27-06-18

TEST REPORT – SEALED ALUMINIUM CANS

Problem description
Sealed packages with dry product (rice) have been prepared with artificial defects. The artificial defects are (presumably): incorrect seal lid tolerances, entrapped (foreign) material, seal foil defects, and seal impurity (product in seal).
The samples are prepared some weeks prior to the inspection.

There are 12 samples, numbered 1 – 12, of which 4 are with no defects.

All samples had suffered from some damages during transport and had dents and other damages.

Inspection method

The products with and without seal defects have been placed on a low-energy X-ray system and imaged at a speed of 14 m/min. The X-ray energy is 18 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 X-ray source, closed water cooling system, CdTe 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 220 mm has been used.

Results
Below are provided images of the products with foreign objects as described above. No specific image processing has been attempted, the pictures are solely converted from 16-bit TIFF to 8-bit JPEG format.

The dark area in the seal zone can be attributed to (1) the small fold in the seal zone; and (2) to additional (contamination) material in the seal zone. In the latter case, the material will look more dispersed and inhomogeneous compared to regular.

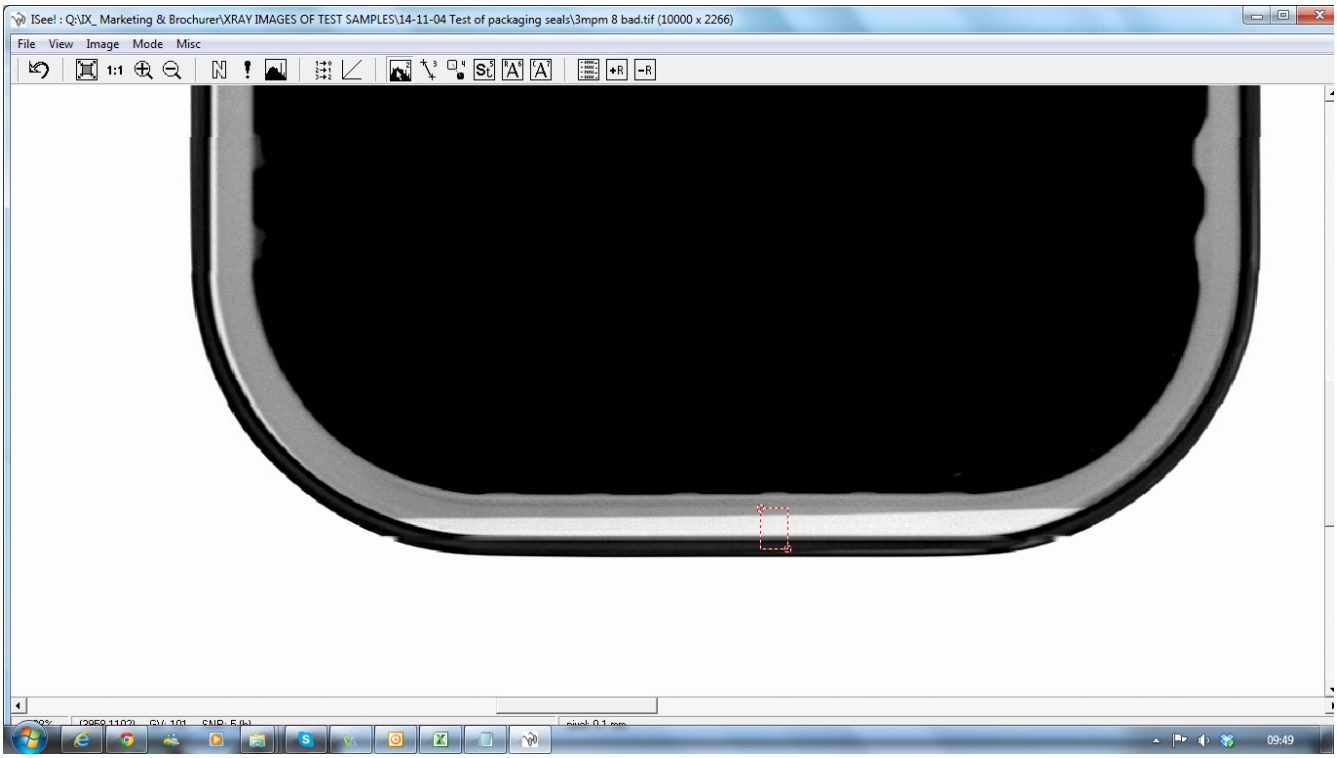


Fig. 2. Sample #8. Clear misalignment of the lid.

