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FINITE ELEMENT MODELING OF COMPRESSIVE ELASTIC BEHAVIOR OF POLYPROPYLENE FOAM

S. M. Sadeghipour[1], F. R. Biglari[1], H. Garmabi[2]

1-Department of mechanical engineering, Amirkabir university of technology, Tehran, Iran and 2-Department of Polymer engineering and color technology, Amirkabir university of technology, Tehran, Iran

garmabi@aut.ac.ir

The elastic behavior of polypropylene foam in compression was investigated using a finite element analysis where the polypropylene foam was produced by extrusion foaming. Hyperelastic model for solid polypropylene behavior and Kelvin's tetrakaidecahedron cell model with cell air pressure were used. The material cellular structure was modeled as regular Kelvin's tetrakaidecahedron cell model made of structural elements in which beams used as cell struts and shells as cell faces. Cell air compression was analyzed by surface-based fluid cavities which contributes to stiffness of the foam. To define the hyperelastic material behavior, stress-strain response of the solid polypropylene analyzed and proper model of hyperelastic material was selected. Non-linear problem was solved using finite element method.
To evaluate the predicted elastic behavior, the uniaxial compression tests were performed and by comparing the force-displacement curve with numerical models, good fitting between numerical model and experimental results was obtained. The finite element modeling of three dimensional foam shows that elastic behavior of foam in compression depends on the relative foam density, size of the cells, fraction of solid in cell faces and struts. Also the predicted results depend on the selected hyperelastic model.