

The world-wide shift from carbonated soft drinks towards still and lightly-carbonated juices and waters has focused fillers' minds on finding ways of using lighter plastics containers without them collapsing during transit and handling.

For without internal pressure, PET bottles, especially in larger sizes and with thinner walls, are unstable. And will be increasingly so as resin prices rise and weights fall.

But a technique for pressurizing containers that has been in use in the canning industry for about 20 years is finding wider application in the bottled juice and water industry. And it uses the most commonly available gas: nitrogen.

A small volume of nitrogen in liquid form added during the filling process expands and provides just the rigidity needed to enable a PET bottle to withstand the rigours of palletizing and shipping.

It's a process, however, that fillers have been overly cautious of adopting, suggests the leader in the technology Vacuum Barrier Corporation (VBC), because the very low temperatures necessary for the gas's handling – almost minus 200 deg C – are regarded by many as awkward to manage.

But it's a challenge that VBC's European arm Vacuum Barrier Systems (VBS) finds customers are increasingly willing to overcome. Because the cost savings in lighter containers quickly make the process pay.

Belgium-based VBS originated as a supplier of liquid nitrogen transfer piping manufactured by Boston-based VBC, a cryogenic hardware manufacturer. It's a technology still used and supplied to a variety of industries for applications that need intensive cooling. Guy Charbonnier and Gerd Büsing have managed the growth of Vacuum Barrier products in Europe since 1980. At the VBS base in Waterloo, Belgium, they were joined by Phillip Kerchx in 1998 to handle the growing liquid nitrogen dosing market.

The dosing technique developed by Vacuum Barrier is one especially devised for filling non-carbonated beverages. Problems with easily crushed and damaged packages of still products in vending machines brought to light the need for a technology that would enable them to be sold and offer an alternative to CSDs.

Another pay off is that the products have a longer shelf life – the nitrogen replaces the oxygen that would otherwise degrade sensitive products like fresh juices.

Whilst Vacuum Barrier developed its first system for non-carbonated drinks around 20 years ago, the technology has come into its own more recently.

Explains Gerd Büsing: "Around three to four years ago there was a sudden explosion in demand for bottled non-carbonated products." The company's customer base includes all the major fillers and filling machine suppliers, both large and small. It also provides a technical service for customers in Europe,

The power of pressure

Liquid-nitrogen dosing systems are becoming a popular means of ensuring the stability and extending shelf life of non-carbonated products in plastics bottles and cans. And Coca-Cola should know: it's just installed two of them. Michelle Baillie went to Belgium to find out more



Middle East and North Africa.

The material cost savings are remarkable, according to Vacuum Barrier. Says Phillip Kerchx: "One customer found they could save several grams of PET per bottle by running one of our dosers at a speed of 20,000 bottles an hour – their return on investment took one month."

Last year it supplied two high-speed duo dosers to bottler Coca-Cola Enterprises, an hour away in Gent for two canning lines. They were an integral part of the plant's most recent installation: two 72-head KHS fillers with Ferrum seamers, specifically for the growing market for non-carbonated drinks in cans. Currently only one of the systems is running – on a line filling 15cl and 25cl cans for products including its Minute Maid juices. The investment, part of the customer's plan to become more self-sufficient in filling these sizes and to move away from contract fillers, is also expected to develop the European market. The second filler, which also runs at

Standing strong: shift supervisor of maintenance at the Gent filling plant of Coca-Cola Enterprises Ivo Van Heyden, with production supervisor Bart Van Leuven and Vacuum Barrier's Gerd Büsing

up to 1,200 cans a minute, is filling carbonated products in larger slim cans but there are plans to utilise the remaining nitrogen doser, the predecessor of its latest HSV Nitrodoser, elsewhere.

The Coca-Cola plant currently runs six lines for bottles and cans; four for Tetra Pak cartons; and one for drums, and supplies the French, Belgian and Dutch markets. It invested in its first liquid-nitrogen dosing system in the early 90s, a Linjector, which was used on the full range of still products including Minute Maid, Cranberry Fanta and Aquarius. A predecessor of Vacuum Barrier's latest systems, this produced a continuous stream of liquid nitrogen, some of which would be wasted between each container.

Explains the Ivo Van Der Heyden, the ▶



plant's shift supervisor of maintenance: "There is a risk with this kind of system that if the line speed slows down, you can get too much nitrogen in the product." The Linjector has been running successfully for more than a decade. "We are hoping to upgrade the doser on this line to the HSD version," he adds.

This enables them, they say, to take advantage of the discrete dosing and speed compensation capability of the newer version.

The first application of nitrogen dosing was in the mid-1980s when Vacuum Barrier developed a system for Coca-Cola in Canada where its Toronto plant was hot filling Five-Alive in aluminium cans. These needed pressurizing to prevent collapse.

