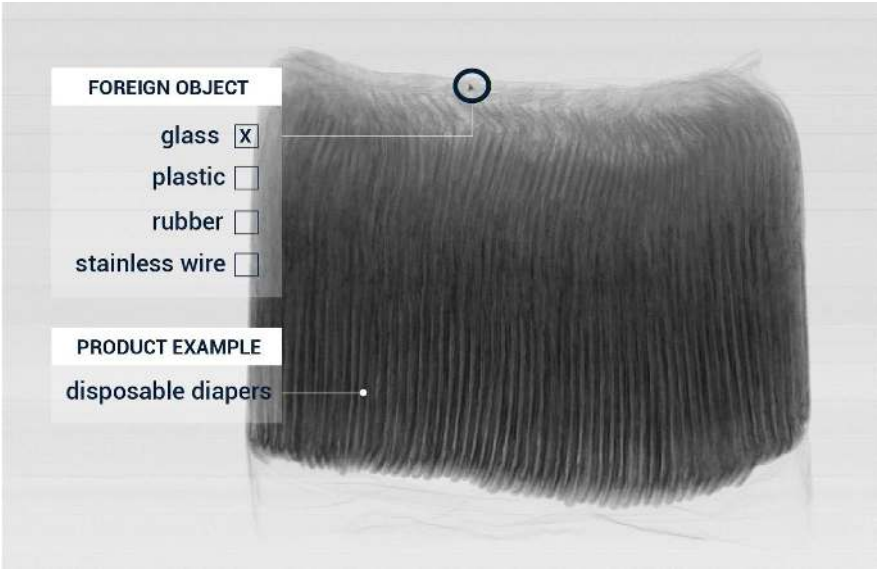
CASE STORY

“High sensitivity X-ray solutions for highly sensitive products and customers”



There have been multiple stories and news on unfortunate situations when parents found sharp and dangerous foreign objects in baby diapers. Big needles, metal fragments, wood splinters and pieces of sharp glass are examples of foreign objects that have been discovered inside baby diapers. Parents wonder how it is possible that such dangerous objects can end up in diapers, and producers on the other hand, often have to react quickly, sometimes even recall the products and provide explanations.

These stories underline the importance of a thorough safety and quality check, especially in the case of such sensitive hygienic product.

How are diapers produced and where are the highest risks of contamination ?

The two main components of disposable diapers are the absorbent pad, typically made out of synthetic hydrophilic polymer together with a fibrous material, and a nonwoven fabric that shields and keeps the absorbent pad in place.

The manufacturing process begins on a moving conveyor belt where the polymer is formed and shaped through various methods. Already at this point, depending on the selected method, product irregularity or contamination may occur. For example, older accumulated polymer residue can contaminate the forming process of the absorbent pad. It is also possible that metal or plastic fragments (that can potentially originate from the production

machinery, conveyor belt) fall in the composition and get blended together inside the absorbent pad.

Next, the nonwoven shielding fabric of the disposable diaper is produced. Plastic resins, which is essentially what nonwoven materials are made of, have to go through an assembling process. After this step, the fibers are melted, flattened and bond together by a heat roller. This also represents a point in the production of diapers where contaminants that do not melt as fast as the plastic resins can simply be pressed together with the diaper sheet, and slip through the production without being detected and eliminated.

Another important aspect to consider is the high speed and high production volume that diaper manufacturing consists of. The raw material is turned into and shaped as individual diapers at a very fast pace. In addition to this, diapers are grouped and packaged in big bundles, often ending up in big packages.

So what is the best method for quality inspection and where is it optimal to implement one?

In the baby care industry, diaper quality control procedures are mostly related to the product's absorbency and leakage tolerance (this being controlled through the polymer/fiber ratio to ensure optimal absorbency and thereby less leakage), the comfort and fit (checking the state of the nonwoven sheet shielding the diaper) and product conformity (material alignment).

Evidently, material quality and risk assessment is important since it addresses quality assurance in terms of avoiding allergies and discomfort, but product contamination with foreign objects can also have serious consequences upon an infant's health and safety. Similar to other industries and production lines, disposable diapers production has become fully automatized. This aspect, however, does not eliminate the risks of contamination with foreign objects, unless a quality inspection system is also part of that automated line.

