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Application News

Bench-top X-ray CT System XSeeker™ 8000

Observation of Cosmetics and Containers Using X-Ray CT System

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User Benefits

- Liquid leakage, poor sealing, and fitting between multiple parts can be inspected, which is useful for container quality control.
- Enables a wide range of tests, such as observing the dispersion state of particles added to cosmetics.

■ Introduction

The appearance and materials of cosmetic containers are determined by various factors such as brand image and cost. In recent years, the structure and design of containers have become more diverse, in keeping with the evolving nature of cosmetics.

To ensure the safety of cosmetics, it is necessary to prevent the ingress of contaminants due to container damage during manufacturing or transport/shipping stages, quality degradation or leakage due to seal failures, and other problems. Therefore, container quality control is also important. Non-destructive testing is useful for evaluating the quality of packaging for cosmetic containers when they are displayed in stores or transported.

X-ray CT systems, one type of non-destructive testing instrument, can provide a three-dimensional visualization of container conditions, such as the sealing status, breakage, and leakage. Furthermore, they can also be used to observe the cosmetics themselves, which is useful for various quality inspections.

This article describes an example of using an XSeeker 8000 bench-top X-ray CT system (Fig. 1) to observe cosmetics and their containers.

Fig. 1 XSeeker™ 8000

■ Scanning Cosmetics

In this study, three types of cosmetics were scanned, as shown in Fig. 2. The following observation criteria were established for each product:

For the cushion foundation, container components were identified, gaps were measured, and foundation liquid distribution was assessed. For liquid lipstick, the container seal was assessed, liquid leakage was detected, and particle dispersion in the liquid was evaluated. For powder eyeshadow, particle dispersion in the eyeshadow was evaluated, density differences between palettes were assessed, and internal cracks were detected.

Fig. 2 External View of the Cosmetics
(Left: Cushion Foundation, Middle: Liquid Lipstick, Right: Powder Eyeshadow)

■ Scanning Conditions

Setting up the scanning conditions for XSeeker 8000 is extremely user-friendly, as it only requires selecting the material (metal or plastic) and the imaging quality (fast or fine). For both metal and plastic, the fine mode takes about 5 minutes (0.1 mm spatial resolution), whereas the fast mode takes about 12 seconds (0.2 mm spatial resolution).

Table 1 shows the scanning conditions for this study. Products that contain high-density materials (e.g., mirrors) were scanned in the "Metal & Fine" mode, while plastic-only products were scanned in the "Resin & Fine" mode.

Table 1 Scanning Conditions

	Cushion Foundation	Liquid Lipstick	Powder Eyeshadow
Scanning Mode	Metal & Fine	Resin & Fine	Resin & Fine
Scanning Time	5 minutes	5 minutes	5 minutes
Resolution	0.1 mm	0.1 mm	0.1 mm

■ Results

Cushion Foundation

Cross-sectional images are shown in Fig. 3 and 4. Fig. 3 shows that the foundation container comprises multiple parts, such as the outer lid, the inner partition, and the sponge base, joined together by fitting and gluing. The mirror glued to the outer lid appears white due to its high density, while the puff and other low-density parts appear an almost blackish gray color. Furthermore, the bottom of the sponge filled with liquid foundation is also visible.

Fig. 4 shows that the gap between the internal parts is approximately 0.58 mm.

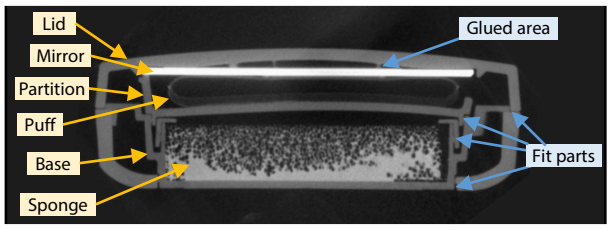

Fig. 3 Cross Section of the Cushion Foundation

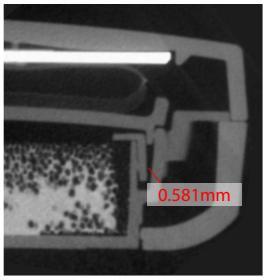

Fig. 4 Gap Dimensional Measurement

The standard CT software is able to display 3D images. By varying the transparency of the 3D image, the three-dimensional position of internal parts can be confirmed easily. Because the software also allows any color to be assigned to a particular luminance value, the liquid foundation can be intentionally colored beige, as shown in Fig. 5.

Specific internal parts can be isolated from the 3D image by changing the luminance threshold value or using the clipping function. A 3D image of only the isolated liquid foundation fluid is shown on the right side of Fig. 5. That shows the liquid penetrating the sponge pores and concentrating along the outer perimeter area of the sponge. X-ray CT can also be used for tests other than containers.

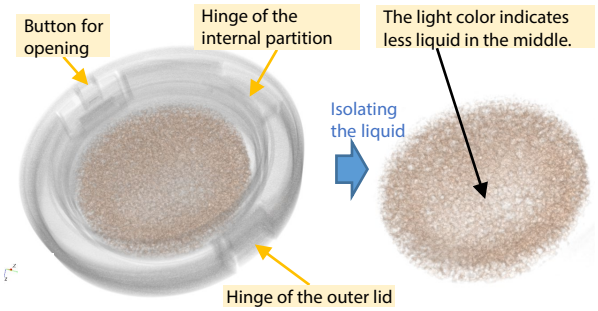

Fig. 5 3D Image of the Cushion Foundation

Liquid Lipstick

A cross-sectional image of the overall lipstick is shown in Fig. 6. It shows that the cap and the tip of the lipstick are made by fitting several parts together.

