

# Application News

## No. N121

### Industrial X-ray Inspection System

## Observations of Superabsorbent Polymers Using the inspeXio SMX-100CT Microfocus X-Ray CT System

### ■ Introduction

Superabsorbent polymers have the property of absorbing from several tens to several hundreds times their own weight of water and instantaneously hardening to a gel. Superabsorbent polymers are used in absorbent materials such as diapers, due to their high water-holding capacity and the fact that they do not discharge the absorbed water. The superabsorbent polymer shown below was extracted from commercially-available disposable diapers for infants. This Application News introduces examples of superabsorbent polymer images taken by an X-ray CT system.

### ■ Observations of Disposable Diapers

Images of disposable diapers containing superabsorbent polymer were taken with an inspeXio SMX-100CT Microfocus X-ray CT System (Fig. 1). A disposable diaper is generally comprised of a surface material, absorbent paper, cotton-like pulp, superabsorbent polymer, and waterproof material. Fig. 2 shows the construction. An approximately 15 mm x 15 mm sample of disposable diaper was excised for imaging.



Fig. 1 Overview of SHIMADZU inspeXio SMX-100CT Microfocus X-Ray CT System

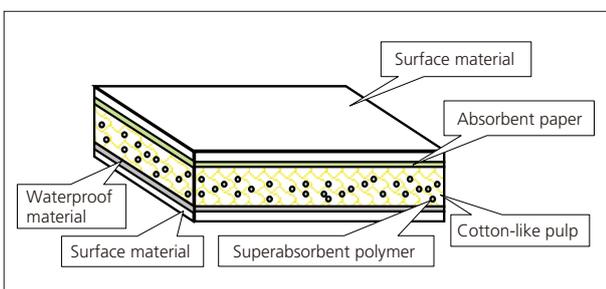


Fig. 2 Schematic Diagram of Disposable Diapers

Fig. 3 shows the MPR image of a disposable diaper before it absorbs water.

In the MPR display, multiple CT images are stacked in a virtual space. Four images – (1) a CT image, (2), (3) mutually orthogonal longitudinal section images, and (4) an arbitrary section image orthogonal to the longitudinal section images – are arranged for display. Images (2) (top-right) and (3) (bottom-left) in Fig. 3 shows sectional images in the thickness direction of the disposable diaper. Image (1) (top-left) shows a fibrous structure that is the cotton-like pulp and white particles that are the superabsorbent polymer. It is apparent that the superabsorbent polymer is dotted throughout the cotton-like pulp. Image (4) (bottom-right) shows the cross-sectional image on the green line in image (2) (top-right). It shows a different section position from image (1).

Fig. 4 shows the MPR image of the disposable diaper in Fig. 3 after it absorbed water. Images (2) (top-right) and (3) (bottom-left) show that the superabsorbent polymer at the top of the disposable diaper has absorbed water and its volume increased. A small amount of water was applied and it is apparent that the superabsorbent polymer at the bottom of the disposable diaper has not absorbed any water.

Fig. 5 and Fig. 6 show three-dimensional representations of the data above. The yellow particles in Fig. 5 are superabsorbent polymer. In Fig. 6, the superabsorbent polymer particles evaluated from observations of the volume to have absorbed water are displayed light blue and the particles that have not absorbed water are displayed yellow.

The three-dimensional images clearly show the superabsorbent polymer dotted throughout the cotton-like pulp and the positional relationships between particles which have absorbed water and those that have not.

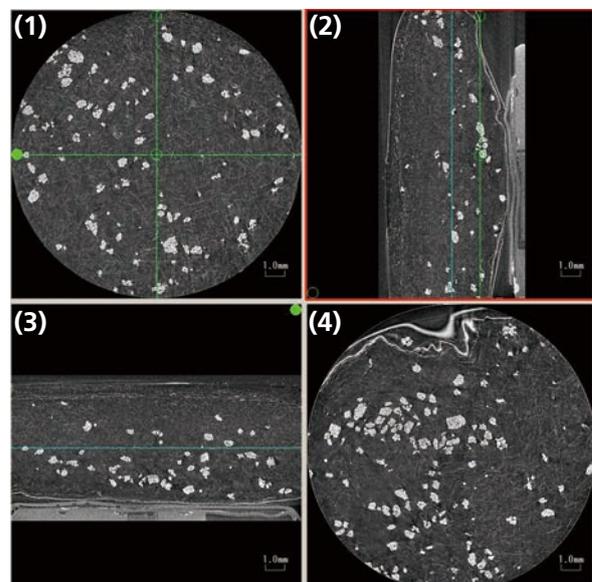


Fig. 3 MPR Image of Disposable Diaper

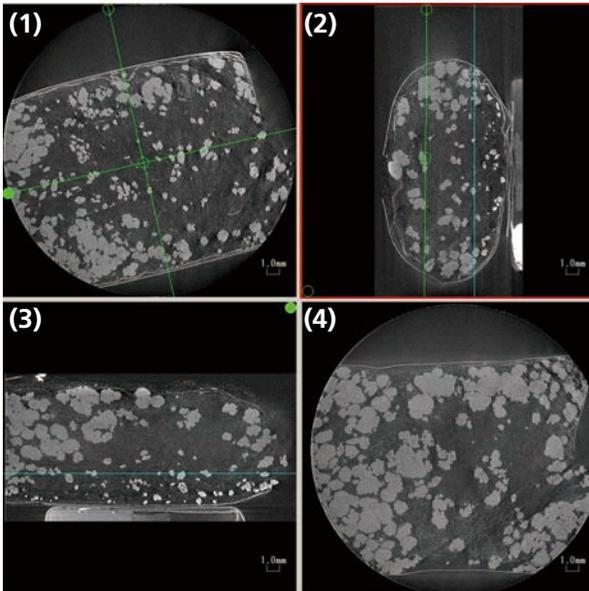


Fig. 4 MPR Image of Disposable Diaper (after water absorption)

