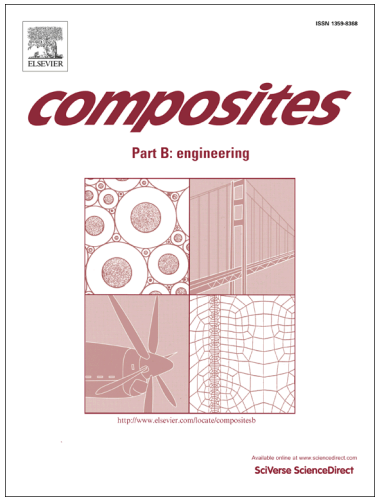

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A combined experimental and numerical study of the behaviour of paperboard composites up to failure

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Abstract

Paperboard composites have been subjected to non–conventional inflation experiments using a novel instrumentation inspired by burst strength testers. The purpose is to understand the behaviour up to failure of strongly anisotropic and heterogeneous material samples under the loading condition more commonly experienced for instance by beverage packaging. The information collected by the exploited prototype equipment has been interpreted at the light of validated numerical models of the performed tests.

Keywords: A**.** Layered structures; B. Anisotropy; C. Finite Element Analysis; D. Mechanical testing; paperboard composites

1. Introduction

Commonly used packaging material consists of functionally layered composites combining paperboard plies (260÷400 μm nominal thickness [1]), which confer stiffness and strength, with a thin aluminium foil (6÷9 μm thickness), which contributes to the overall mechanical properties and acts as a barrier from external agents together with external coating layers made of polymeric films (15÷30 μm thick). Components are produced in coils and are assembled together by the thermo–mechanical adhesion.

Paperboard presents markedly anisotropic mechanical properties, which are transferred to the overall composite. As an example, Fig. 1 visualizes the characteristic output of uniaxial tensile tests performed on two paperboard batches under displacement control (20mm/min) according to Standard procedures [2]. Specimens consist of thin material strips (15 mm wide, 180 mm long) cut parallel to machine direction (MD or 0°), cross direction (CD or 90°) and diagonal (45°) direction. The graphs in Fig. 1 represent nominal stress versus nominal strain curves, which are quite repetitive and little dispersed. Typical features of the material response are high stiffness and strength along MD, while ductility (in the sense of large irreversible deformation before material failure) is exhibited along CD.