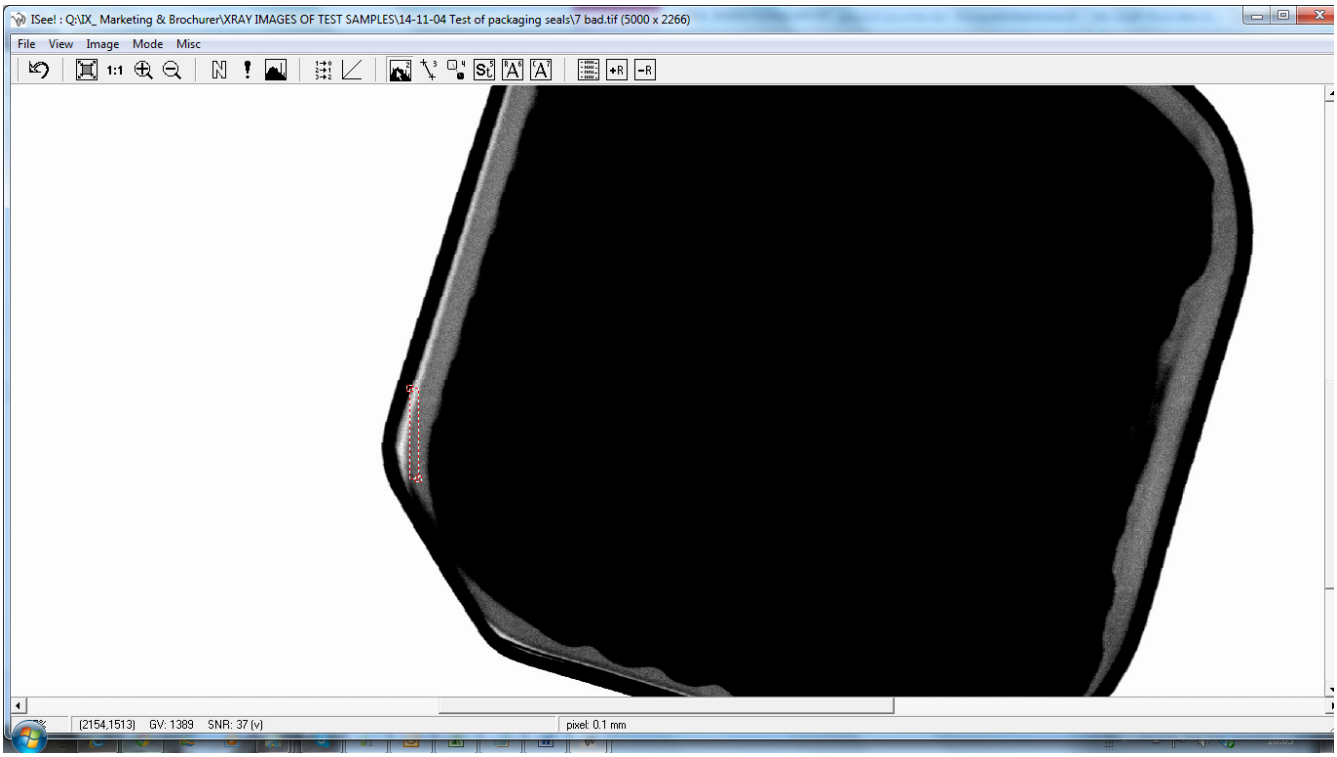
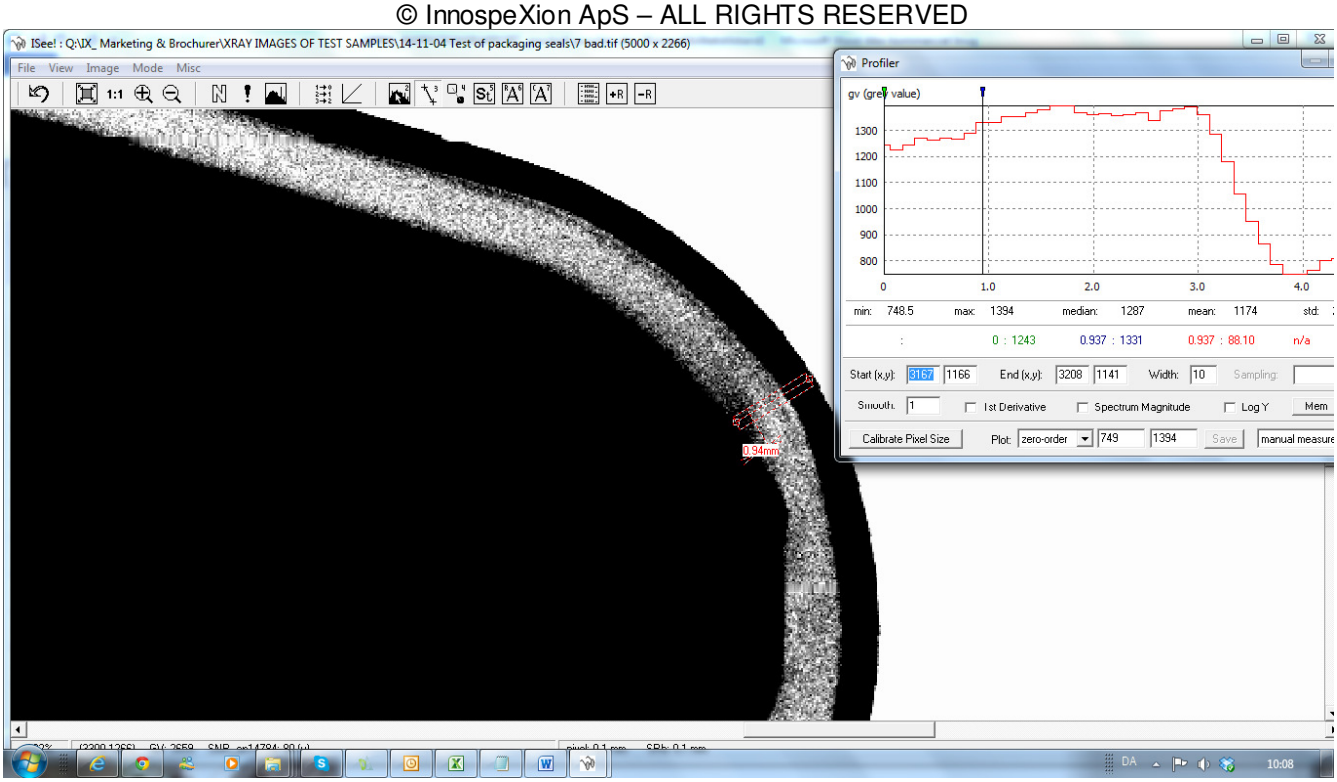


