SHIMADZU

Application News

Industrial X-Ray Inspection System No.N112

Inner Observation of Aluminum Die Casting Parts

■ Introduction

X-ray fluoroscopy systems have been widely used to detect blowholes, porosities, cracks, and other internal defects in aluminum die cast products.
In recent years however, with increased miniaturization and density of machine components, detailed information on such defects including positioning, shape, and size is increasingly demanded, and detailed 3 dimensional observations have become essential.
As a means of responding to such demands, this paper introduces examples of the observation of internal defects in aluminum die cast parts using an X-ray CT system.
The inspeXio SMX-225CT microfocus X-ray CT system (shown in Fig. 1) was used to obtain the images.

Fig.1 External Appearance of the inspeXio SMX-225CT X-Ray CT System

■ Observational Results

The sample utilized for observation in this case was the aluminum die cast part shown in Fig. 2.
Images of this sample taken using conventional X-ray fluoroscopy are shown in Fig. 3. The right-hand image is a magnified view. Multiple blowholes and porosities, marked with arrows, are evident at the center of the image. It is difficult however to discern their depth, directional positioning, or shape in any detail.

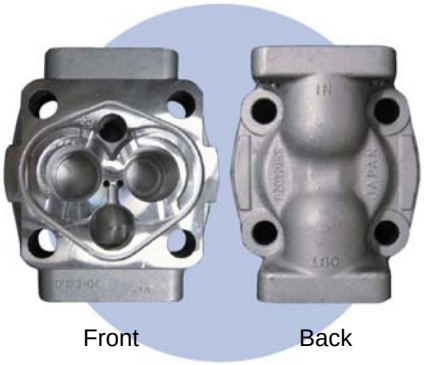

Fig.2 External Appearance of the Sample (Aluminium Die Cast Part)

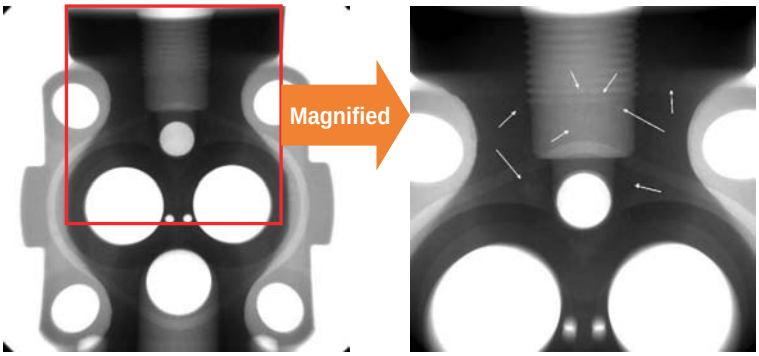

Fig.3 Example of Fluoroscopic Image for an Aluminium Die Cast Part

Accordingly, to perform a more detailed analysis, focused observations of the blowholes and porosities were made using MPR (Multi Planner Reconstruction). In this approach, cone beam CT imaging was performed under the conditions in which the fluoroscopic images in Fig. 3 were obtained. Any cross-sectional image was then reconstructed for display from the CT images obtained in this way. (Fig. 4)
Fig. 4, (1) shows a cross-sectional image corresponding to the red frame in the fluoroscopic image to the left (identical to Fig. 3.), (2) shows a vertical section reconstructed from the ○ line in (1), while (3) shows a vertical section reconstructed from the ● line in (1).
In examining these images, the positioning and arrangement of the blowholes and
porosities, which were difficult to ascertain from the fluoroscopic image, are now
clearly evident. (For example, a large pore cavity is evident at the position indicated
by the red arrow in Fig. 4.)
It is also possible to create 3-dimensional images based on this CT imaging data. (Fig. 5)