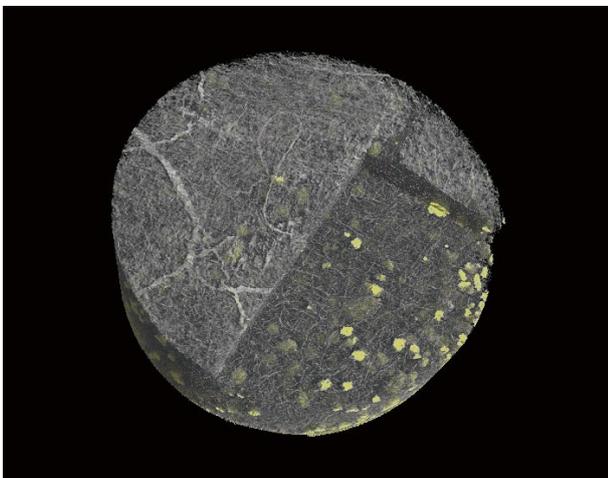


Fig. 5 3D Image of Disposable Diaper

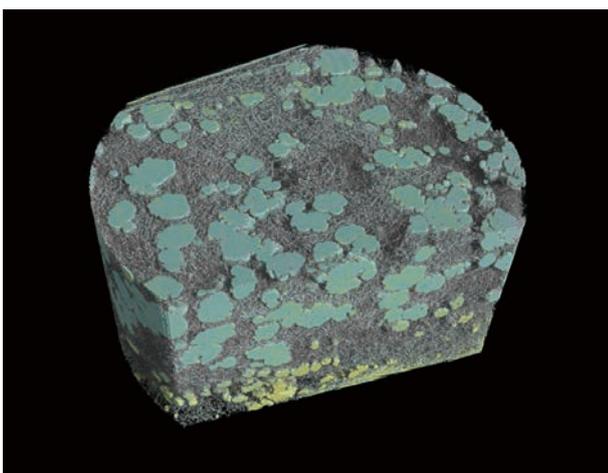


Fig. 6 3D Image of Disposable Diaper (after water absorption)

### ■ Observation of Superabsorbent Polymer

Fig. 7 shows images of the superabsorbent polymer extracted from a disposable diaper. This is the same superabsorbent polymer that was observed as particles in the disposable diaper images. However, it is apparent that it comprises layers of fine particles. The particle sizes of these layered particles are from several 10  $\mu\text{m}$  to 200  $\mu\text{m}$ .

Fig. 8 shows a three-dimensional representation of this data. It shows a three-dimensional image of the positions of the particles.

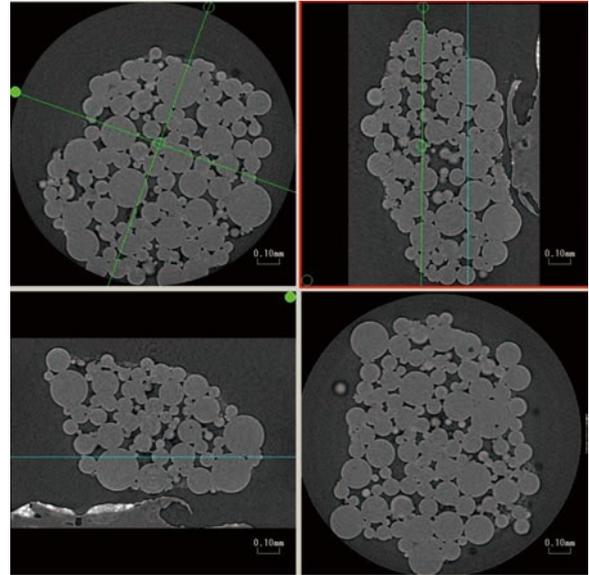


Fig. 7 MPR Image of Superabsorbent Polymer

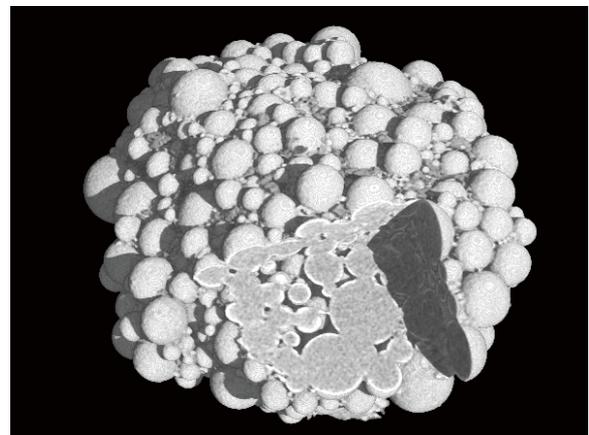


Fig. 8 3D Image of Superabsorbent Polymer

### ■ Conclusion

inspeXio SMX-100CT reveals both the layered structure of the disposable diaper containing the superabsorbent polymer particles and the detailed internal structure of the individual superabsorbent polymer particles, without the need for complex pretreatment. It also allows simple observations in cases where it is difficult to excise a cross-section, such as observations after water absorption.