

APPLICATION OF LASER HOLOGRAM INTERFEROMETRY TO
THE DISTORTION DETERMINATION OF SUGAR-COATED TABLETS

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ABSTRACT

Sugar-Coated tablets of different core materials were prepared and the degree of distortion of the sugar coat was determined by the laser holographic interferometry of double exposure method. It was found that, as the degree of expansion of the tablet core material increased, the sugar coat became more distorted. By the present method, non-destructive measurement of a minute amount of distortion is possible and thus superior to conventional methods.

INTRODUCTION

The authors consider one cause of cracking on the surface of sugar-coated tablets to possibly be volume change in the tablet core. This change, due to moisture sorption or hydrate formation in the core substance, can be directly measured by a micrometer.

Distortion of the sugar coat cannot be determined by conventional method since the deformation is so little. In this paper, a double-exposure hologram interferometry was used to determine this distortion. In contrast to the conventional interference method and photoelasticity measurements, the subjects require no mirror surface nor have to be transparent when laser holography is carried out. Moreover, this technique may provide information not only on the amount but also distribution of distortion by non-contact and non-destructive measurements.

Recently, the strain recovery of a powder bed following compression was determined by Ridgway Watt et al.¹⁾ by hologram interferometry. In the present work, using two kinds of core tablets differing in moisture sorbing properties, the distortion of each tablet was examined.

EXPERIMENTAL

Preparation of Tablets --- As shown in Table I, two kinds of tablets of considerably different moisture sorbing capacity were prepared by direct compression with a high speed tableting machine, RTM-36S-2S (Kikusui Seisakusyo). Fifty thousand of each kind of tablet were sugar coated and dried in a desiccator at 25°C over silica gel.

Determination of Dimensional Change in Core Tablets Due to Moisture Sorption by an Electronic Micrometer --- Dimensional change in the diameter of uncoated tablets (core tablets) was measured with an electronic micrometer at 30°C and 68% R.H.. This device is shown in Fig.1.

Holography --- The outline of the optical system in this study is shown in Fig.2. The light source is He-Ne laser GLG-5350 (Nippon Electric Co.) with 6328 Å of wavelength and 5mW of power.

Table I Formulations for Two Kinds of Tablet Used

INGREDIENT	FORMURATION	
	A	B
Lactose	125.0	125.0
Crystalline Cellulose	60.0	-
Cornstarch	50.0	-
Calcium Sulfate	-	107.0
Hydroxypropylcellulose	10.0	10.0
Carboxymethylcellulose Calcium	2.5	-
Magnesium Stearate	2.5	2.5
Total (mg)	250.0	250.0

A beam emitted from a He-Ne laser and passed through an objective lens is collimated by a collimeter lens. The beam is then divided into two separate beams by a beam splitter. The reflected beam illuminates the surface of a sugar-coated tablet perpendicularly. The scattered light passes through the beam splitter and falls on a holographic film. The reference beam is obtained from a part of the laser beam, transmitted by the beam splitter and reflected by a mirror. To obtain an excellent hologram, the device must not be allowed to vibrate. Our device was supported by air cushion and placed in a tightly closed container.

Double exposure was made before and after moisture sorption. When distortion of a sugar coat occurred between the first and the second exposures, the resulting hologram gave interfering fringe patterns on reconstruction. The operation diagram appears in Fig.3.