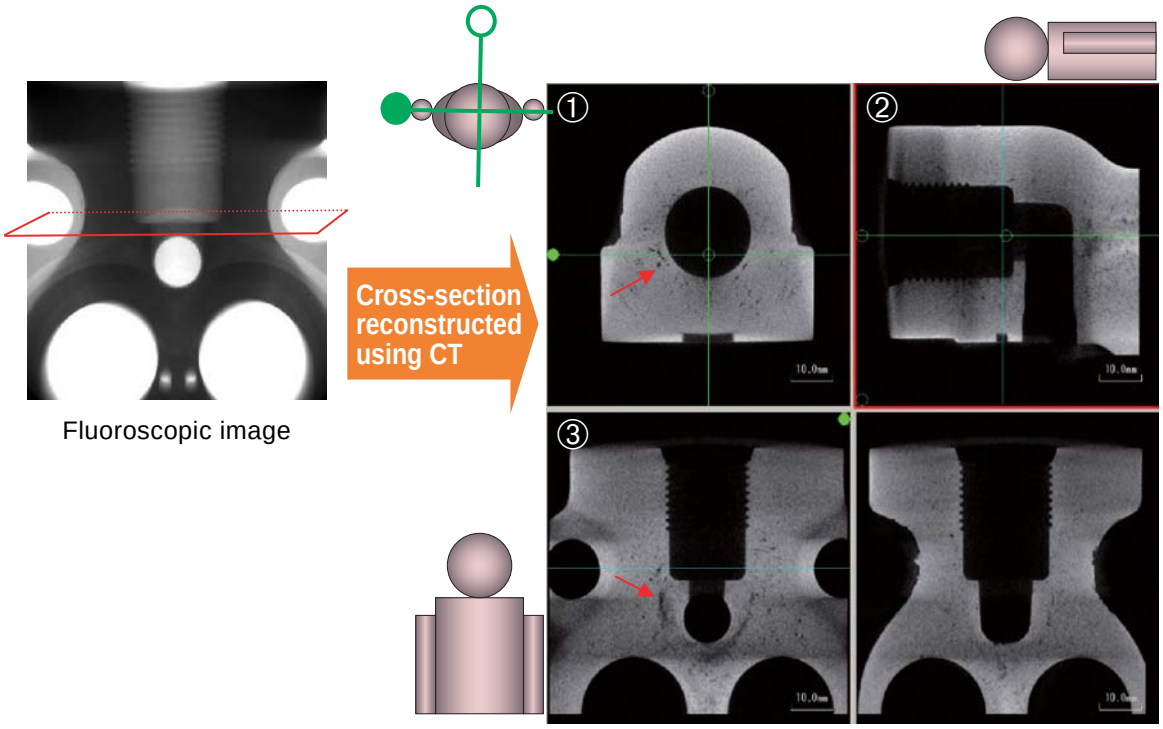

Fig.4 Example of CT Image for an Aluminum Die Cast Part

Fig.5 Example of 3-Dimensional Image for an Aluminum Die Cast Part

As an example of statistical analysis, the defect detection software provided with the system is capable of automatically detecting the blowholes and porosities in Fig. 5, color coding the defects by size, and then displaying a 3-dimensional image of the results. Fig. 6 illustrates this process. Here, the size (small: blue → large: green) and distribution of the blowholes and porosities are easily determined.

