the quality inspection sector, overcoming the weaknesses of conventional solutions. A team of professionals made of data scientists, electronic and nuclear engineers, mathematicians and physicists, AI and software developers

what we do
(why we are so unique)

We perform a real-time (few milliseconds) chemical-physical analysis of the product to identify foreign bodies and defects or non-conformities not detectable by existing inspection technologies

how we do it

Thanks to XSpectra®, our patented technology. It is not simply innovative but rather disruptive as it performs a multi-energy analysis of the x-ray spectrum (up to 1,024 energy bands) and detects also low-density contaminants. Like no other, it is the result of a unique synergy between photonics, nuclear micro-electronics and Machine Learning software

XNEXT

ADVANCED INSPECTION TECHNOLOGY

SEE THE IMPOSSIBLE, SEE THE FUTURE

XSPECTRA XINSPECTOR

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