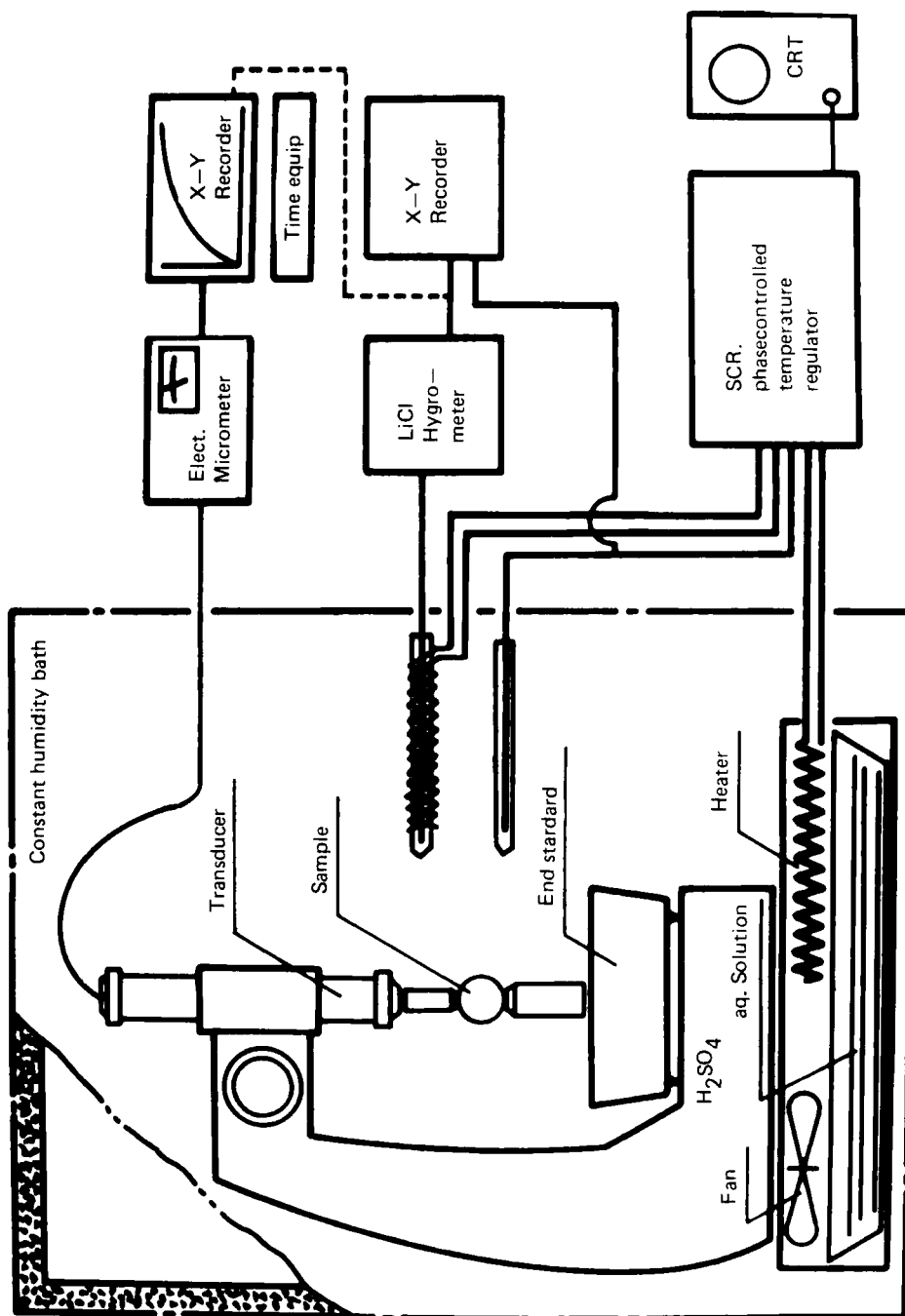


Fig.1 Device for Measurement of Expansion of Core Tablets

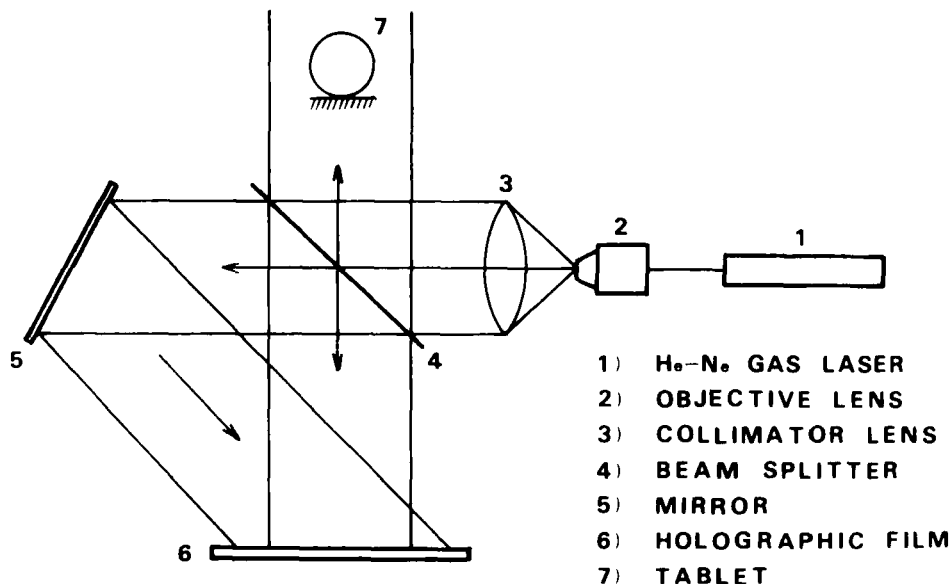


Fig.2 Schematic Diagram of Optical Arrangement for Hologram Interferometry

RESULTS AND DISCUSSION

Expansion of Core Tablets --- An increase in the diameter of core tablets as a result of moisture sorption was measured with the electronic micrometer. As shown in Fig.4, a remarkable volume change occurred in tablets containing crystalline cellulose and cornstarch. The details of similar phenomena have been described in previous papers.^{2).3)}

Distortion of the Sugar Coat --- Fig.5 shows interferograms for the sugar-coated tablets of the formulations A and B. Each photograph shows the deformation of sugar coat which occurred during the indicated time interval at 15°C and at 60% R.H.; for example, the figure at "30 min" indicates the change occurring 20 to 30 min following the start of the experiment. Each measurement was carried out 5 times.