Fig. 7 shows the area where the liquid was intentionally applied to the threaded area (between the cap and the body) as white. In X-ray CT cross-sectional images, whiter areas indicate higher density materials. So, if the density of the liquid is higher than the density of the cap and body, the white area can be identified as liquid and used to evaluate leakage.

Fig. 8 shows the dispersion of particles in the liquid. This lipstick is a commercial product, so the particles are dispersed uniformly in the liquid. However, such images could be used to evaluate particle dispersion inconsistencies during product development or quality inspection.

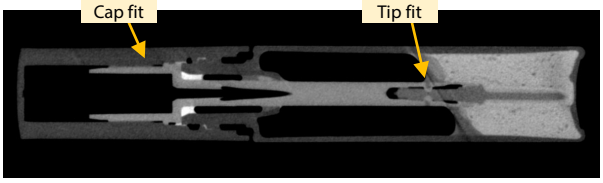

Fig. 6 Cross Section of the Liquid Lipstick

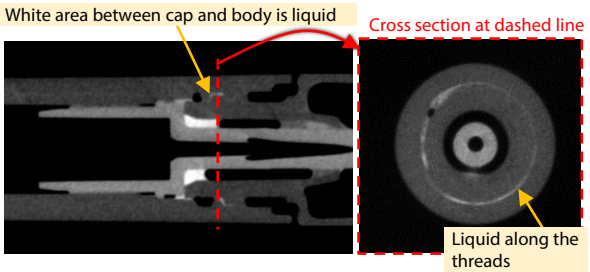

Fig. 7 Cross Section of the Liquid Lipstick
(Enlargement of Area with Liquid Applied)

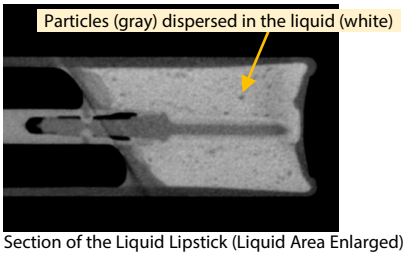

Fig. 8 Cross Section of the Liquid Lipstick (Liquid Area Enlarged)

Powder Eyeshadow

Fig. 9 shows cross-sectional images. In the upper-left area (blue square in Fig. 9), there are high-density particles dispersed in the base material. Thus, particle dispersion in solid as well as in liquid can be observed by X-ray CT.

Also, the color of the lower right area (green square) appears whiter than that of the upper left area. That indicates that the lower right area is made of denser material or more cohesive particles.

The left side of Fig. 10 shows cross-sectional images from another part of the lower right area that show internal cracks. Also, the position and the shape of the cracks can be determined from the 3D image (right side of Fig. 10). Thus, X-ray CT can be used to discover cracks inside cosmetics that cannot be detected by external inspection.

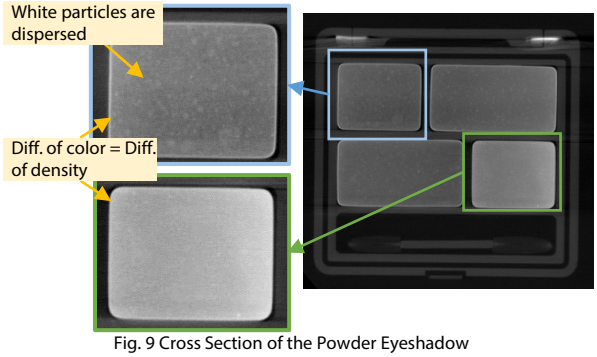

Fig. 9 Cross Section of the Powder Eyeshadow

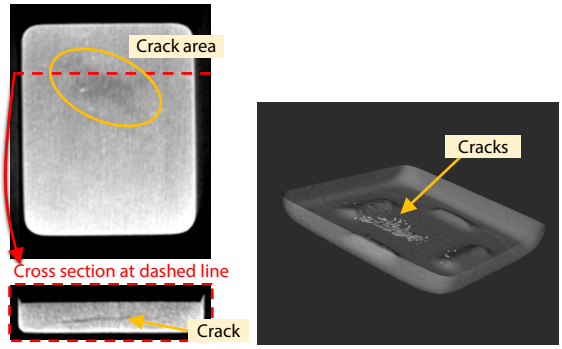

Fig. 10 Crack Area (Left: Cross Section; Right: 3D Image)

■ Conclusion

This article describes examples of observing various types of cosmetics and their containers using the XSeeker 8000 tabletop X-ray CT system.

X-ray CT can be used for various applications, such as identifying parts, determining the distribution of foundation liquid, inspecting the cap fitting or leakage status, observing the dispersion of particles in liquid or powder, and detecting internal cracks. XSeeker 8000 allows anyone to easily and non-destructively inspect and evaluate cosmetics and their containers.

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