RETHINK YOUR PET PACKAGING

ColorMatrix liquid additives & colorants
PolyOne is a leading innovator in specialist additives and liquid colorant technologies, engineered under the ColorMatrix brand to advance the performance, processing, aesthetics and sustainability of PET packaging.

This PET optimization guide provides a brief overview of some factors to consider when choosing PET as a packaging material. It also includes a summary of our current technology portfolio for this sector—the culmination of our advanced thinking in optimizing the value of PET for use in product packaging.
A NEW ERA FOR PET PACKAGING

Today’s advances in polymer additives make PET an attractive packaging solution for an ever increasing range of beverages, foods, household and personal care products.

PRODUCT PROTECTION
Fully flexible product protection systems can now accommodate a host of different product sensitivities, container designs, sizes and thicknesses.

SHELF LIFE MANAGEMENT
Recent innovations are now enabling more sophisticated approaches beyond product protection to tailoring and controlling shelf life according to very specific product requirements.

FULL RECYCLABILITY
Balancing product protection and container clarity to ensure good recyclability can be challenging. Fully recyclable additive technologies that don’t compromise recyclability are now a reality. Advanced reheat systems, developed by ColorMatrix, used during PET processing are also now enabling long-term, multi-trip recyclability

LIGHTWEIGHTING AND REDUCED PORTION SIZES
The lightweight nature of PET makes it a highly practical and sustainable packaging material option for handling and transportation. Converters can now push boundaries in container light weighting with the assurance of maintained product protection. This can deliver important savings in both material costs and carbon footprint throughout the supply chain.

LESS WASTE DUE TO BREAKAGES
Compared to glass as a packaging medium, plastic is less susceptible to breakages and can offer measurable savings in waste due to breakages.

MANUFACTURING EFFICIENCY
By working in collaboration with PET processors, ColorMatrix has been able to make significant advances in formulations that improve cycle times, eliminate production waste and reduce product inventory requirements. As brand owners and processors place an ever increasing emphasis on lowering carbon footprint, our innovations in liquid carrier systems now enable manufacturers to reduce energy consumption during PET container processing.

REGULATORY ASSURANCE
PET for packaging beverage and food products is safe and tightly controlled by a global network of regulatory bodies. Converters and brand owners who work with suppliers who can provide support in this area will have the assurance that their products are fully compliant with all necessary regulations, wherever their product is to be marketed.
MANAGING SHELF LIFE

OXYGEN SENSITIVE PRODUCTS
Exposure to oxygen can be detrimental for a range of different foods and beverages—typically fruit and vegetable juices, alcoholic beverages, teas, dairy products and tomato based sauces.

Oxygen sensitive products packaged in PET can over time be exposed to oxygen either passing directly through the container sidewall, through the closure or even from oxygen trapped in the sidewall itself.

Product protection and shelf life can be carefully managed with the appropriate application of oxygen scavenging technologies.

CARBONATED PRODUCTS
For carbonated products such as beer which are susceptible to both oxygen ingress and carbon dioxide egress, shelf life management requires an additional level of protection.

When determining the type of gas barrier protection required, there are a number of factors to be considered:

- Wall thickness
- Crystallinity
- Product type
- Closure type
- Empty storage time requirement

Depending on your specific beverage or food product requirements, ColorMatrix’s portfolio of advanced gas barrier technologies can be tailored to deliver a cost-effective, easy to use and recyclable packaging solution.
## FRESH THINKING
**Amosorb™ Gas Barrier Solutions**

<table>
<thead>
<tr>
<th>Product</th>
<th>Performance</th>
<th>Typical applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amosorb™</td>
<td>Active $O_2$ scavenger—up to 6 months</td>
<td>Non-carbonated; wine, juice, dairy</td>
</tr>
<tr>
<td>Amosorb™ SoLO₂</td>
<td>Enhanced $O_2$ scavenger: Carbonated and non-carbonated, for extended shelf life.</td>
<td>Carbonated - beer, Non-carbonated - wine, juice, dairy</td>
</tr>
</tbody>
</table>

- Single product solution for any PET grade, including recyclate
- Powerful, “always-active”, consistent performance
- Fully flexible loading for tailored use
- Easy implementation for faster market access
- Good container clarity and recyclability

## CLEARER THINKING
**HyGuard™ advanced oxygen management system**

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<tr>
<th>Product</th>
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<tr>
<td>HyGuard™</td>
<td>Advanced $O_2$ management system, full recyclability. Performance &gt; 24 months, wide range of PET packaging formats</td>
<td>Wide range of beverage and food applications</td>
</tr>
</tbody>
</table>

Latest generation of catalytic oxygen management system - opens opportunities for PET packaging across a much wider range of food beverages applications and container types.