One diaper producer talks more openly about the measurements they take for safety, hygiene and quality assurance. This producer has implemented an in-line vision control system, as well as two metal detectors: one placed before the manufacturing process, and one after the diapers are packaged. The issue is that, precisely as it can be seen in the previous examples, it is not just metal that may slip through a production line. A metal detector, and not even two, will not be able to detect sharp glass, sharp plastic or wood splinters.

InnospeXion's X-ray contamination detection capabilities

Fig. 0. Image illustrating the inspected package of disposable baby diapers with a foreign object placed on top. The foreign object in this case is a 1 cm long glass fragment. The package contains 56 disposable diapers.

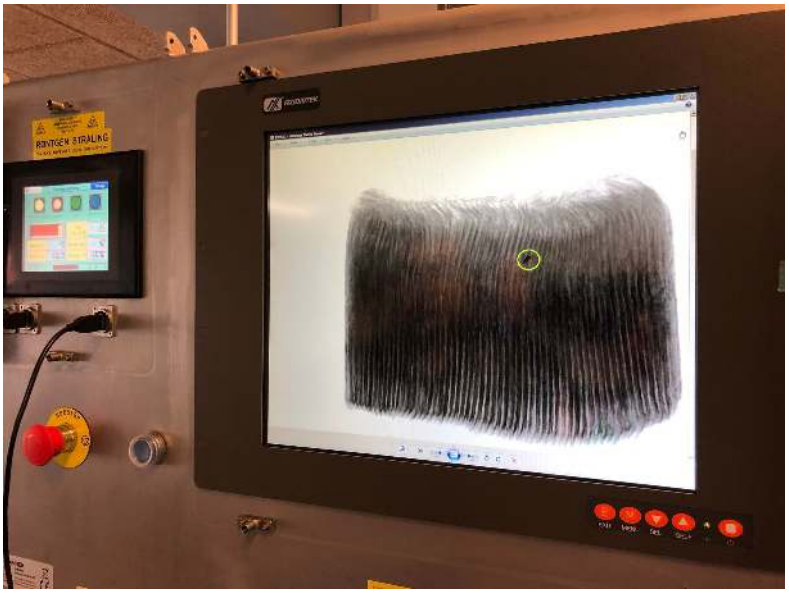


Fig. 1. X-ray image displayed on InnospeXion's X-ray system, illustrating the identified foreign object (the 1 cm long glass fragment) that has been placed over the package containing diapers.

In order to challenge our system's detection capabilities, we added additional types of foreign objects and placed them all under the package at the moment the inspection, as opposed to being placed over the package during the first round of tests. The additional foreign objects samples were: stainless wire (size 0.9 x 5.0 mm down to 0.2 x 5.0 mm), stainless (size 0.8 mm down to 0.3 mm), and glass (size 6.0 mm down to 1.0).

