TEST REPORT

X-ray inspection of dried consumer products

Problem description

X-ray systems are ideal for inspection of packaged products and detection inside the parcel of a variety of possible foreign objects.

A few selected products have been provided, supposedly free of contaminants.

The products considered were:

- A bag of quinoa grains
- A package of chocolate balls
- A bag of dried apricots
- A bag of pumpkinseeds
- A bag of hazelnuts

The packages ranges from 200 to 500 g.

Figure 1. Photos of the 5 different test subjects. From left to right it is: Quinoa grains, chocolate balls, sun dried Apricot, pumpkin seeds and hazelnuts.

Figure 2. Picture of the MCIS system on which the tests have been made.

Inspection method

The products have been placed on a low-energy X-ray system and imaged have been take at an energy of 25 kV. The system has been operated in off-line (manual) mode, facilitating the acquisition of images. No specific sorting and/or automatic detection has been accomplished.

The X-ray system is ultra compact, and based on the newest and most effective X-ray detection technology. This involves high stability, long life metal ceramic X-ray source, closed water cooling system, high sensitivity detector with 0.1 mm resolution, optional PLC master configuration, bar code reader etc. Maximum conveyor speed at optimal detection settings is about 0.5 m/s. In the present set-up a detector width of 150 mm has been used.

Results

Below are provided ordinary X-ray images of the products along with processed images showing foreign objects when these were detected. All processing has been done manually. The images are processed in 16-bit TIFF format but are here displayed in 8-bit JPEG. Note that the products are commercially purchased, and no defects are intentionally included.

Figure 3. Quinoa grains: First a Photo, then an ordinary X-ray. On the X-ray it is possible to glimpse a few dark spots near the top of the bag.
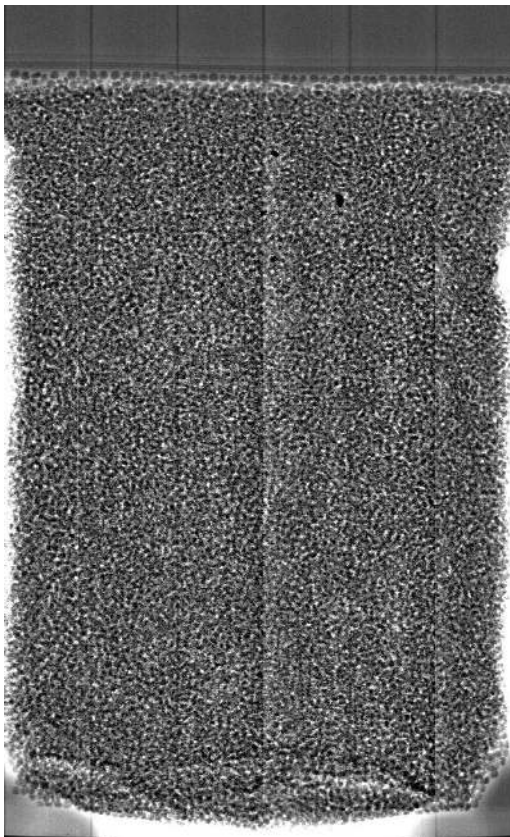

Figure 4. Processed images of the Quinoa grains. This is the same X-ray image as in figure 3 but processed to show the small stones(?) inside the bag. The stones have been detected automatically and sorted from the rest of the image into the picture on the right.

Figure 5. Chocolate balls: First a Photo, then an ordinary X-ray image. The X-ray image does not immediately reveal any foreign objects.
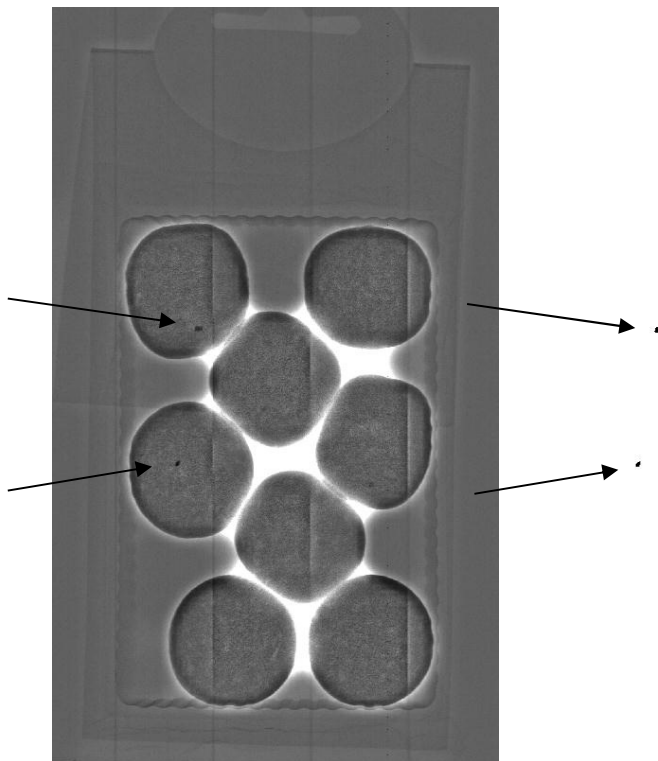

Figure 6. The processed images of the chocolate balls show with arrows two small (1mm in diameter) and a few tiny (0.4 mm in diameter) defects. It is possible to make a program to automatically detect the two larger objects, and possibly also smaller ones.

