

“The Free-Volume Properties and Barrier Performance of Polyesters“

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Abstract:

Polyesters are widely used for beverage, food, medical container/packaging, and they can be made from terephthalic acid (T) or naphthalene-2,6-dicarboxylate (N) polymerized with different ratios of ethylene glycol (EG) and 1,4-cyclohexanedimethanol (CHDM). The good attributes of most polyesters especially poly(ethylene terephthalate) (PET) and poly(ethylene 2,6-naphthalate) (PEN) have decent gas (O₂ and CO₂) barrier properties and most of polyesters exhibit excellent clarity and chemical resistance with good tensile and impact strength.

Positron Annihilation Spectroscopy (PAS) was used to study the free-volume hole properties of the polyesters and polycarbonate. The results showed that there was a non-linear correlation between the free-volume values and barrier performance. The larger mean free-volume size or fraction showed much higher degree of permeation or lower degree of the barrier.

The developments in improving the barrier of PET with increasing shelf life of carbonated soft drinks (CSD) or flavored alcoholic beverages bottles, or medical container/packaging will be outlined, and the challenges for developing a super high barrier of polymeric materials will be proposed.