

Technical Note

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Usage of Metal Detector and X-Ray Inspection System Together Recommended

Metal detectors and X-ray inspection systems are widely used for contaminant inspection. Is a metal detector alone sufficient enough? Can an x-ray inspection system detect all types of contaminants?

Let's see how these two systems detect contaminants.



[1] Detecting contaminated products

With high concern about food safety among consumers, food manufactures have implemented various quality control measures. Although the number of contaminant accidents has been decreased, there still are significant numbers of food contamination cases reported every year, with some developing into critical issues (Table 1). There are various contamination: metal, stone, rubber, glass, plastic, etc. Therefore, it is important to understand the characteristics of contaminants and select correct inspection systems.

Year	Number of Complaints
2005	756
2006	855
2007	1,141
2008	1,365
2009	927

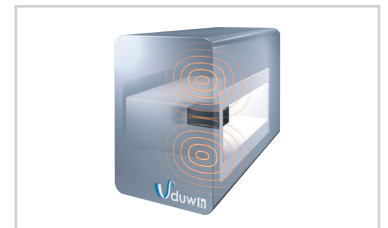
Table1: Numbers of complaints regarding food contamination

Source: Statistics of Food Safety Complaints (2009).
Tokyo Bureau of Social Welfare and Public Health

[2] What is the difference between metal detectors and X-ray inspection systems ?

Although Metal detectors and X-ray inspection systems are major tools used for contaminant inspection having different detection methods, they are common for monitoring product effects. Products containing contaminants show not only product effect but also the contaminant effect. Therefore, you can identify passed products and faulty products. Let's call these effects "effect values". Now we compare the effect values of metallic and non-metallic contaminants using the metal detector and the X-ray system.

Metal detectors can catch the changes in magnetic fields caused by products passing through the detection head. Metallic contaminants can be detected because they generate large effects in the magnetic fields. Whereas non-metallic contaminants, such as rubber and glass, are not detectable since they don't affect the magnetic fields.



Pic.1: Detection head of metal detector

The popular X-ray used in radiography at hospitals show organs as light shadows since the X-ray is subject to easily pass through the organ material. In contrast, bones are shown as dark shadows since the X-ray cannot easily penetrate through the bone material. The X-ray inspection system also analyzes variations in shadow darkness. Regardless of contaminants' magnetic properties, high-density contaminants are detected easily since they block X-rays and create dark shadows. Non-metallic contaminants such as rubber and glass can also be detected if they are shown darker than the product.

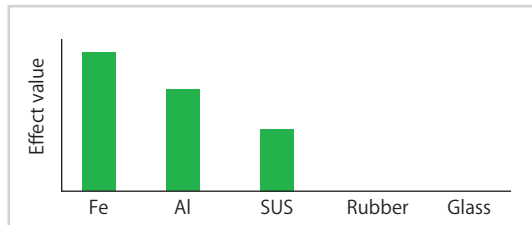


Fig. 2.1: Contaminant effect value with MD

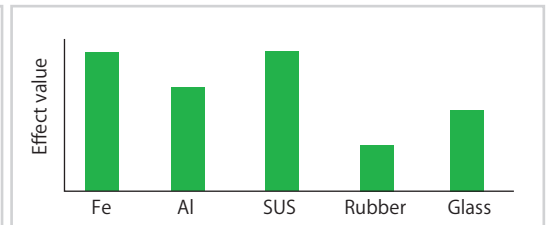


Fig. 2.2: Contaminant effect value with X-ray

[3] Can an X-ray inspection system alone detect all types of contaminants?

You may think if the X-ray systems can detect both metallic and non-metallic contaminants, we don't need metal detectors. The answer is "No".

Unfortunately, the X-ray system is not an almighty contaminant detector; The thinner the contaminant becomes, the more difficult it becomes to detect by x-ray.

Even if a contaminant is high density, the thinner the contaminant is, the easier it is for X-rays to pass through it, and hence the effect value becomes lower. Metal detectors outperform X-ray machines in detecting very thin metallic objects such as metal rust and aluminum foil.

Fig. 3.2 is the X-ray image of peel of iron rust adhered to a slice of fish.

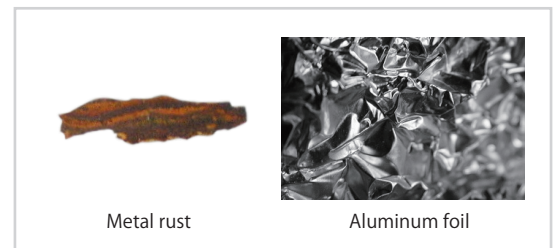


Fig. 3.1: Metal rust and aluminum foil

When the iron rust is extremely thin, the X-ray can easily pass through, and hence hardly displayed in the image. Fig. 3.3 shows the comparison of effect values of the X-ray system and the metal detector. Since the effect of the contaminant is clearly shown by the metal detector, the metal detector accurately detect the contaminant. In contrast, the X-ray inspection system cannot detect the contaminant since the effect value is not shown clearly.

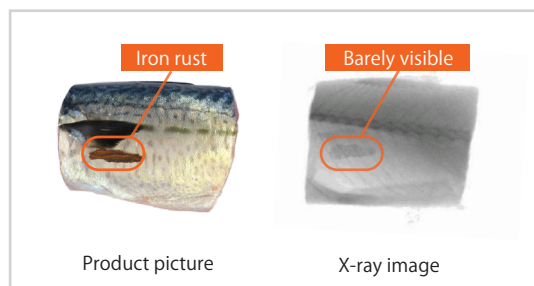


Fig. 3.2: Iron rust being inspected by X-ray

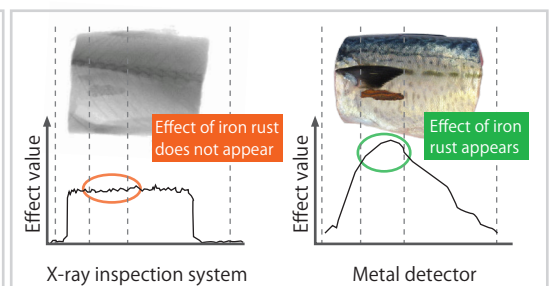


Fig. 3.3: Effect value of iron rust

[4] Combine the two systems utilizing the advantages of each

Metal detectors and X-ray inspection systems have their own advantages and disadvantages. The two systems can complement each other quite effectively, and therefore using both systems in tandem will offer the safest food inspection process.