Technical Note

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Why do seal defects occur?

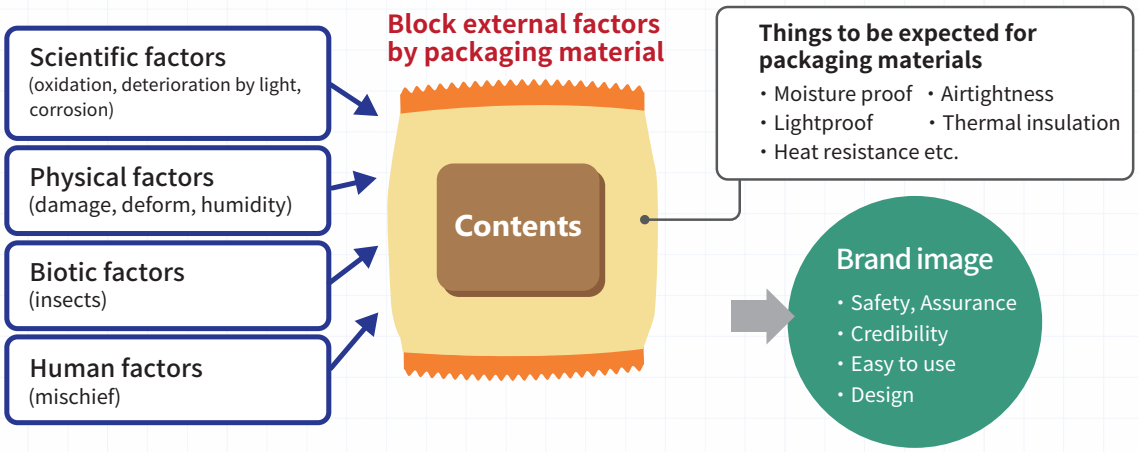
When you go to a supermarket or a convenience store, you notice many products with a variety of packaging materials on the shelf. For instance, horizontal-pillow packaging which is used for a pastry and individually wrapped confection, standing pouch packaging which is used for a hamburger steak and potato salad, and thermoforming packaging which is used for sliced ham. According to the product's characteristics, and external factors such as light, and humidity, a different type of packaging is used for each product.

Sometimes, a part of the product protrudes from a package or the product is caught in the sealed part during the production. This type of product defect is called a seal defect.

In this paper, we explain the cause of the seal defect with examples of packaging. In addition, we introduce the package check inspection using the X-ray inspection system to prevent the defective product from reaching consumers.

1. Why can the seal defect be seen as the problem?

The seal defect can lower the tightness and moist proofness of the product and cause the deterioration of the contents, which makes the food harmful for human consumption. Although the seal defect does not cause health-related harm, the consumer who notices the product with the seal defect may have doubts about the quality of the product itself.



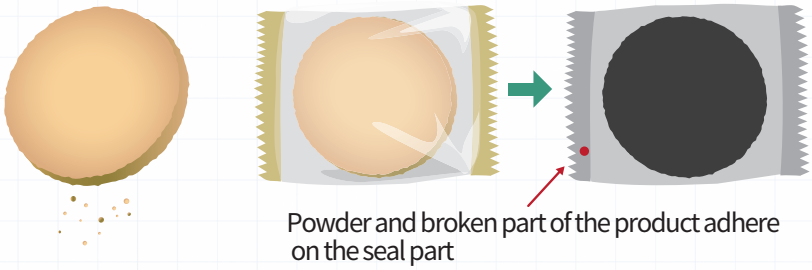
2. Why do products trapped in the seal area (factor analysis)?

Processing capacity

In recent years, due to the integration and shutdown of factories, output for each production line tends to increase. Moreover, cultivation of the new sales channels and new hit products can make the production quantity to boost. The increase in production can lead to the expansion of sales figures; however, the existing production equipment needs to meet the required capacity.

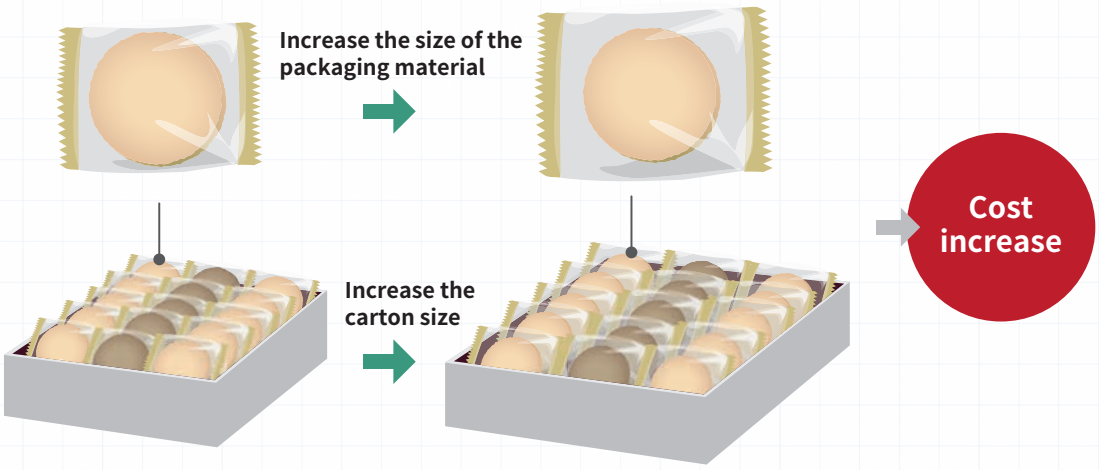
The issues relating to the above-mentioned situation can be solved if the existing equipment is renewed. However, due to the company's limited budget, the use of the existing machines is the most common way to handle these situations.