Fig. 3., Sample #7. The sample has suffered during transport. The left seal is not well represented but expectably within tolerances



FrFig. 4. Sample #7, upper right corner showing possible seal contamination (0.9 mm wide, approx. 3-4 mm long).

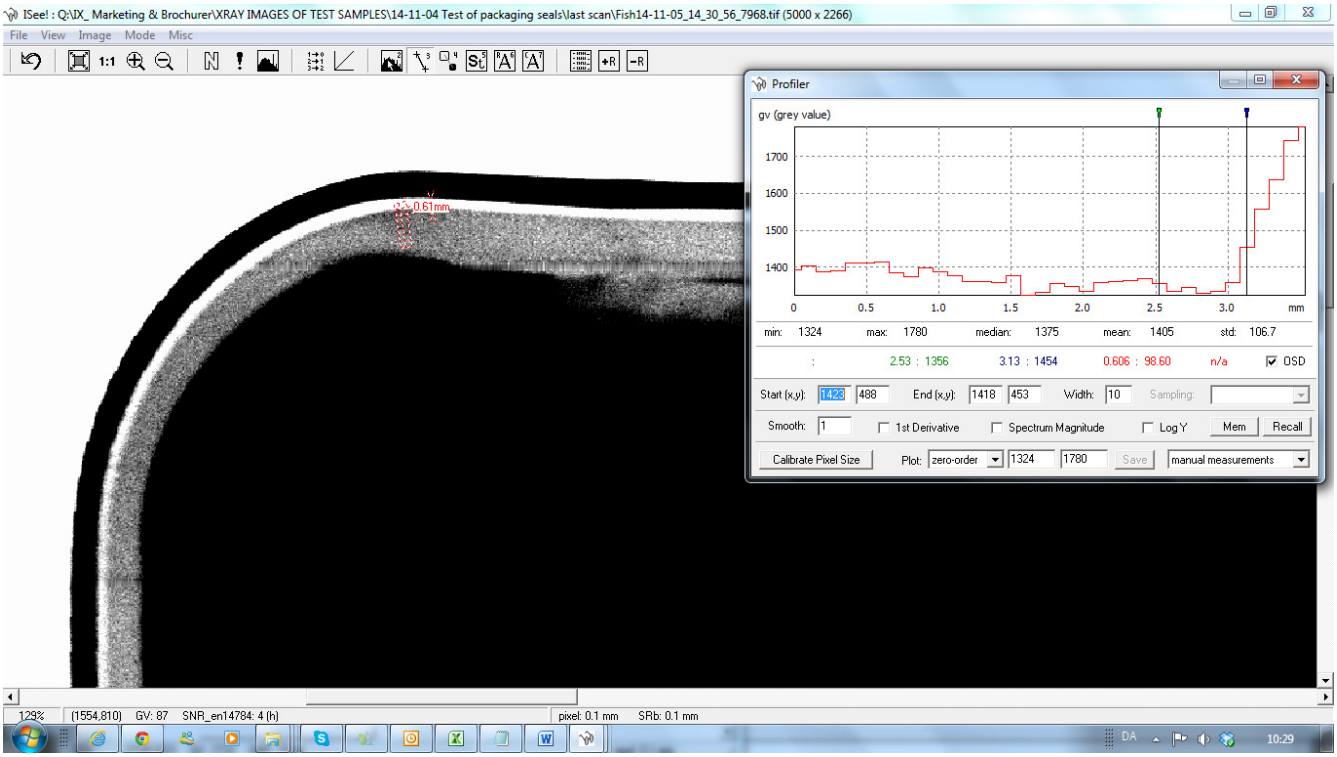


Fig. 5. Sample #5 upper left corner (opener at lower left). Contamination at side of seal. Difficult to detect automatically. Possibly dried out. Should be inspected right after closure…..

Fig. 6. Sample #10. Obvious failure in seal.