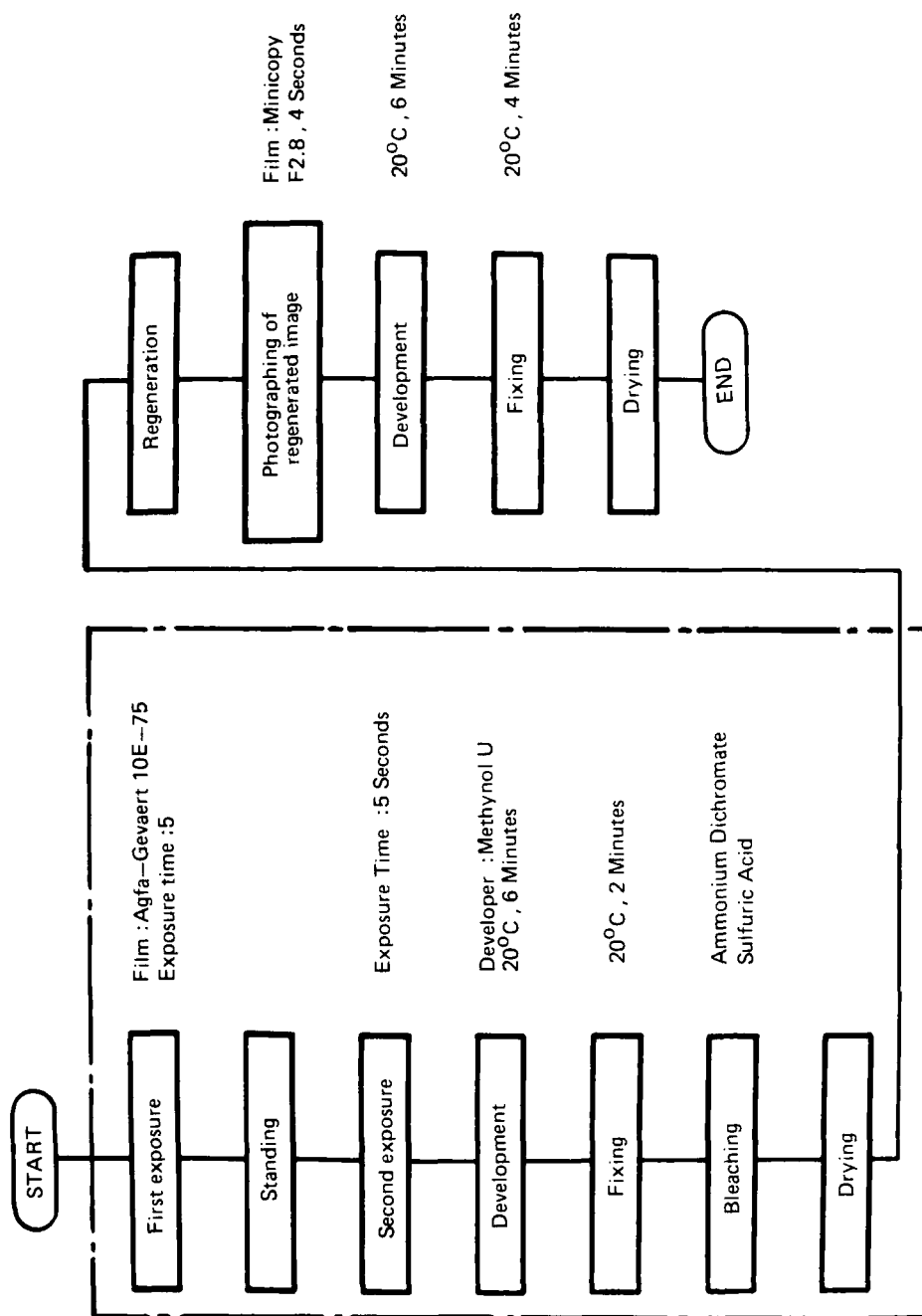


Fig. 3 Diagram for the Operation

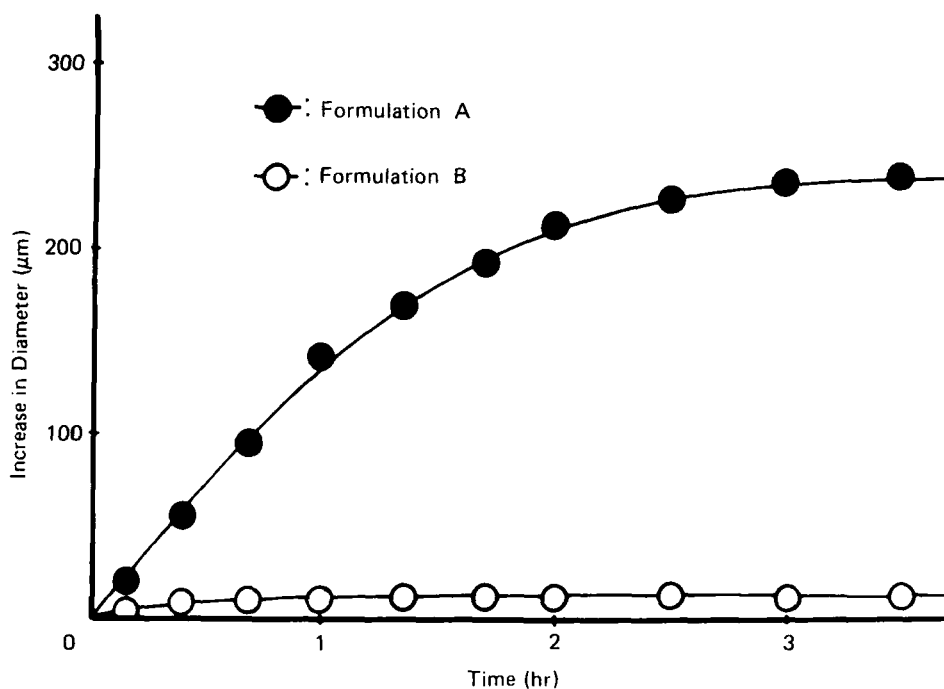


Fig.4 Increase in Diameter for Two Kinds of Core Tablet Due to the Sorption of Moisture Measured by an Electronic Micrometer