Figure. 7. The sun dried apricots. The X-ray image does not at first show any foreign objects.
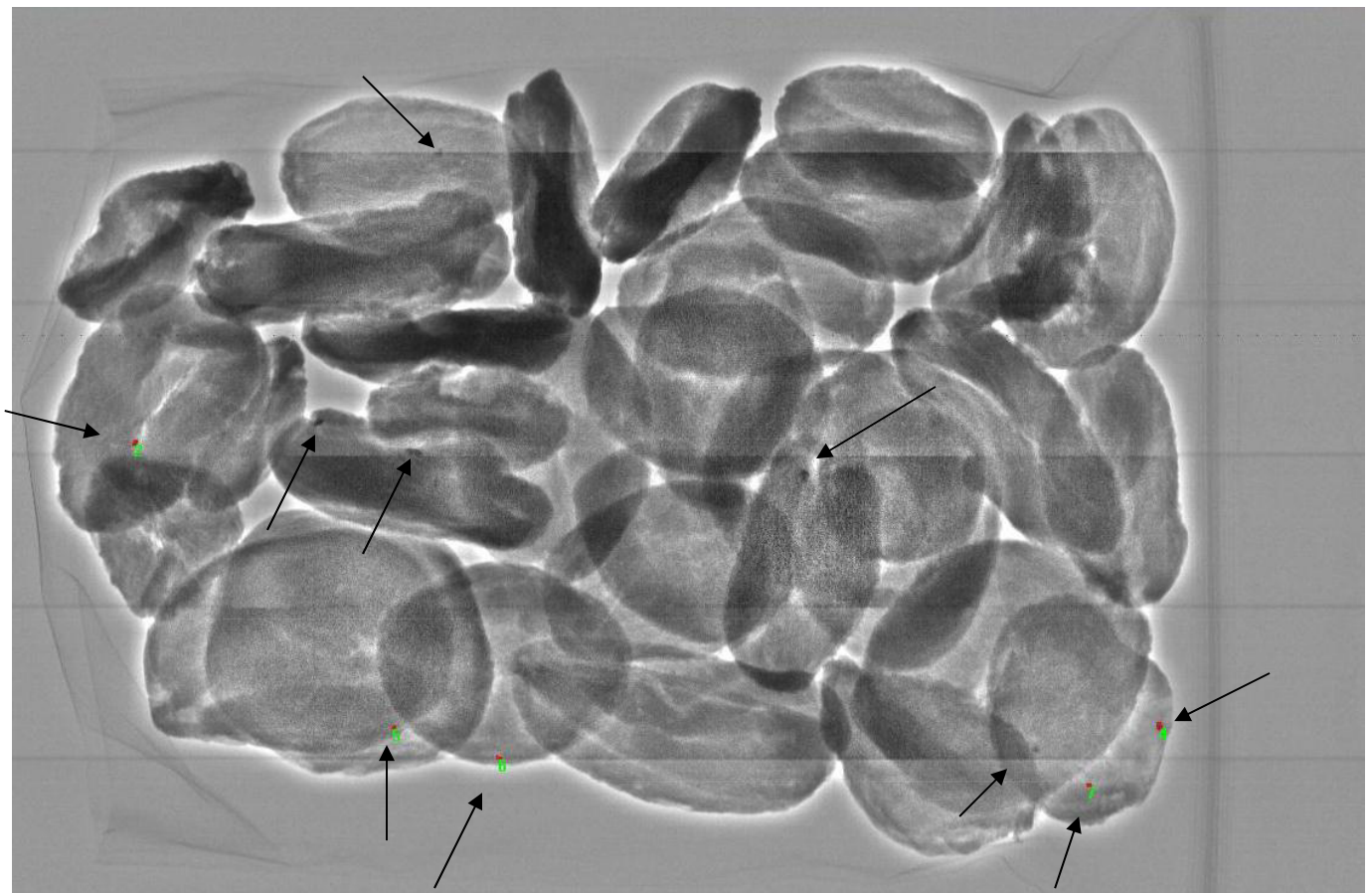

Figure 8. The processed image of the sun dried apricots show a number of dark spots (arrows mark most of them) which could be foreign objects or seed pieces. It is possible to detect most of these automatically.

Figure 9. Photo and X-ray image of the Hazel nuts. The X-ray image did not show any foreign object and further image processing did not disclose any.

Figure 10. Photo and X-ray image of the Pumpkin seeds. The X-ray image did not show any foreign object, nor did further image processing.

Discussion

The results unveils the capability of the low X-ray energy technology to detect even small and thin foreign objects if they have a different density than the material surrounding them. It therefore also allows detection of foreign object in already packed products.

Low energy X-rays stipulate much smaller radiation levels are intrinsically safer than conventional X-ray systems. They use less power and does not include any lead.

Conclusions & Notes

It was possible to detect some foreign object in both the quinoa and the chocolate balls while a large number of dark spots were detected in the sun dried apricots. However no defects were disclosed in nether the pumpkin seeds or the hazel nuts.

The InnospeXion low energy X-ray scanner is available in a number of tailored versions, specifically suited to specific tasks concerning overall interfacing, design of conveyor, conveyor attachment to existing production line and integrated software with TTL-based triggering for ejection and sorting. The system is available as stand alone units or as completely integrated PLC controlled systems operating in automatic, self-regulating mode.

Please contact InnospeXion or your local representative for further information.