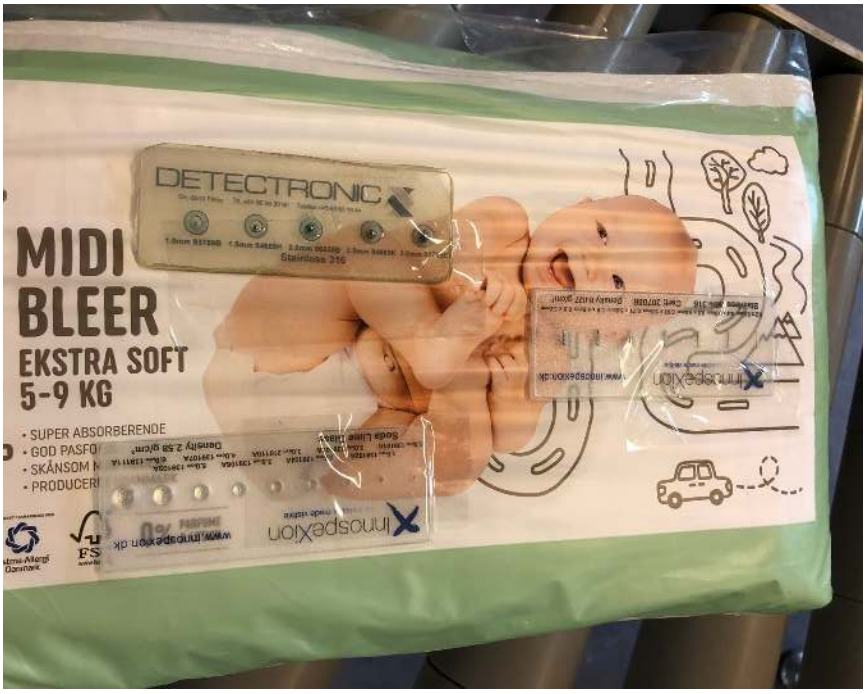


Fig. 2. Image illustrating the inspected package of disposable baby diapers with different foreign objects placed on the package. During the second round of tests, the package has been subsequently flipped over so that the foreign object will be under the package at the moment of the X-ray inspection. The additional foreign objects samples are: stainless wire (size 0.9 x 5.0 mm down to 0.2 x 5.0 mm), stainless (size 0.8 mm down to 0.3 mm), and glass (size 6.0 mm down to 1.0).

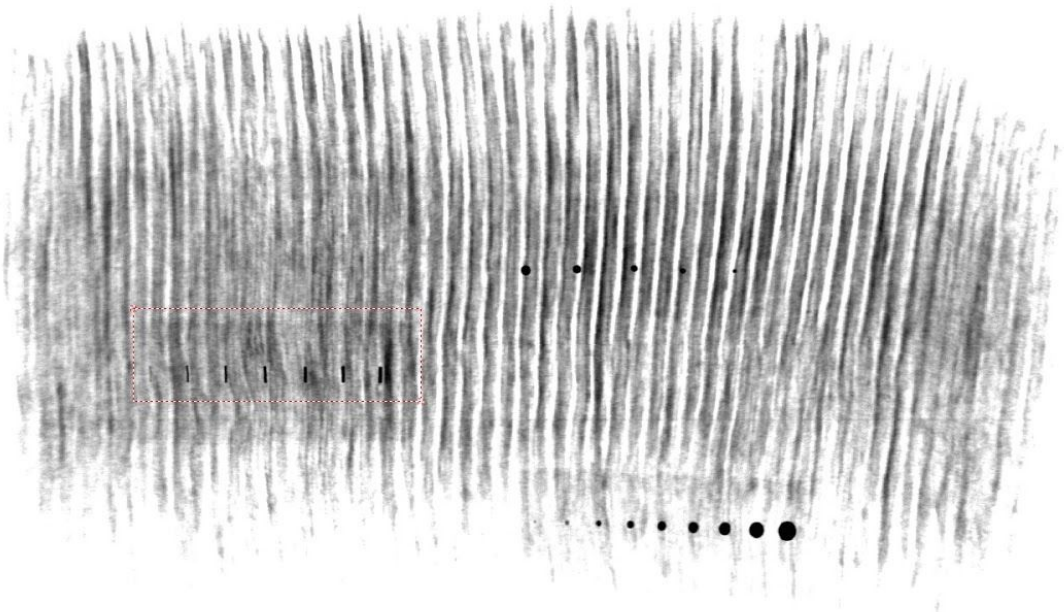


Fig. 3. X-ray image of the diapers package with foreign objects placed under the product.

The position of the stainless wire test sample has also been alternated between a perpendicular position related to the vertical lines created by the individual diapers through the X-ray system, as well as parallel with the shape lines of the diapers. The system could, however, successfully differentiate between the wires regardless of their positioning.

Fig. 4. Image illustrating the inspected package of disposable baby diapers with a smaller glass fragment during the second round of tests (4mm long), which has been positioned towards the bottom and place under the diapers package.