- Hot fill, wide mouth, aseptic closures
- Perfect container clarity, fully recyclable*
- Lightweighting
- Fully controllable performance, beyond 24 months if required

*HyGuard™ is the only oxygen scavenging technology to be endorsed for recyclability by the Association of Post-consumer plastic Recyclers (APR) and the European PET Bottle Platform (EPBP)
LIGHT BARRIER PROTECTION

UV and visible light can cause changes in taste, odor and texture of light-sensitive products packaged in PET. It can also degrade some colored dyes in plastics. Light barrier additives provide protection for PET packaging colors and offer an extended shelf life for a range of products including foods, beverages, personal care and household products.

Products
- Fresh juices
- Enhanced mineral waters
- Dairy products
- Personal care
- Cosmetics
- Household products
**BRIGHT THINKING**

*Light barrier solutions*

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<tr>
<td>Ultimate UV 370</td>
<td>UV light protection up to 370nm</td>
<td>Juices, vitamin waters, personal care products</td>
</tr>
<tr>
<td>Ultimate UV 390</td>
<td>UV light protection up to 390nm</td>
<td>Juices, vitamin waters, personal care products</td>
</tr>
</tbody>
</table>

- Cost effective UV protection allowing less than 10% UV light transmission up to 395nm
- Excellent clarity, full recyclability*

* Ultimate UV is the only light barrier technology to be endorsed for recyclability by the Association of Postconsumer plastic Recyclers (APR) and the European PET Bottle Platform (EPBP)

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<td>Lactra™ SX</td>
<td>Full light blocking (99.9% light barrier in mono-layer containers)</td>
<td>Long shelf life UHT dairy mono-layer containers with/without sleeves. Yogurt, breakfast beverages, dairy.</td>
</tr>
</tbody>
</table>

- Design for shelf life, ergonomics and differentiation
- Lighter weight bottles
- Lower system cost vs. other rigid packaging
- Recyclable with general PET waste stream, even though additive is also present
- Offers light-weighting for PET bottle without reducing light blocking performance
- Flexible portfolio of formulation options
ACETALDEHYDE REDUCTION

Acetaldehyde (AA) can form during PET melt processing due to increases in temperature, pressure or shear. It can also form as a result of exposure to light and other environmental conditions. AA can migrate from a PET container wall into the packaged product which in some cases, notably in mineral water, can cause an undesirable taste or odor.

Such products can benefit from the use of established AA reducers to eliminate AA and ensure product integrity.

CLEAN THINKING

AA reducer solutions

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<tr>
<td>TripleA™ -1+</td>
<td>Dispersion; can be combined with color; up to 80% AA reduction</td>
<td>Mineral waters</td>
</tr>
<tr>
<td>TripleA™ -1r</td>
<td>Dispersion; can be combined with color; up to 80% AA reduction</td>
<td>Mineral waters - for use with recycled resin</td>
</tr>
</tbody>
</table>

- Up to 80% AA reduction
- Controllable and accurate
- Recycle friendly
- Reduces product risk

PET PROCESSING

Smarter thinking in PET processing can make significant improvements in production efficiencies, energy consumption and product quality.

Slip agents allow smoother conveyance and more efficient processing of PET preforms and containers. They can also deliver significant reduction in product rejects.

Reheat agents can deliver energy savings during PET processing and can improve container clarity and recyclability.

