



AT THE CUTTING EDGE OF GLASS MANUFACTURING:

From 'lightweighting' to innovative energy reductions

Thousands of years since it was first discovered, glass remains an integral part of our lives. An ancient material with a rich cultural heritage, glass is more important to modern life than ever before: it is used in technology such as fibre-optic cables, solar panels and telescopes, architecture, art, and, of course, packaging. At the cutting edge of this ancient art, is the current quest to find more energy-efficient and sustainable ways of creating and using glass, including lightweighting – using less glass to create containers without losing too much strength. This is no small feat.

Glass is an incredible packaging material. It is inert, so it doesn't interact with its contents. It is impermeable, so it protects our food, drink and medicines from outside contaminants. And it is 100% recyclable – none of it is lost when it gets turned into another glass product – so it's especially desirable today as we look for ways to make our packaging more sustainable.

Glass is perfectly suited for use in the "circular economy" – in which materials can be infinitely recycled in a closed loop without any loss of quality. But making glass still requires energy. Glass is made inside giant furnaces, where raw materials – sand, soda ash and limestone, alongside "cullet" (recycled glass that has been crushed and sorted) – are melted together at approximately 1 500° C. The stream of molten glass is fed to container-making machines which use compressed air and metal plungers to form the glass into containers.

Finding ways in which to reduce the amount of energy used per glass container is a focus for glassmakers like Ardagh Glass Packaging (AGP). Ardagh Group earlier this

year acquired the well-known South African glass brand, Consol, becoming the leading producer of glass packaging on the African continent. AGP's furnaces and facilities across the continent include advanced monitoring, automation and control systems that reduce the amount of energy needed to make high-quality glass. The first generation of renewable-energy-powered furnaces is also being tested, which will lead the way to zero-carbon glass.

But there is another method of reducing energy usage that AGP has been perfecting for more than twenty years. This is "lightweighting" – reducing the amount of material used in a container without compromising its strength.

Lightweighting

It sounds simple, but a lot of science (and some art) goes into making lighter bottles that keep consumers and contents safe. It takes time and effort to develop the skills, people and technology needed to excel in the field, but over the past two decades lightweighting has become one of AGP's core competencies, a key competitive advantage and a point of considerable pride in the company.

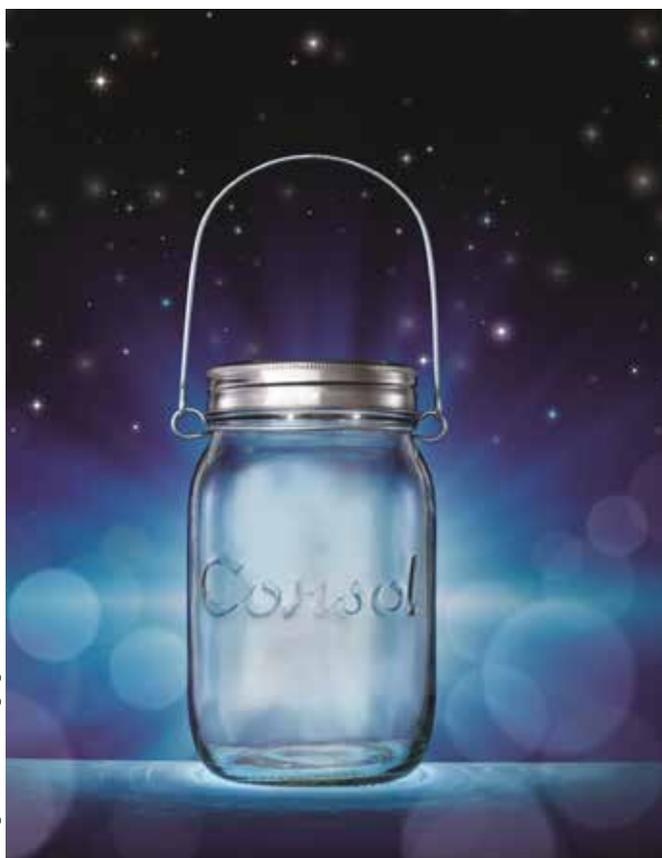
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Glass bottles in a glass manufacturing plant.

The company's lightweighting journey began in the late 1990s when South Africa's markets opened to the rest of the world and industries were pressured to innovate quickly to catch up.

A breakthrough in lightweighting occurred when a new bottle-forming process – the narrow-neck press-blow (NNPB) method – was adopted. NNPB uses a metal plunger to press a cavity directly into the "gob" (a small



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One innovative use of glass was the creation of the Consol Solar Jars, creating a useful solar-powered lamp from a simple glass jar.

section of molten glass). NNPB has considerable advantages when your goal is to use less material while retaining exceptional control over the final product. But this control comes at a price, namely the requirement for astonishingly tight tolerances in the process. To get the desired results the level of molten glass in the vast furnaces that feed the forming machines can't deviate by more than half a millimetre. The temperature of the molten glass supplied to the forming machine, typically around 1 200°C, can't vary by more than a degree.

Moulds running across the glass-forming machine must be meticulously aligned and maintained to precisely match so that each bottle manufactured meets the very tight specification tolerances. And because glassmaking is a non-stop process (once a furnace starts producing molten glass, stopping it is difficult and expensive), these tolerances need to be achieved 24/7, 365 for years on end!

Constant collaboration, coordination

Alongside technical skill and rigorous processes, collaboration is key to a successful lightweighting project. It is a deeply interactive process that might begin with AGP's analysis of market conditions and trends suggesting a new design to a customer, or with a customer coming to AGP with a request to determine what's possible within a certain shape. Designs are drawn up, debated, and sent for stress analyses. Eventually a small trial run of physical samples will be produced, followed by a run of several thousand samples which can be tested for packing and transport.

The testing at every stage is exceptionally rigorous. It must be. There's a lot at stake when designing a lighter bottle. Absolute control over bottle strength and quality must be assured. Most bottles carry products with carbonation, and their safety needs to be guaranteed until they are eventually recycled.

Glass has been a touchpoint of celebration, commerce, culture and science for over two thousand years. The beauty, versatility and endless sustainability of the material inspire continual innovation and creativity.

Lightweighting is just one way in which the technology behind glass manufacturing continues to update the material for a changing world.

Article prepared for Quest by Ardagh Glass Packaging – Africa (formerly Consol Glass), a part of the Ardagh Group.

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