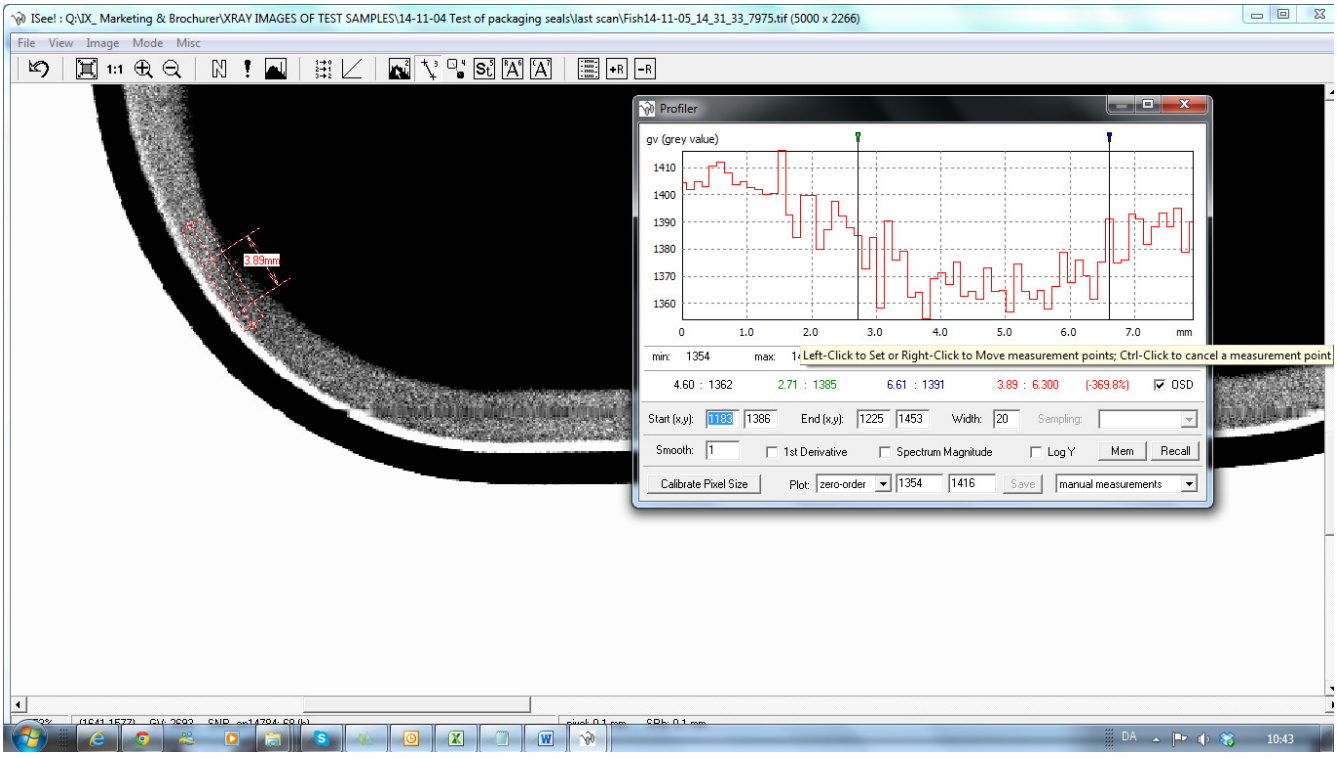


Fig. 7. Sample #12. Small, 4-5 mm long 1-2 mm wide indications of former material in seal – now dried out and only solids remain. This defect cannot be detected automatically when dried out – but will be detected when inspected right after the closure process.

