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Application News

No. MT-2304

Materials Testing System

Compression Displacement Measurement Testing of Foams and Insulation

■ Introduction

Insulation is an essential component in many industries including construction, aerospace, automotive, apparel, and electronics. They can be made from various materials such as foam, fibers, ceramics, and aerogels. Some insulations also serve as thermal barriers or fire suppressant layers, for instance in battery packs. They must often be manufactured with precise densities to ensure the right balance of mechanical stability, weight, and performance is achieved for a given application. For that reason, it is essential to have the ability to accurately measure the stiffness, strength, and resilience of insulation materials to understand their response to extreme compressive forces.

Compression tests can be performed with a Universal Testing Machine, such as a Shimadzu AGX-V2 equipped with compression plates, which are available and a wide range of capacities and dimensions. When high force tests are performed, the test frame experiences compliance, where the compression and bending of the test frame itself causes an inaccurate measurement of the distance between the compression plates. To address this, Shimadzu provides devices for measuring displacement directly between the compression plates, for more accurate determination of a sample's thickness as it is compressed.

Performing these tests with a Universal Testing Machine enables programming complex, dynamic compression methods with test criteria determined by the sample thickness, such as cycle tests, progressive force tests, and extended hold tests. In the examples below a foam insulation sample was tested to high forces to illustrate the difference between the sample height measurement using the crosshead, and the more accurate displacement measuring devices. The sample was then tested under cyclic load to 25 kN and the sample was observed to compress to progressively thinner heights as the cycles increased.

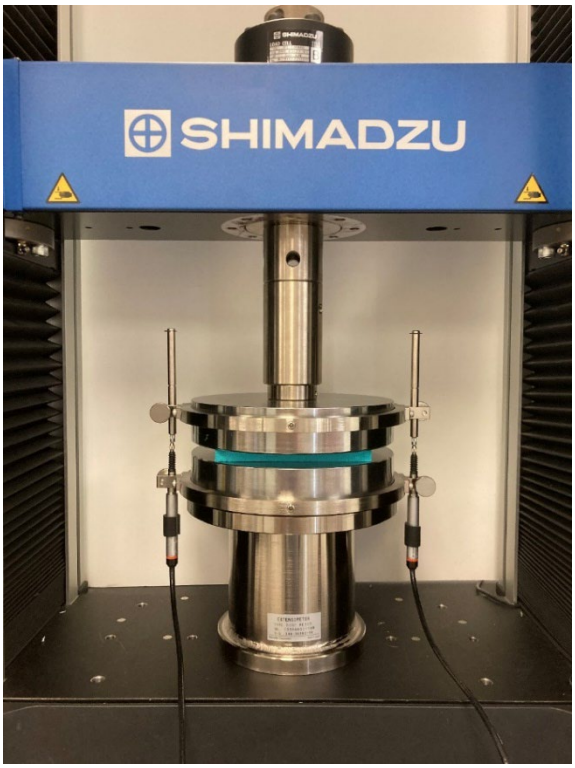

Figure 1: Shimadzu AGX-V2 Testing Machine Equipped with Devices for Measuring Displacement Between Compression Plates

Table 1: Specification of Test System and Conditions

Instrument	AGX-V2 50kN
Fixture	200mm diameter steel compression platens
Linear Gauges	Averaging Type, 10mm range, 0.1µm resolution
Software	TrapeziumX-V
Test Speed	2500 N/sec
Data Processing	Displacement and Sample Height at Max