Resin toners counteract yellowing that can occur during PET polymer processing to improve visual clarity in PET containers.
### SMART THINKING

**Slip agent solutions**

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<tr>
<td>Eze™ Fill-1+</td>
<td>Slip agents reduce static buildup during PET preform and container production</td>
<td>PET preform and ISBM container process</td>
</tr>
<tr>
<td>Eze™ Fill-2</td>
<td>Slip agents reduce static buildup during PET preform and container production</td>
<td>PET preform and ISBM container process</td>
</tr>
</tbody>
</table>

- Reduced rejects due to scratches and blemishes
- Smoother mold release and improved process rates

### Reheat solutions

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<tr>
<td>Joule RBK</td>
<td>Slip agents reduce static buildup during PET preform and container production</td>
<td>PET preform and ISBM container process</td>
</tr>
<tr>
<td>Joule RHB</td>
<td>Slip agents reduce static buildup during PET preform and container production</td>
<td>PET preform and ISBM container process</td>
</tr>
<tr>
<td>SmartHeat</td>
<td>High performance, controllable reheat, minimal impact on clarity</td>
<td>PET preform, particularly beneficial for colors</td>
</tr>
</tbody>
</table>

- Significant energy savings
- Joule RHB enables long-term, multi-trip recyclability

### Toner solutions

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<tbody>
<tr>
<td>Optica™ PRT Dispersion</td>
<td>Red/Blue dispersions; enhanced color control, easy handling, excellent clarity</td>
<td>PET resin for beverage containers</td>
</tr>
<tr>
<td>Red-2 or Blue-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optica™ PRT Red-2</td>
<td>Red/Blue dry powders</td>
<td>PET resin for beverage containers</td>
</tr>
<tr>
<td>or Blue-2</td>
<td></td>
<td></td>
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</tbody>
</table>

- Significant energy savings
- Joule RHB enables long-term, multi-trip recyclability
SUSTAINABLE THINKING

PET provides a lightweight, resource efficient and durable packaging solution for an increasing range of products. ColorMatrix continues to innovate new solutions that help further advance the sustainability of plastics.

CONTAINER RECYCLABILITY
- Improved clarity of product protection technologies
- Advanced reheat agents that enable long-term, multi-trip recyclability

ENERGY CONSUMPTION
- The industry’s leading carrier systems and reheat agents that help reduce processing energy consumption

CONTAINER LIGHTWEIGHTING
- The latest gas and light barrier technologies allow product protection to be maintained in ever thinner and smaller container sizes
- Advanced formulations mean that high level product protection no longer needs to compromise container clarity and recyclability

WASTE AND INVENTORY
- Process agents that improve product quality and reduce rejections
- Lean manufacturing processes that enable more cost-efficient production and procurement

WIDER USE OF RPET
- ColorMatrix technologies are engineered where possible for optimum utilization with pre and post consumer recyclate
- ColorMatrix is a member of sustainable plastics organizations Petcore and APR
COLORFUL THINKING

Not all liquid colors are the same! Since pioneering the development of liquid color dispersions in the 1970s, ColorMatrix is now a leading innovator in advanced liquid colorants for thermoplastic applications. Our colorant systems include:

• Opaques
• Transparents
• Translucents
• Special effect colors

In packaging, these technologies can deliver significant advantages for converters and brand owners of products packaged in PET including:

• Fully stable formulations that enable more energy efficient processing
• Intelligent carrier systems that allow additional product functionality
• Precise, accurate and consistent dosing with minimal wastage
• Clean, lean and 99% on-time product delivery
• Accelerated color development and more effective color management

As part of the PolyOne Corporation, our color portfolio can also support customers requiring solid masterbatch solutions. Please contact us for more details.
PolyOne is dedicated to supporting its customers with a full package of support services to ensure optimum value from our advanced colorant and additive technologies.

**Rapid color development**
Accelerated color match, development and delivery for rapid market access.

**Dosing systems**
Proprietary dosing systems designed specifically for optimized metering of PolyOne advanced ColorMatrix liquid technologies.

**Regulatory advice and support services**
Our team of experts in global regulatory compliance can advise and provide required supporting documentation.

**Process reporting**
Advice and direction on where production efficiencies can be achieved through applying PolyOne technologies.

**Technical Support Services**
Our team of technical service engineers are located globally to provide full training and manufacturing support.
COLOR IS GLOBAL

At PolyOne we think a lot about plastics: how to make them process better, perform better, look better and be kinder to the planet. With a passion for innovation and more than 40 years’ experience, this advanced thinking in specialist polymer additives and liquid colorants is now helping our expanding network of customers around the globe to prosper and grow.

PolyOne delivers globally consistent formulations to its customers around the world. To find your nearest ColorMatrix facility, go to polyone.com.
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