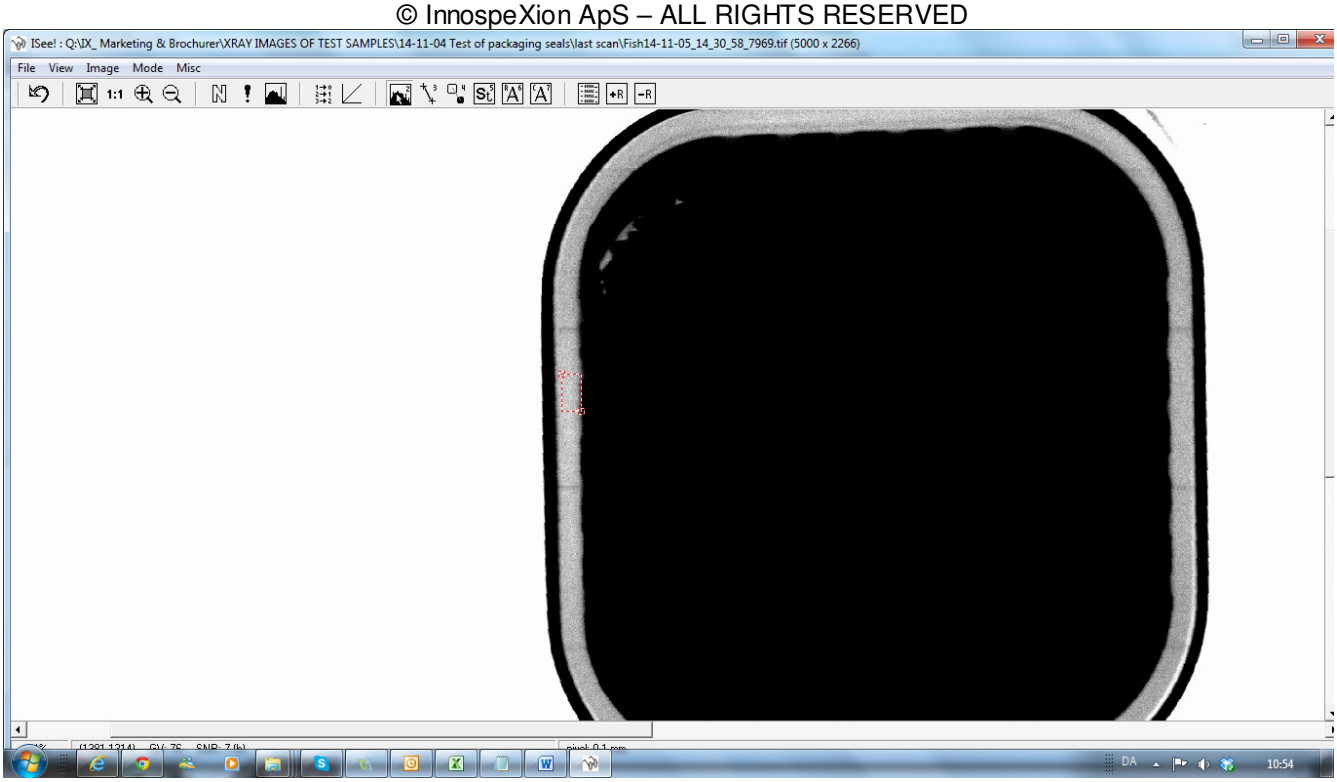


Fig. 8. Sample #6. Seal contamination with dried product. Impossible to see/detect. Reason is that the contamination has dried out.