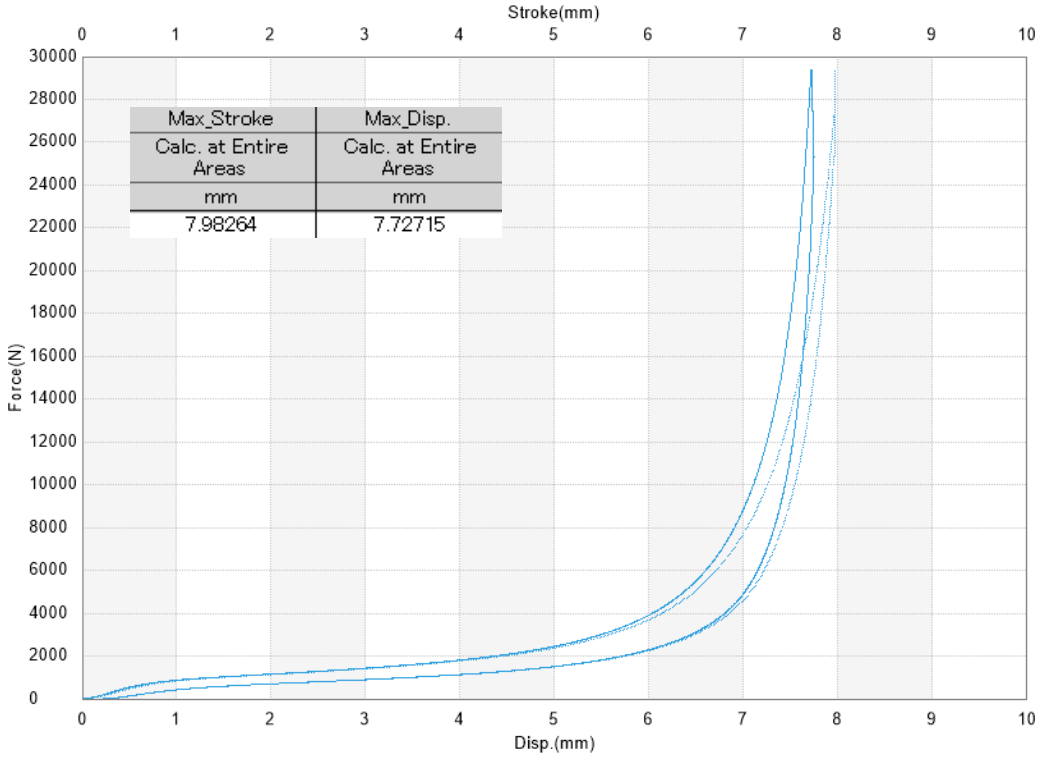

Figure 2: Compression and release test of an foam insulation square shows that the crosshead stroke (dashed line) and displacement measurement device (solid line) differed by over 250 micrometers.

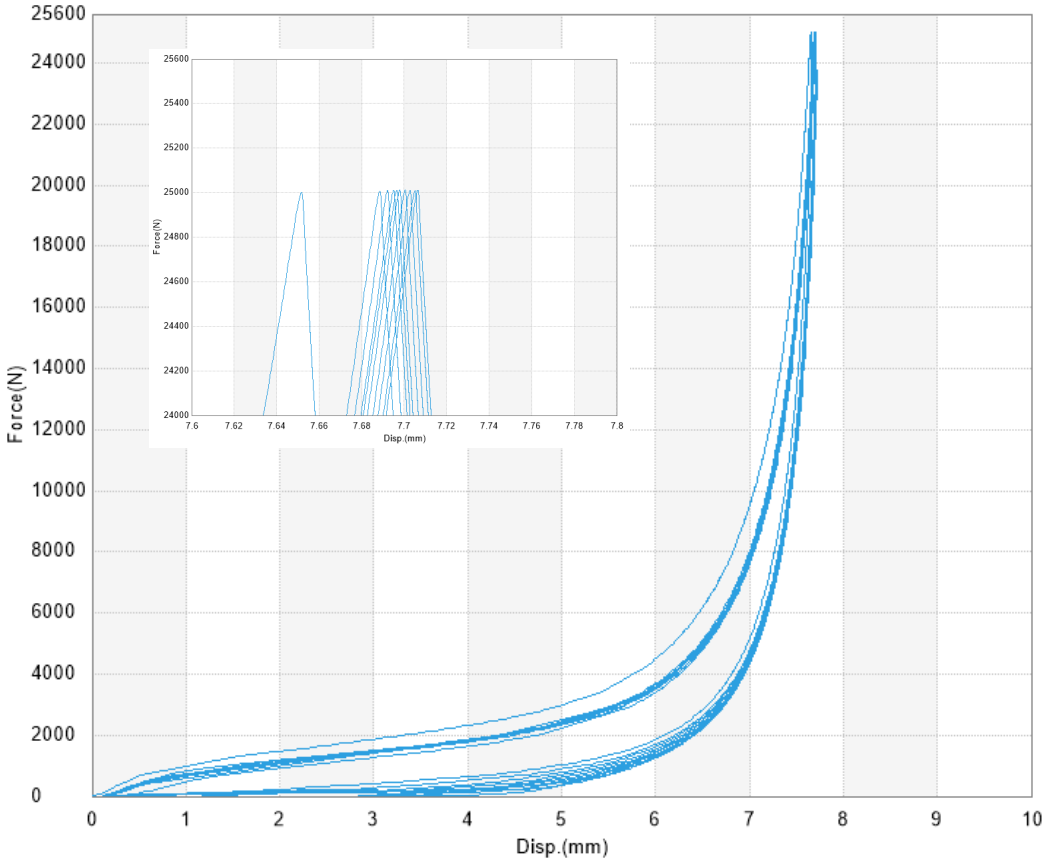

Figure 3: Example data of a cyclic test. The inset shows that the displacement at maximum force progressively increases as the sample is cycled. The sample also exhibits hysteresis as the force is released due to the absorbed energy during compression.

■ Conclusions

In conclusion, Shimadzu precision Universal Testing Machines can be equipped with a wide range of accessories for compression, tension, bending, and adhesive testing of insulation materials and foams. Accessories for displacement measurement are essential for accurately characterizing material properties.

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