COmité Technique de Recyclage des Emballages Plastiques

INTRODUCTORY TECHNICAL SHEET

1/ Barriers and recyclability – General remarks

Barrier technologies are used when greater impermeability to gases (CO^2 and 0^2) is needed.
These technologies are mainly used for sparkling beverages (sparkling water, beer) and for fruit juice and flavoured water.
The need for a product to use a barrier solution to make PET more impermeable is also determined by the bottle's size and shape and its intended lifespan.

The main barrier technologies currently on the market are:

- Multilayer: 3 or 5 layers with Nylon or EVOH
- Blends: barrier material (Nylon or other type) mixed with PET
- Coatings: silica or carbon layer deposited inside or outside the bottle.

These technologies draw on materials with different properties from PET and so will influence PET bottle recycling. That influence will depend on:

- The nature and quantity of barrier material used
- The use of PET/barrier material compatibility agents
- The material's separability in the different reclaiming stages.

Generally speaking, as the barrier materials are present in small amounts compared with PET (concentrations < 10%), they cannot be detected by the optical sorting techniques currently on the market.
Consequently, these materials can only be eliminated in operations on flake (after bottle grinding) mainly in the washing and aerodynamic separation stages (use of the latter technology is not general practice among all recyclers).

2/ Studies carried out on the behaviour of PET barrier bottles during reclaiming and recycling stages

Analyses of PET barrier bottle behaviour are mainly conducted on the light PET stream. This is the most sensitive stream as any yellowing or opacifying is much more visible than in coloured streams.

These bottles' behaviour during recycling was studied in reclaiming and recycling tests on a pilot line representing the lines used by PET recyclers in Europe.

a. Reclaiming study

The goal of the test is to study the influence of barrier technologies in the various stages (sorting, grinding, floating, washing, drying) and to obtain flake suitable for use in downstream recycling stages.

The following stages are carried out on barrier PET bottles:

- Grinding
- Pre-washing with detergents and caustic soda at 85°C
- Washing with detergent at 85°C
- Rinsing in hot water
- Floating in cold water bath
- Flake drying (140°C)
- Aerodynamic separation (elimination of fine particles, not applicable in the case of blend or coating barriers)

The flake obtained can then be used in different applications (fibre, bottles, sheets, strapping). These applications all involve different manufacturing processes. We have therefore assessed the impact of these technologies in the two main applications, bottle to bottle and fibre extrusion.

b. Bottle to bottle recycling study

The goal of the test is to analyse the impact of barrier technologies in the stages needed to manufacture new bottles.

The following stages were carried out on PET flake/barrier PET flake blends:

- Granulation
- Solid Stating (increase in viscosity index)
- Preform and plate injection
- Plate assessment (colorimetry and opacity)
- Preform assessment (viscosity and appearance)
- Bottle blowing
- Assessment of physical properties (heat stability, stress cracking, burst and drop test, CO^2 retention, colorimetry)

Product appearance is assessed by visual observation (on flake, granules and preforms), and by colorimetric analysis of 2mm-thick plates and of bottles (injected from granulate).

Acceptability limits are the same as those set in the “Bottle to Bottle Protocol” published by PETCore:
- Colour (Lab) and transparency (Haze) of produced plates
- Viscosity index after Solid Stating
- …

These acceptability limits are set in reference to a control sample that has gone through exactly the same stages as the tested blends.

c. Recyclability study for fibre applications

This study is designed to assess the behaviour of barrier technologies in fibre extrusion and drawing stages.
Studied parameters are blend extrudability, pressure variations during extrusion, and the appearance and strength of the obtained fibres. Tests were conducted according to COTREP test procedure P 1.05.2006

- Fibre extrusion (flake was granulated beforehand)
- Fibre drawing
- Evaluation of the mechanical (tenacity, elongation), thermal (temperature hold*)* and optical (colouring) properties of the obtained fibres.
- Comparison with a benchmark sample comprised of 100% standard RPET granules.

NB: Fibre characteristics and manufacturing conditions vary widely from one producer to another, depending on whether applications are for continuous or unwoven fibre. Consequently, it is difficult to extrapolate the results of a study conducted with a single type of technology to the entire fibre industry.