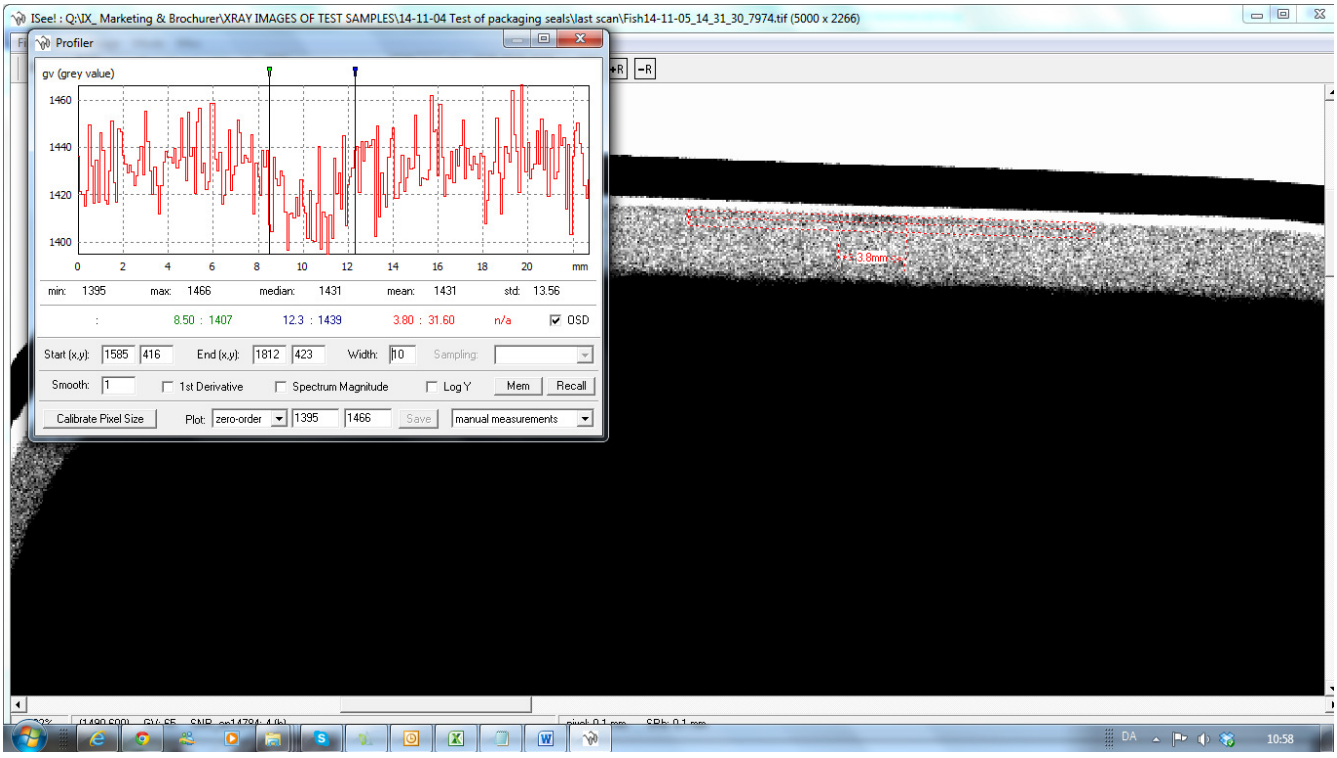


Fig. 9. Sample #11. Seal contamination vaitly visible at seal edge- 5 mm long. Obviously dried out. The detection of a seal contamination is almost impossible when dried out.