In this case, because of the lack of the facility's capacity, a product with packaging defects such as products trapped in the sealed area can occur more often on the production line. Especially, horizontal pillow packaging products, individually wrapped chocolate, cookies, candies, etc. are manufactured as fast as several hundred per minute. When the processing capacity is increased, the orientation or the position of the product can deviate, which can cause the product to be sealed in a wrong position, or damaged during the conveyance so that the powder and chipped products can be trapped in the sealed area.



Reduce the cost of the package materials

Manufacturing companies keep the cost for the packaging material to a minimum. This means, the size (inner dimensions) of the packaging material is slightly bigger than the product, so there is always the risk of seal faults. For instance, if the size of the packaging material is made large enough to prevent seal defects, a carton for the delivery (individually packaged products are boxed in each carton) needs to be enlarged. As a result, the costs of packaging materials for each product as well as the cost for transportation can be increased, leading to the decline of business earnings.



Appearance of the product matters

As you may have experienced, if there are two types of products in which the taste and the price are nearly equivalent on the shelf at a grocery store, you would want to buy the one in which the content is fully stuffed in the package without less empty space.

By emphasizing the appearance of the product, the size of the packaging is tending to get smaller. As mentioned above, seal faults can easily occur to the product packed in the minimum required size (inner dimensions) when the packaging timing deviates for some reason.

3. Typical examples of seal defects by packaging configuration

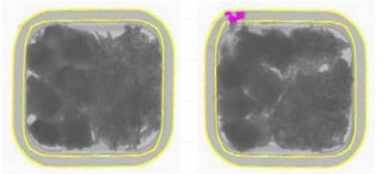
Tray sealing, thermoforming type package

This section describes examples of seal defects in a top seal on a tray package and a thermoforming type package.
Generally, consumers feel inclined to buy the product with its content are filled fully in a package. However, the increase in the volume of the content can cause a product to be caught in a seal part.

On the production line for side dish products, a discharge hopper of an automatic weigher comes lower than the top edge of the container when the content is being filled. If the filling volume is larger or close to the volume of container, the product can get trapped in the seal area easily. Even with visual inspection by a worker and wipe off the seal area, it cannot be fully ensured.

Sliced ham is formed and aligned on the conveyor and placed into a thermoforming type package automatically. Before sealing, workers perform a visual inspection and replace a below-standard product with a good quality product. Since the product is processed at 200 products per minute, the position of sliced ham can deviate, resulting in the product being trapped in the sealed area.

Side dishes packed in a tray



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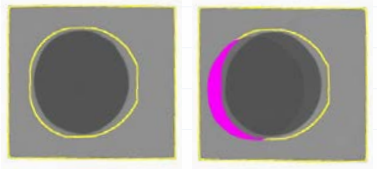
Sliced ham in a thermoforming package



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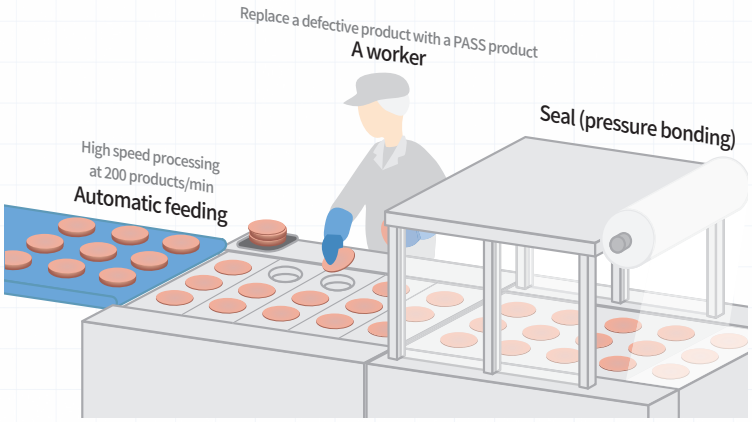
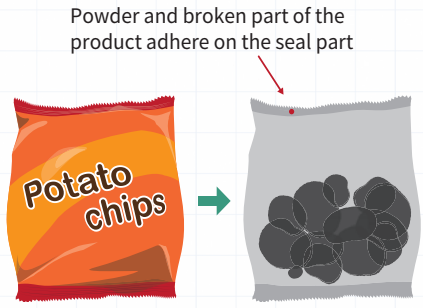


Vertical pillow packaging

Vertical pillow packaging is commonly used for snack foods. A vertical pillow packaging machine placed right under an automatic weigher, which forms a bag and drops the content in the bag from the top, and then seals the top edge of the container.