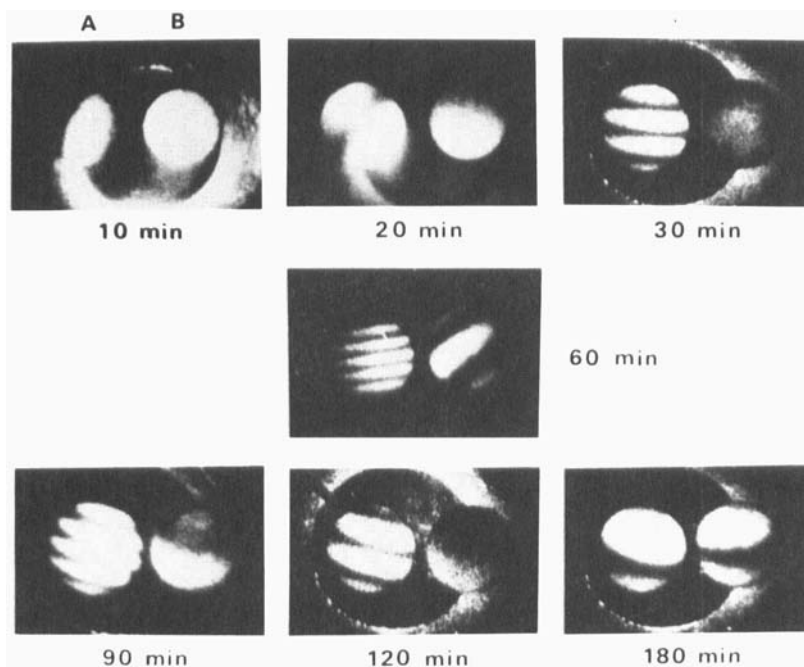


Fig.5 Interferograms for Two Kinds of Tablet

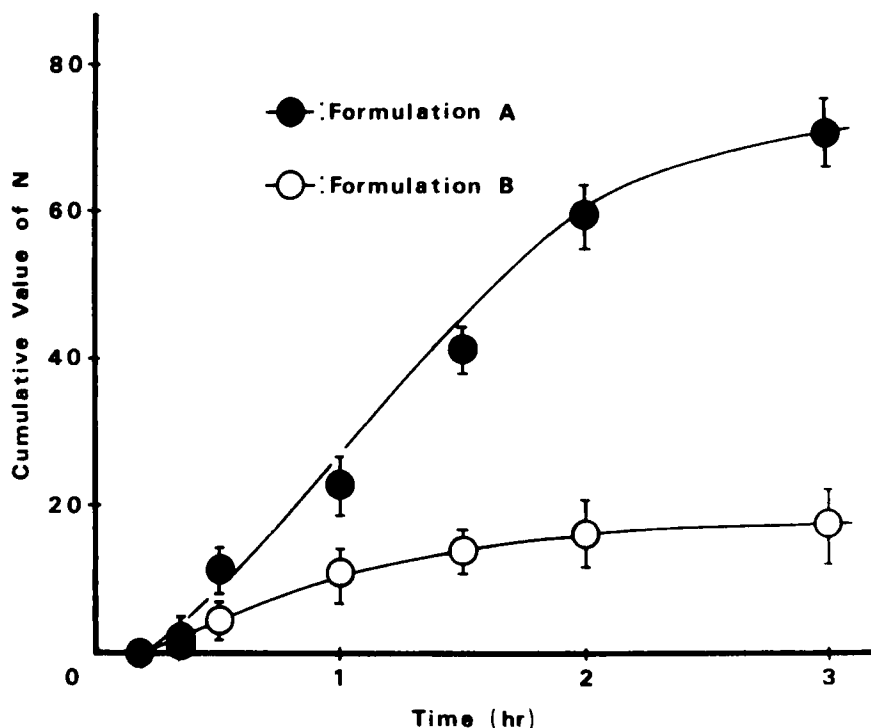


Fig.6 Change in the Cumulative Value of the Each Number of Fringe on a Tablet (N) against Time

If it may be assumed that each fringe corresponds to a deformation of a half wavelength, the number of fringes on a tablet (N) should be a measure of the distortion of a sugar coat within each prescribed time interval. In Fig.6, the cumulative value of N for a tablet, corresponding to total distortion after the start of the measurement, was plotted against time; the vertical lines indicate standard deviation. It is evident that the greater the degree of core expansion, the more the surface of the sugar coat was distorted. An induction period was observed for each curve, this may indicate that water vapor requires a few minutes to diffuse into the sugar coat.

