EXPERIMENTAL CHARACTERISATION OF THE DILATION ANGLE OF POLYMERS

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1 Introduction

The development of reliable micromechanical analysis requires accurate constitutive models to describe the various phases of composite materials. Drucker-Prager (DP) plasticity-based models are popularly used to represent polymeric matrices, due to their flexibility and practical implementation [1-3]. One of the parameters required in this model is the dilation angle, which provides an idea of the volumetric change of the polymer during plastic deformation. While relevant for DP plasticity models, to the authors' knowledge, this parameter is rarely actually measured. In this work, we present the experimental characterisation of the dilation angle of polymers *via* a uniaxial compression test and full field measurement of strains.

2 Experimental

The geometry of the specimens is shown in Fig. 1. Specimens were machined from poly(methyl methacrylate), PMMA, and an untoughened epoxy resin.
Experiments were conducted in quasi-static regime in the servo hydraulic machine Instron 8872. Loading anvils were specially designed to introduce the compressive load uniformly in the specimen. Cameras were setup to conduct Digital Image Correlation (DIC). Histories of force were obtained from the load cells and then converted into stresses. The history of the strain components was obtained from the DIC full field measurements. These measurements were then conveniently post-processed to extract the plastic components, the plastic Poisson's ratio, from which the dilation angle was evaluated.

3 Results and Conclusions

A selected result is shown in Fig. 2 where the dilation angle ψ of PMMA seems to stabilise at around 8°.

This work showed the methodology to characterise the dilation angle of polymers up to large compressive axial strains. The results and methodology from this study will help to improve the accuracy of micromechanical models for composite materials, to account for the actual volumetric change during plastic deformation.

Acknowledgments
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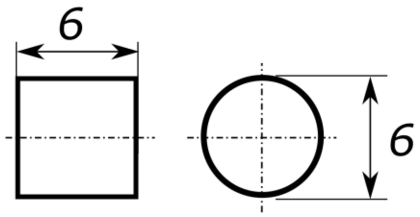

Fig.1. Specimen geometry.

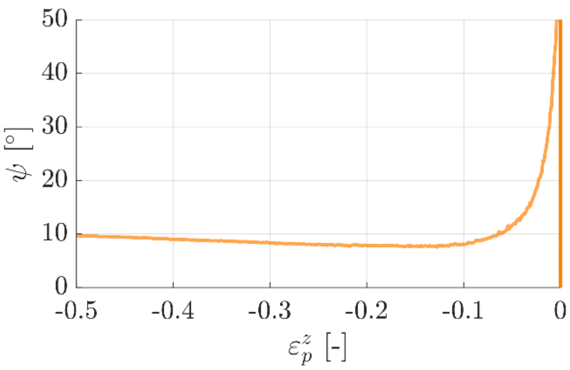

Fig. 2. Dilation angle of PMMA *vs.* axial strain.