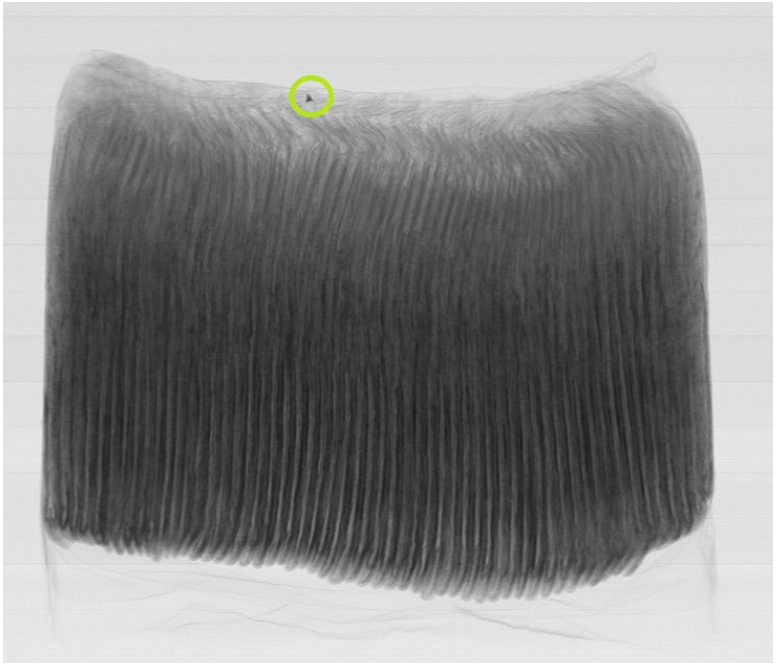


Fig. 5. X-ray image of the disposable diapers package with the small glass fragment (4mm long) placed under the product.

A complex quality assurance solution

The most cost efficient solution would be to inspect each diaper before the packaging process, however, typically the setup of diaper production line does not make it possible to include an X-ray inspection system in that point. However, with our X-ray inspection system, it is possible to detect all the above mentioned foreign object, even in big packages as diapers typically are packaged in.

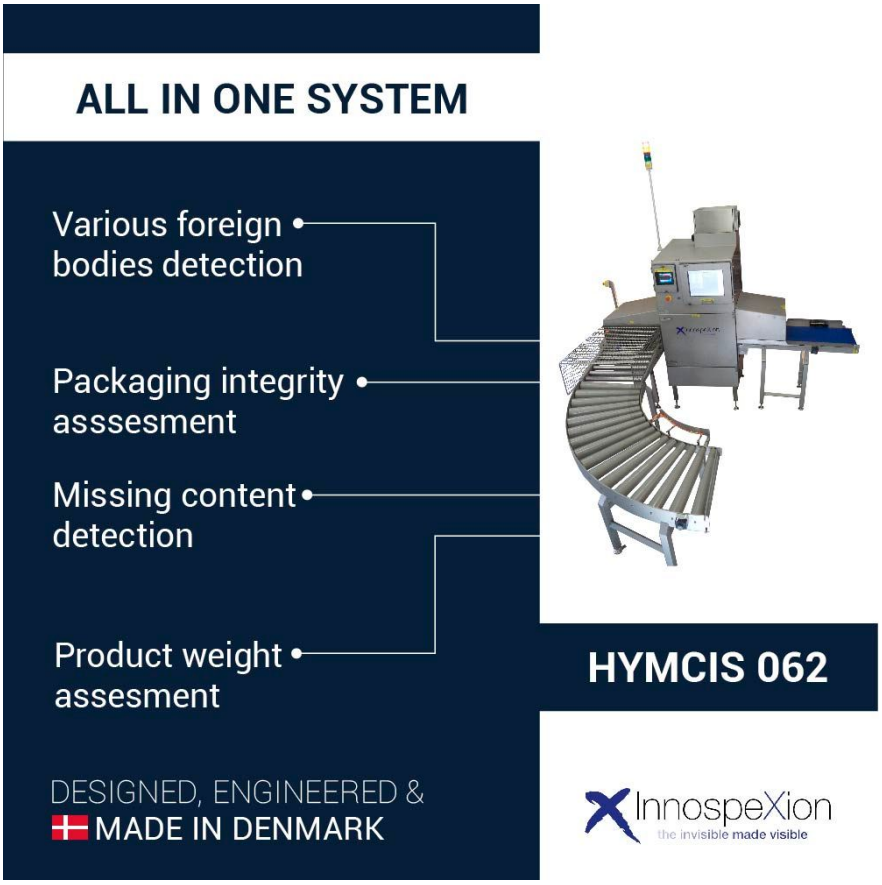


Fig. 6. Infographic of HYMCIS062 illustrating the system's unique functionalities: Various foreign bodies detection - Packaging integrity assessment - Ability to check content for missing material - Product weight check: All in one system

Besides detecting foreign objects, by purchasing the same system, you can check the content of the packages (for instance if there are missing items, the size and weight of different items), action that is not possible to perform with a metal detector. The system also verifies the packaging integrity (identify potential packaging defects that might affect the integrity, quality and safety of the product).

Finally, the most unique functionality and benefit that an X-ray quality inspection system will add to your production is the ability to gather data for documentation, analysis and future

reference. All the inspections that you perform with our system will be documented and this will, undoubtedly, give you the power to trace, gather and strategically make use of your production data.