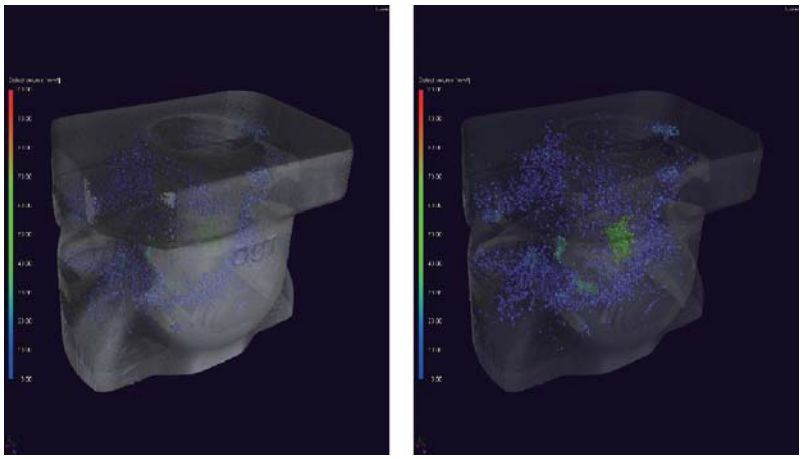

Fig.6 Example of 3-Dimensional Image for an Aluminum Die Cast Part

The data processing software provides a number of such analysis functions, which can be utilized to improve productivity.
Fig. 7 shows the process of marking the largest blowholes and porosities identified from the image, and then digitizing their position data for display. Since the blowholes and porosities detected are digitally classified on an individual basis, it is simple to display charts of the relationship between pore cavity size and frequency, as shown in Fig. 8.

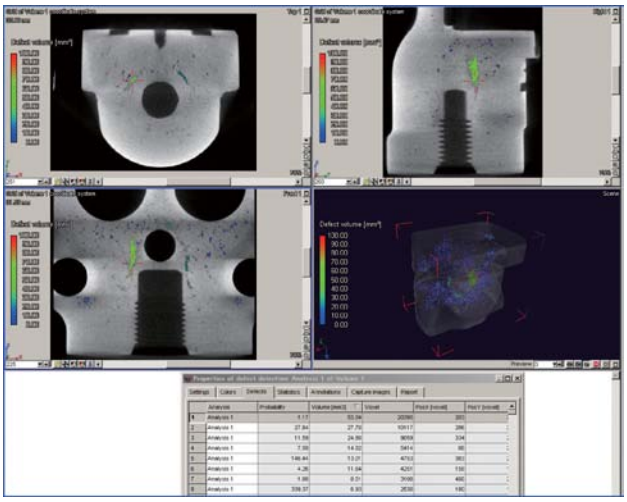

Fig.7 Example of Defect Analysis for an Aluminum Die Cast Part

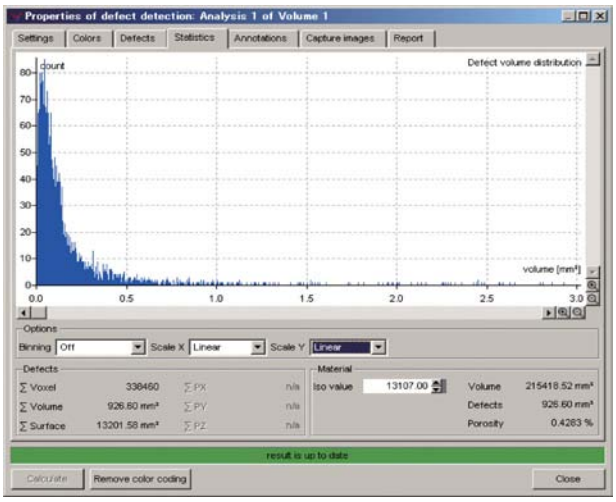

Fig.8 Example of Defect Analysis for an Aluminum Die Cast Part

In this paper, an X-ray CT system has been used to inspect and analyze of blowholes and porosities in aluminum die cast parts. The same procedure can also be used to investigate the distribution of defects in other materials, such as voids in resin molded products.
While X-ray fluoroscopy systems are generally limited functionally to identifying the presence or absence of blowholes and porosities, they are widely utilized in quality control processes where the focus is on operational convenience. In contrast, using the variety of data provided by the CT system introduced here (such as crosssectional images, 3-dimensional internal images, and digitized information obtained by extracting the defects) enables more detailed analysis. This will contribute significantly to design feedback and to improvements to manufacturing processes.

NOTES:
✻This Application News has been produced and edited using information that was available when the data was acquired for each article. This Application News is subject to revision without prior notice.

SHIMADZU

SHIMADZU CORPORATION. International Marketing Division

3. Kanda-Nishikicho 1-chome, Chiyoda-ku, Tokyo 101-8448, Japan Phone: 81(3)3219-5641 Fax. 81(3)3219-5710
Cable Add.:SHIMADZU TOKYO

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