Snacks are easily broken or chipped, so fragments or powder can fall on the conveyor after an automatic weigher closed a discharge hopper. A seal fault can occur when chipped parts and powder adhere to the upper end of a bag. Since a roll film used in a packaging material can charge static electricity, it is impossible to completely eliminate static electricity from a production line. Static electricity can also cause seal defects.

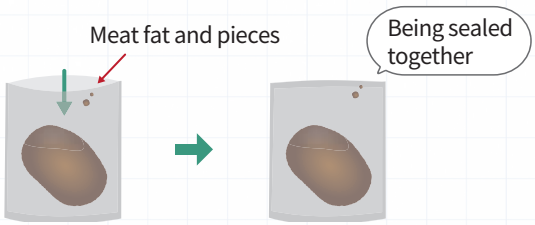


In addition, as for multi-packs used for individually packaged products such as rice crackers and chocolate, the content fed at the end of processing tends to protrude to the sealing part, which can cause the product to be trapped in the sealing part. The content is filled in a vertical pillow package with its three sides (right and left, and the bottom) being closed, so that the deviation in the product orientation and a bump can easily occur, which can result in seal defects.

Pre-made pouch (or bag) feeding package

A bag-feeding wrapping machine is used to wrap a hamburger steak. The packaging machine supplies a bag with its three sides (both ends and bottom) being closed to a discharge part of the filling machine, and seals the top of the bag after the content is filled. The product is conveyed and automatically dropped into a bag by a stainless steel chute.

Occasionally, the hamburger steak may touch the inside of the upper end of the package. Also, meat fat and pieces from the hamburger may stick on the conveyor belt and can fall accidentally on the product, which leads to a seal defect.



4. Identify a seal defect by X-ray Inspection System

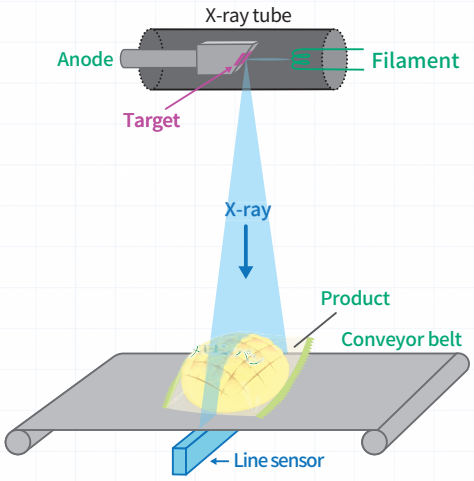
There are various methods to detect seal defects, such as visual inspection by a worker, appearance inspection by a camera, and thickness inspection of the seal part by a pressure sensor. We offer inspection solutions using X-ray inspection systems.

The advantage of using an X-ray transmission image is that it can detect seal defects with high sensitivity and stability even for the package printed on the full surface and aluminum packaging materials.

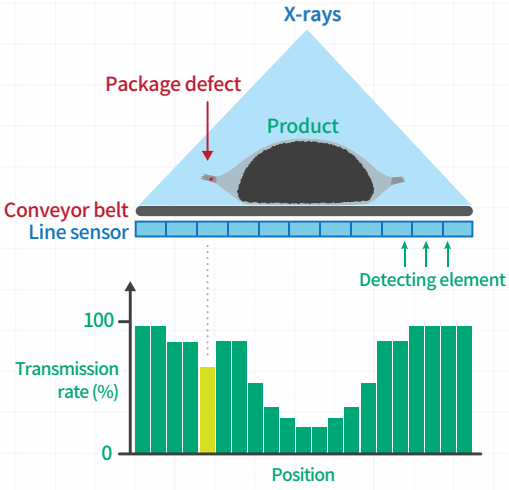
The principle of seal fault detection is basically the same as for the contaminant inspection.

X-ray inspection system radiates x-rays to a product to be inspected on the conveyor, detects radiation dose by the x-ray sensor and then rejects a defective product by evaluating x-ray transmittance on an x-ray image. With x-ray systems, "the seal area" can be set on the sealing part of the package. If something caught in or wrinkles on the seal area occur, the x-ray absorption rate will be larger. Our X-ray inspection systems accurately detect defects in the seal area by measuring the difference in x-ray absorption rate between a PASS product and a defective product.

