# Damage extension and failure of polyurethane foams through bands of deformation

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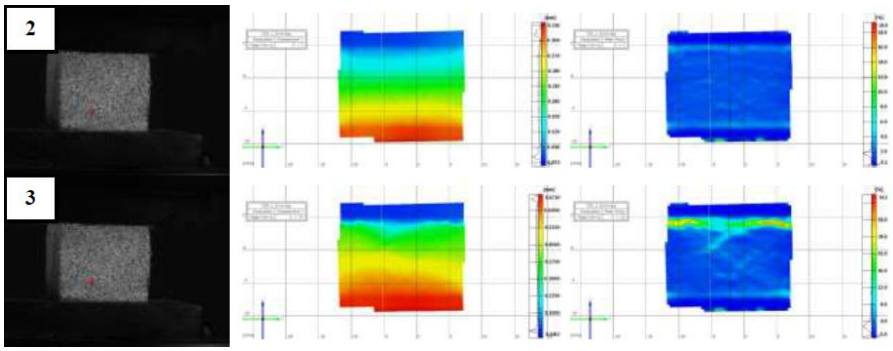
Foams with densities of 35, 93, and 200 kg/m$^3$ were tested in compression at -60 °C, 23 °C, and 80 °C, at speeds from 2 mm/min up to 6 m/s. One of the analyzed issues was the damage extension during testing and the formation of the bands of deformation in these foams and in sandwich composites with glass fiber sheets and a core made out of these foams.
The damage was monitored using a Photron high speed camera at an acquisition rate of 17000 images per second by applying random speckles of paint on the surface of the samples as a digital image correlation (DIC) analysis has been done by using the ARAMIS system.
Compression tests on the rise direction of the foam of 35 kg/m$^3$ show the appearance of crush bands inclined with approximately 45°, but if compression is produced on an in plane direction the damage observed on the surface of the specimen is mostly uniformly distributed over the height.
Compression on samples manufactured from sandwich composite material having a core with a density of 200 kg/m$^3$ give a maximum stress at yielding approximately equal to the values obtained on samples made only out of foam, but the modulus of elasticity is almost 50% greater. In the figure bellow are to be observed the damage mechanisms established at a testing speed of 2 mm/min in different stages (2 and 3) as being mostly localized at the interface between the sheet and the core.




a) b)

Damage determined with the ARAMIS system: a) displacement fields; b) Mises strains.

By increasing the compression force, the values of Mises strains become greater until a critical value is reached and a deformation (crush) band is formed along the interface. Further on, while compression continues, other new crush bands are formed close to the same interface without being spread over the height of the specimen.

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