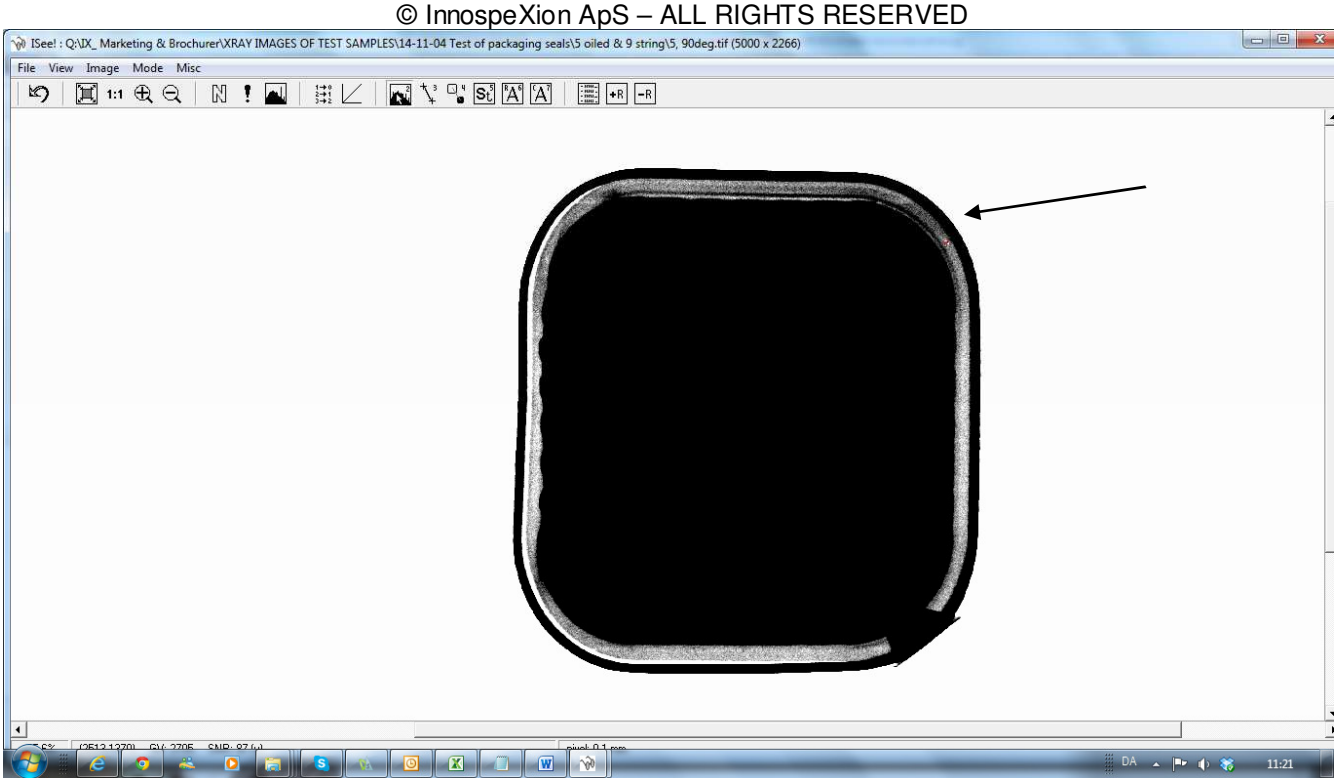


Fig. 10. Sample #5, with a <0.05 mm thick emulsion of oil in upper right corner. This is clearly seen as a local drop in grey level value by about 20% (seal area by arrow). The oil emulsion was placed in a very thin layer to illustrate how a seal contamination would look like in reality (i.e. not dried out).

