SHIMADZU

Application News

Material Testing System No.i227

Compression Test on Hollow Beaded Glass by Micro Compression Testing Machine

■ Introduction

Inorganic fillers, such as calcium carbonate or talc, are mixed into plastic and rubber products for various purposes such as adding functionality (e.g. improved shrinkability, heat resistance and mechanical strength) and reducing costs. However, since these inorganic fillers have a larger specific gravity than plastic and rubber materials, they have a disadvantage in that they increase the product weight.
On the other hand, hollow beaded glass, whose use has started spreading recently, is gaining the spotlight since it solves the problems with inorganic fillers described above, ensuring lighter products with new distinctive functions such as heat insulation and moisture-retaining qualities.
However, care must be taken to prevent hollow glass beads from breaking when they are being mixed in, so their strength must also be ascertained. The following introduces an example of a compression test performed on hollow glass beads using the "MCT-W500 Micro Compression Testing Machine" (overview shown in Fig. 1).

Fig. 1 Overview of MCT-W500 Micro Compression Testing Machine (with Side Observation Kit)

■ Specimens and test method

Table 1 shows the two hollow glass bead specimens (specimen A and specimen B) used in this test.
The test was performed using the MCT-W500 Micro Compression Testing Machine (Fig. 1) and the jig and load conditions listed in Table 2. Fig. 2 shows a conceptual diagram, where a force of up to 196 mN was applied on one particle at a constant rate.

Table 1 Test specimens

Specimen type	Hollow beaded glass	
Specimen name	A	B
Specimen particle size	45 to 55 µm (nominal value)	
Specimen particle shape	Sphere	

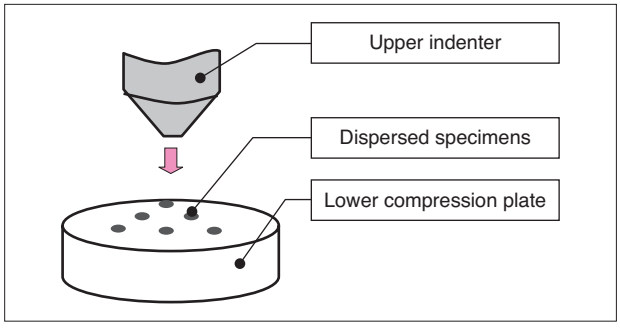

Fig. 2 Conceptual diagram

Table 2 Test Conditions (Loading Conditions)

Upper indenter	200 µm dia. flat indenter (tip made of diamond)
Specimen type	Compression test
Max. force	196 mN
Loading rate	12.912 mN/sec
Holding at max. force	0 sec
Test method	A small amount of specimens were dispersed on the lower compression plate, and the compression test was performed on one bead. (See Fig. 2.)

For measurement in the load process, the force and indenter displacement (amount of movement) were recorded. Also, observation images were obtained from the side of the specimens by the side observation kit provided with the system.

■ Test results

Fig. 3 shows the test results obtained by performing the compression test on two hollow glass bead specimens (specimen A and specimen B), in the form of a force-displacement graph. From these results, it can be seen that specimen A breaks under compression at a lower force than specimen B.

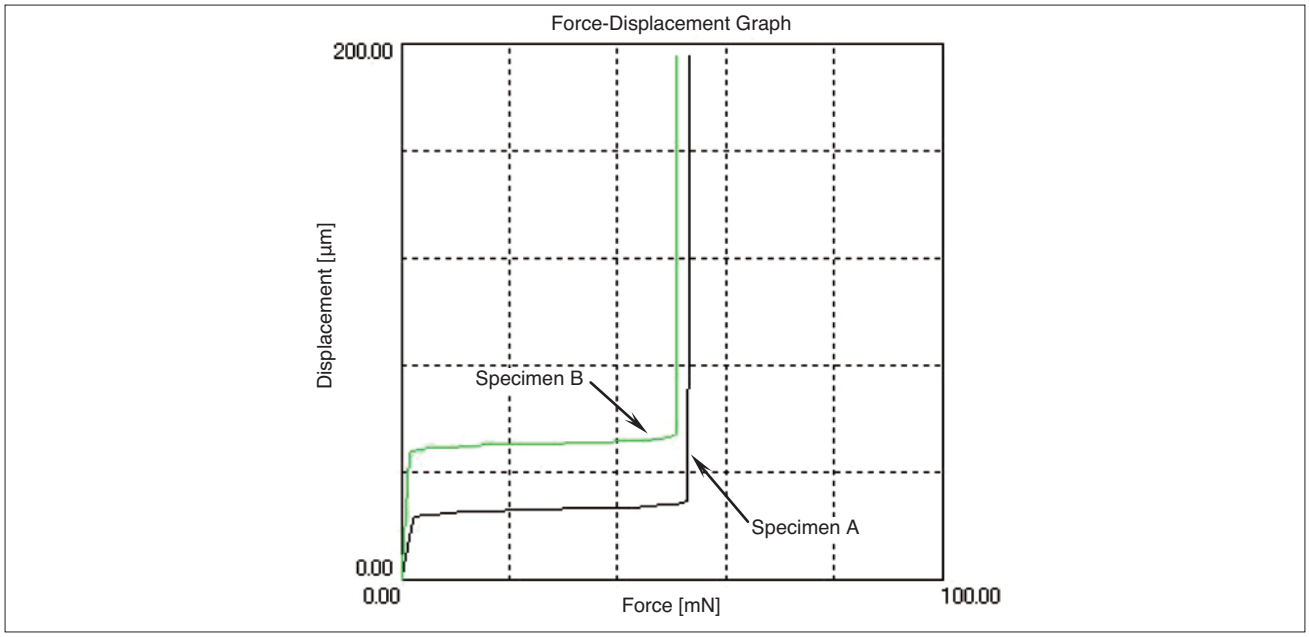

Fig. 3 Test Results (Force-Displacement Graph)

Table 3 lists the results of calculating the mechanical property values of each specimen from the test data. Fig. 4 shows an example of an image observed during application of the load taken by the side observation kit.

Table 3 Test Results

Specimen name	Breaking force (mN)	Particle size (µm)	Breaking strength (MPa)
A	25.005	53.110	7.901
B	48.957	51.100	16.710

Remarks) The breaking strength (St) was calculated by the following formula:

$St = 2.8P/\pi d^2$

St : Breaking strength [N/mm^2 or MPa]
P : Breaking force [N]
d : Particle size [mm]

* Reference : Hiramatsu, Oka, Kiyama: Nippon Kogyo Kaishi (Journal of the Mining and Metallurgical Institute of Japan), vol. 81 (1965)

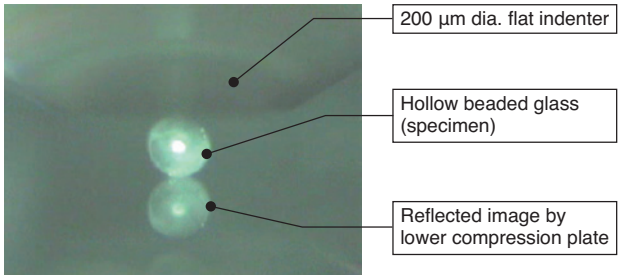

Fig. 4 Example of Observed Image of Specimen

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