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DEPENDANCE OF THE SHELF-LIFE OF CARBONATED SOFT DRINKS FROM PET PERFORMANCES AS REQUIRED BY "THE COCA-COLA COMPANY"

C. CORIOLANI[1], V. RIZZO[2], F. LICCIARDELLO[2] and G. MURATORE[2]*

[1]Sibeg S.r.l., Catania, Italy

[2]Section of Food Technologies, DOFATA, University of Catania, Via S. Sofia 98, 95123 Catania, Italy

* Corresponding author: g.muratore@unict.it

ABSTRACT

PET (Polyethyleneterephthalate) is one of the most important resins used for the package of carbonated water and soft drinks. Preforms are intermediate products which are manufactured in a wide range of designs and colours by injection moulding of PET. The cost of the resin covers a high percentage in the overall cost of the produce, especially due to the recent increments on the price of petroleum, from which PET is derived. As a consequence, according to the numerous standards fixed by "The Coca-Cola Company®", Sibeg S.r.l. decided to test a new cheaper PET preform which was suggested by a possible new supplier.

The experiment consisted in the comparison of the main performance characteristics of the old PET bottles in comparison with the ones obtained from the new preforms.

"The Coca-Cola Company®" requires specific test procedures to authorize a new package. Among the methods used to test new materials, the gas-barrier properties have a main importance as they are directly linked with the shelf-life of the bottled produces. Shelf-life of carbonated soft drinks is determined by the internal CO_2 level, and limits for this parameter are different for different the types of beverages. Therefore a material with higher CO_2-barrier property would be effective in extending the shelf-life of carbonated drinks. Results evidenced a similar behaviour of the two materials tested for what concerns the characteristics of the bottles (dimensions, appearance, distribution of the material, stress cracking test), showing, in particular, comparable CO_2 internal pressure after 12 weeks of storage.

Key words: carbonated beverages, CO_2 internal pressure, shelf-life, PET

INTRODUCTION

PET (Polyethyleneterephthalate) is one of the most important resins used for the package of carbonated water and soft drinks, thanks to the specific characteristics of clarity, lightness, simple transformability and also the possibility to recycle.The final price of PET preforms is highly influenced by the price of the raw material, the resin, that can reach the 80% on the final total cost. In front to this prices increments, all the factory try to make better the own production, trying all the possible solutions to make lower the incidence of raw material's cost.

Preforms (or parisons) are intermediate products in the production of bottles. They are manufactured in a wide range of designs and colours by injection moulding, and are then blow-molded to obtain the final bottles with volumes ranging from 0.5 to 2 litres.

Sibeg s.r.l., authorized producer of "The Coca-Cola Company" products, located in the province of Catania, follows a specific matrix that provides the guidelines, requirements, tools, specification, and test procedures needed to authorize a new package, recommended by "The Coca-Cola Company" (Packaging Authorization for Non-Refillable Plastic Bottles).

The shelf-life of soft drinks is determined by the CO_2 level, which decreases due to permeation through the packaging material. Therefore, the choice of bottles with higher CO_2 barrier properties could extend the shelf-life of such products.

Standard shelf-life of "The Coca-Cola Company" products is fixed, as a function of the bottle size, to:

6 months: for PET bottles >1 litre

5 months: for PET bottles <1 litre

12 months: for glass bottlesAccording to the numerous standards fixed by "The Coca-Cola Company", Sibeg s.r.l. decided to test a new PET preform for 1.5 litre bottles, a little bit heavier (0,5 g more), but cheaper than the usual preform which was suggested by a possible new supplier.

Shelf-life tests were performed using two different resins type:•Laser+® (ADVANSA)•Alphapet – sd

Fig. 1. Zahm and Nagel piercing device for CO_2 retention test.

MATERIALS METHODS

*Carbonation Retention Test*The test is performed to assess the carbonation loss rate of a plastic beverage bottle and to extrapolate shelf life to a 21.4% loss when bottles are initially carbonated to 4.2 volumes, and to a 17.5% loss for bottle initially carbonated to 4.0 volumes (1 volume= 1.98 g/L)

Sealed not-refillable PET bottles must retain the carbonation in the beverage when initially carbonated to a level of 4.2 ±0.1 volumes. That level must not fall below 3.3

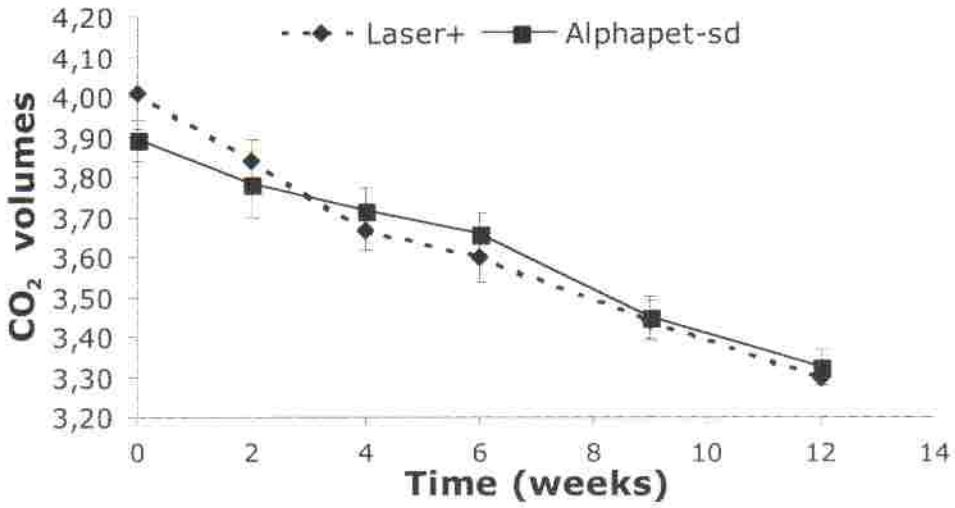

Fig. 2. Variation of CO_2 internal pressure in bottles obtained from different preforms.

volumes within established storage periods under standard laboratory testing conditions of 22° ± 1°C at 50% relative humidity. Storage periods are referred to as the "standard shelf-life" of the bottles and depend on bottle size. For bottles smaller than 1 liter, storage time is 12 weeks, for 1 liter bottles and larger it is set to 14 weeks.

Twelve bottles were randomly chosen 24 hours after the seal, and the CO_2 content was evaluated on each bottle by means of a calibrated Zahm and Nagel piercing device with pressure gauge (Figure 1), collocated on the cap of the bottles. Before the measurement of the CO_2 concentration, the air in the headspace was eliminated, then the cap was pierced by means of the device; the valve was opened in order to discharge the pressure, and the device was calibrated to zero. Bottles were then agitated and let rest until stabilization of the manometer. The test was repeated after 2, 4, 6, 9 and 12 weeks.

RESULTS AND DISCUSSION

The mean CO_2 loss rate (Figure 2) amounted to 0.075 g/L per week for Laser+ and to 0.073 g/L per week for Alphapet-sd, however the loss was much higher in the first 24 hours, and corresponded to 4.5 and 7.4% respectively. The CO_2 overall loss amounted to 21.5 and 21% for Laser+ and Alphapet-sd, respectively, therefore differences were not significative.

In conclusion, results showed not significant differences between the two tested materials. Despite the lower cost of the new suggested preform, Sibeg s.r.l. decided to keep on using the old material, due to comparable CO_2 retention performances, and especially to better mechanical behaviour and constant yield quality.

REFERENCES

Packaging Authorization for Non-Refillable Plastic Bottles. The Coca Cola Company, 20-Dec-2004.