

Application News

Autograph Series Universal Testing Machines

Tensile Test for Flexible Cellular Polymeric Material According to ISO 1798

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User Benefits

- ◆ Fast testing using pneumatic flat type grips up to break without any slippage
- ◆ Easy to use software to get tensile strength and elongation at break without any further calculation

Introduction

Polymers are an incredibly versatile class of materials [1]. Among them, polymeric foams, called also cellular or expanded polymers which have played an important role in everyday life [2]. Therefore, producing polymeric structures with specific mechanical properties is highly attractive for engineering applications such as automotive, construction, sports and leisure, packaging, piping and so on [3].

In this regard, recycled polymeric foams could also have a second life chance to be used in the mentioned fields since they exhibit a prominent role in sustainable development [4]. To do that, the mechanical properties should be first analyzed as they present a crucial parameter to maintain certain quality.

International standard ISO 1798:2008 (E) provides a method to measure both tensile strength and elongation at break for flexible cellular polymeric materials when the sample is extended at a constant rate until it breaks [5]. In this Data sheet, a tensile test has been performed for three different polymer foams. Based on the obtained mechanical characteristics, the final application will be thereafter chosen.

Measurement Conditions and Samples

Table 1 shows the composition of the test system. A Shimadzu AGS-X, table-top type, autograph series universal testing machine, with a capacity of 10 KN has been used during the measurements. Pneumatic flat grips and flat grip faces with diamond coating have been used to prevent any slippage. The test set-up is presented in Fig. 2.

Testing machine	AGS-X
Load cell	10 KN
Grip	Pneumatic flat grip
Grip face	Flat grip face, Diamond coated
Software	Trapezium™ X (Single)

Prior to the test, the samples were cut (Fig. 1) and conditioned. All the tests were conducted under the same conditions described in Table 2 in accordance with ISO 1798.

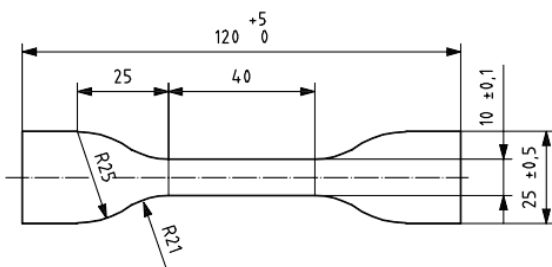


Fig. 1 Sample geometry and dimensions

Table 2 Test conditions

Test speed	500 mm/min during the whole test up to break
Test conditioning	23 °C and 50% relative humidity

Table 3 Sample information

Dimensions	ISO 1798 Type 1A (Fig. 1) Gripping distance: 90 mm
Material	3 polymeric foams (3 batches) 2 samples per batch



Fig. 2 Test set-up

Test Results

The investigation of the three batches for the different polymeric foams revealed almost the same behavior (Fig. 3). In fact, it is the behavior of ductile materials. The latter go through a yield point which defines the onset of irreversible plastic deformation and results in ductile fracture (break).

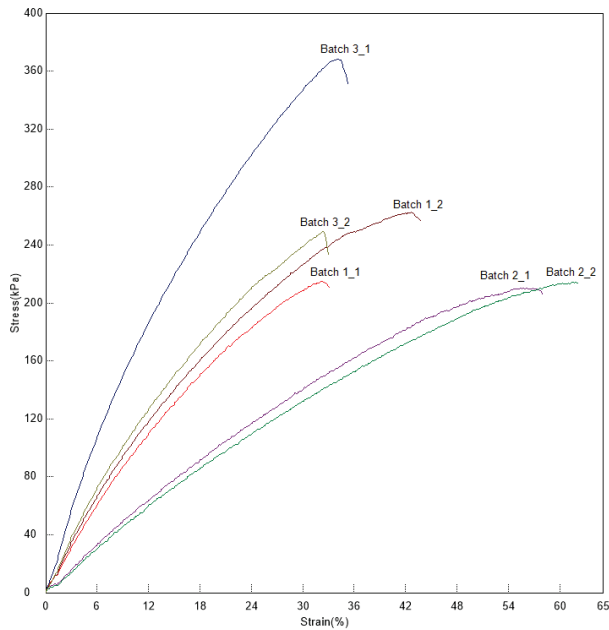


Fig. 3 Stress-Strain curves for all the samples

The obtained tensile strength and elongation at break are summarized in Fig. 4 and Fig. 5. According to them, a reproducibility for each batch could be confirmed.

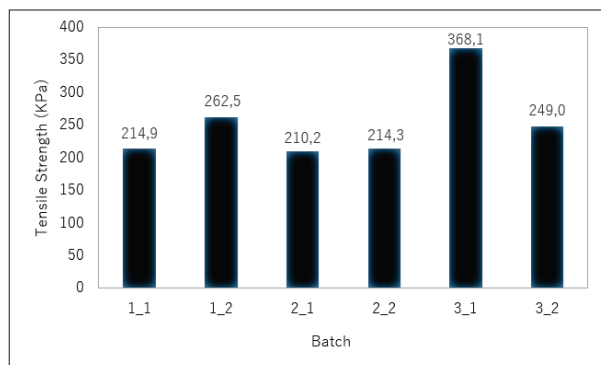


Fig. 4 Tensile strength for all the samples

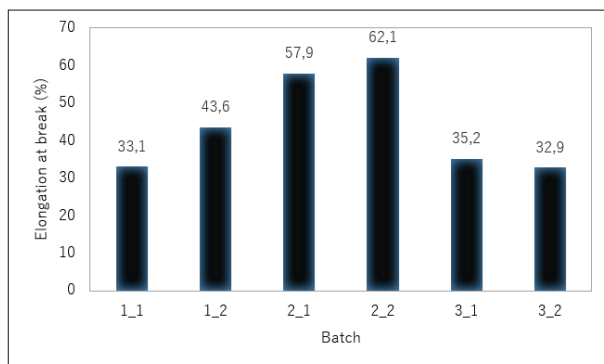


Fig. 5 Elongation at break for all the samples

■ The Package

The recommended hardware and software configuration is listed below.

- ❑ **Main Unit**
AGS-X
- ❑ **Accessory**
10 KN Load cell
Pneumatic flat grip
Flat diamond coated grips face
- ❑ **Software**
Trapezium™ X (Single)
From now on, Trapezium™ X-V is highly recommended for all autographs

■ Conclusion

In this data sheet, a tensile test of various polymeric foams has been performed in accordance with ISO 1798. In order to conduct the test up to break, so the tensile strength and elongation at break could be calculated, AGS-X is used with pneumatic flat grips and flat diamond coated grip faces to avoid any slippage of the samples.

In this regard, a big lineup of grips and grips faces could be proposed for each specific applications with polymers.

■ References

- [1] [Polymeric Materials – Department of Materials Science & Engineering \(ufl.edu\)](#)
- [2] J. Drobny, "Handbook of thermoplastic elastomers (second edition)", plastics design library, pages 33-173, 2014.
- [3] www.federalecofoam.com
- [4] Q. Wang et al., "Chemically recyclable polymer materials: polymerization and depolymerization cycles", Green chemistry, Issue6, 2022.
- [5] [ISO 1798:2008\(en\), Flexible cellular polymeric materials- Determination of tensile strength and elongation at break](#)