One favorable feature of the laser holography by double exposure may be that sample deformation can often be measured sim-

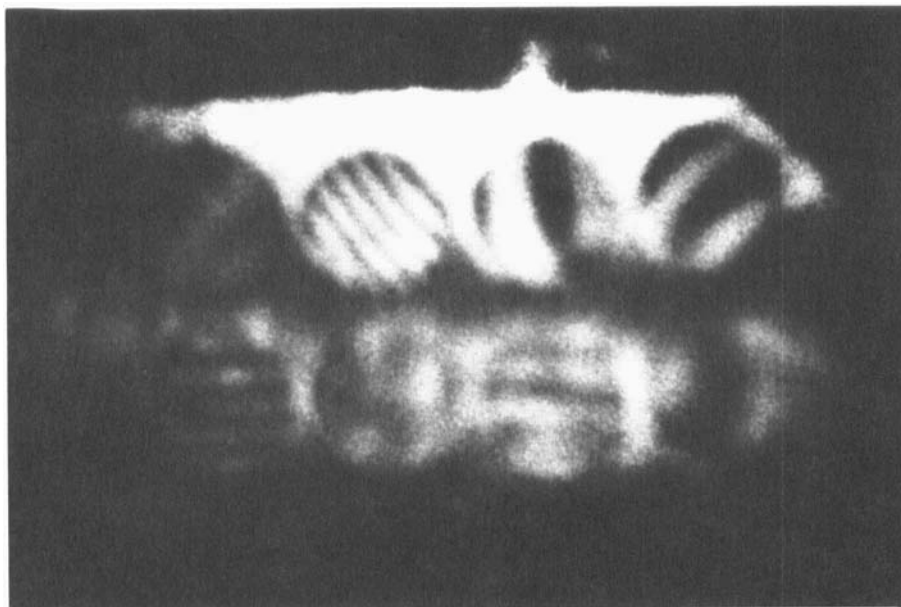


Fig.7 Observation of Distortion of Sugar Coat for Many Tablets

ultaneously under the same conditions. Fig.7 shows fringe pattern photographs for 8 tablets.

The above results indicate that the hologram interferometry by double exposure method is excellent for measuring minute amounts of distortion on the surface of a sugar coat and predicting the occurrence of cracking of sugar-coated tablets. Moreover, many samples can be examined at one time, so that this method may be applicable to quality control in tablet preparation and storage.

ACKNOWLEDGEMENT

The authors express their appreciation to Mr. Haruhiko Kajimoto Toa pharmaceutical industries Ltd., for his assistance in carrying out the experiments.

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