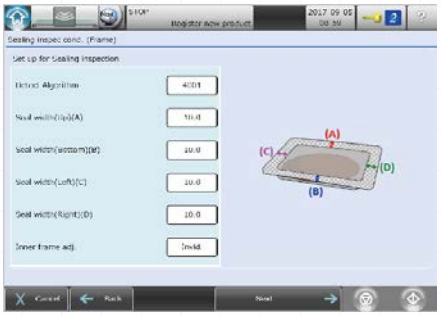
Anritsu's X-ray inspection systems can set the seal area suitable to each packaging material, accurately detecting seal defects with high sensitivity.



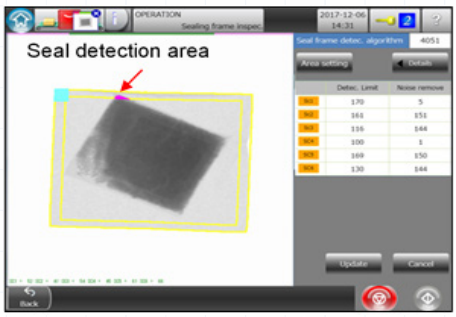
X-ray tank and sensor construction



Principle of Package Check



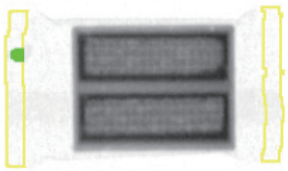
Seal area setting screen

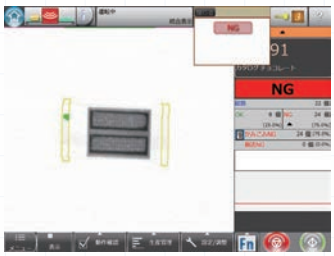


Detect seal defect within a seal area

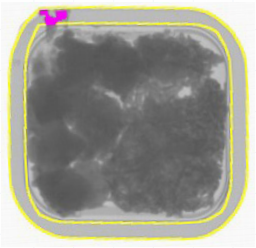
Inspection Examples of Anritsu X-ray Inspection System

Horizontal pillow

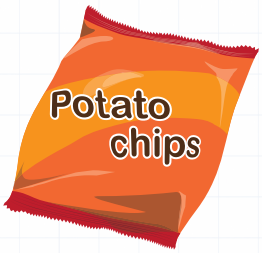


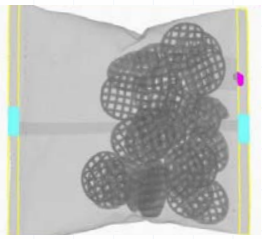


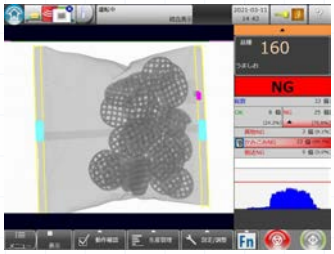
Tray package



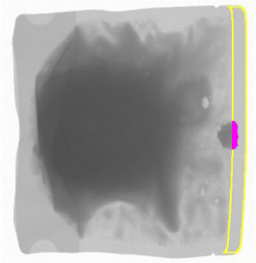
Vertical pillow package

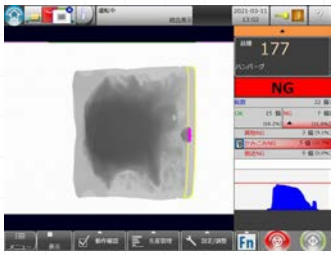




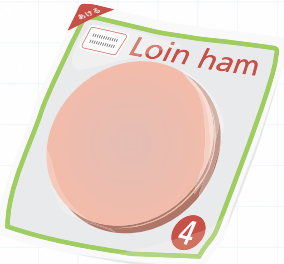


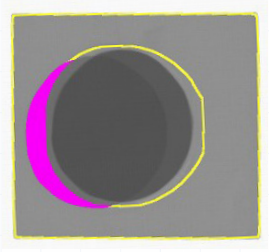
Bag-feeding package

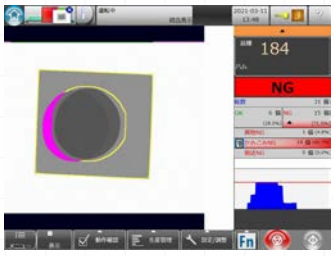




Thermoforming package







Conclusion

This paper explained typical cases of products caught in the seal area according to different packaging materials. They are not considered as a special case and can occur anytime on the production line. We recommend implementing an x-ray inspection system to those who are not satisfied with the existing measure for seal defects or thinking about taking measures to prevent seal faults.

Latest x-ray inspection machines are capable of performing seal integrity inspection, contaminant inspection, and missing item inspection simultaneously.

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Anritsu Advancing beyond