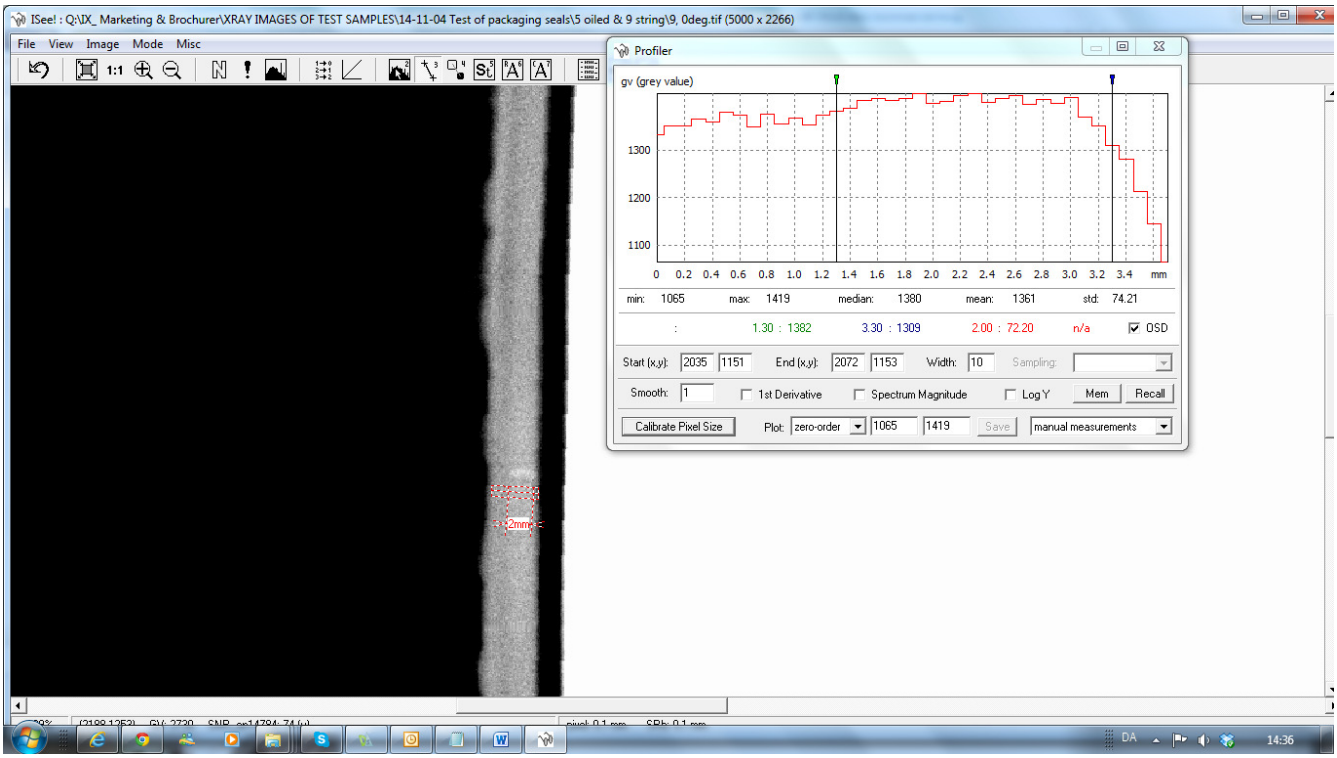


Fig. 11. Sample #9, small foreign object (cotton chord) trapped in seal. The defect gives rise to missing seal which looks like a hole in the seal. The defect is visible and is detectable, however, very small defects like these may give rise to a higher amount of false positives in order to ensure that the defect is detected automatically by the software.

Discussion

The results unveil the capability of the low X-ray energy technology to detect even small and thin irregularities in the seal zone of the considered range of products.

However, a majority of the samples have been prepared with a seal contamination that has completely dried out. For that reason, the detection (automatically) will be nearly impossible.

In the real scenario, the X-ray system is placed right after the lid sealing system. At this time, the entrapped seal contamination will still be in a vapor (or liquid) phase. This is what enables the technology to detect the seal contamination.

The technology is e.g. used in the production of plastic lid fish product packages, placed up to 10 meters after the sealing machine. Here, the seal contamination is still clearly visible in the X-ray images, and automatic detection and reject is possible.

The technology allows inspection rates up to 2 – 2.5 cans per second (21-27 m/min), and detects:

- Seal contamination
- Seal folds
- Seal misalignment
- Seal tolerances in general
- Can damages (dents etc)
- Product contamination (foreign objects)
- Product homogeneity
- Product mass distribution.

For seal contamination, the false positives is < 1 % with a POD of more than 95 of hundred, at full production speed.

Notes

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 por your local representative for further information.