Soon after, Guinness launched its draft stout in cans with widgets in the UK. Key to the success of the canned beer was that it would foam on opening like a draft beer when pulled from the cask, and was the result of a huge development programme in which nitrogen dosing was a vital component. During the filling process, the hollow plastic widget containing a tiny hole was pressurized with nitrogen and the product. On opening the can the pressure would be released to create the signature foaming head on the beer.

Currently more than 2,000 liquid nitrogen dosing systems are installed worldwide, with a high percentage in Europe. Whilst Vacuum Barrier is one of three worldwide suppliers of the nitrogen systems for filling applications, it was a sector that a number of companies have been toying with.

Says Charbonnier: "Liquid nitrogen pro-



When it's hot to be cold: Coca-Cola Enterprises in Belgium installed a high-speed duo nitrogen doser downline on one of its two new KHS can fillers for non-carbonated drinks, including Minute Maid. Inset: A heater is used to prevent condensation freezing on the doser—that's the reason for the sign which means 'hot surface'

ducers at one time created systems that would support the use of their gas. They never really devoted enough resources to it and the cost of the hardware was high – it was hard for them to focus on equipment sales. It provided us with the perfect opportunity to capitalise on the problems found with the other systems and create a reliable alternative."

Shelf life improvements for sensitive products in PET containers are also being increasingly appreciated by customers, in addition to the possible material savings that pressurizing provides. The nitrogen – an inert gas – replaces oxygen in the head space that would otherwise spoil the product. In some cases it even doubles the shelf life.

As a natural gas, nitrogen doesn't negatively affect the product. "Around 80 percent of the air is nitrogen gas anyway, it doesn't dissolve in the product and it is released the minute you open the bottle or can," Büsing says. It's

a by-product when you create oxygen and by liquefying substantially reduces in volume, so 700 litres of gas gives you one litre of liquid nitrogen used by fillers. It's price competitive and it only takes a small amount of liquid nitrogen, typically one- to two-tenths of a gram per 50cl to 150cl bottle, or for 33cl cans it can be less than one-tenth of a gram. "It's a one-time

treatment to ensure the quality of the bottle or can from the production line to the user's fridge," adds Charbonnier.

Nitrogen dosing is also applied to hot filled containers to prevent deformation, as it helps compensate for when the product cools and shrinks.

Vacuum Barrier's latest product range highlights the diverse needs of the filling industry. Its Nitrodoser Easy Doser individually doses each bottle or can to reduce nitrogen consumption, running at a rate of 300 containers a minute. It's a product popular with smaller companies and start-up filling lines.

Vacuum Barrier's mid-range speed offering, the Nitrodoser MS, is a multi-speed version that individually doses using a pneumatic valve at a rate of 550 containers a minute, with an auto-switch function that can change to continuous stream if the line runs at higher speeds. For higher speeds, the Nitrodoser HSV again individually doses at speeds to match all PET and can line speeds currently available and also has the continuous stream option for higher line speeds. For aseptic solutions the company also offers the Nitrodoser HSA. All are PLC controlled.

Vacuum Barrier's earlier high-speed dosers featured a dual head that would dose ▶



Left: liquid nitrogen injection systems are popular with PET bottles to enable lightweighting to reduce material costs. Left: doser in action — the growing juice, water and flavoured water markets created a boom in demand for its systems says Vacuum Barrier. Top: The bottle on the left was filled using a liquid nitrogen doser, whereas the one on the right didn't and lacked rigidity. Above: the precise nitrogen stream of a dosing head

alternate packages. But as technology has advanced it now uses single-head systems to achieve the same speeds. The precision of the individual dosing at any speed and with any liquid nitrogen charge is also key. Explains Büsing: "With continuous stream dosing systems for cans you would lose around 20 percent of the nitrogen — with PET bottles as the openings are smaller you would only get about 20 percent into the bottles." The dosing valves open for a just a few milliseconds to dispense the nitrogen.

Storage and handling of the ultra-cold liquid nitrogen is tricky. The systems, located between the filler and capper, are fed by vacuum-jacketed pipes running from an external bulk storage tank or a portable unit. With a typical bulk storage version, the insulated pipes either feed the doser directly or go through a phase separator, an intermediate tank which minimises evaporation. An internal vessel controls the pressure and feeds the dosing valve. A heater is fitted at the outlet where the liquid nitrogen falls to keep the system warm and stop it freezing, whilst the dos-

ing head hovers just above the packages. Before the nitrogen vapourises in the container the cap or lid is added and the gas pressurises the container.

Vacuum Barrier guarantees a dosing accuracy with a maximum of five percent variation between containers but it also relies on a consistent fill level. A container with too little pressure could collapse, whilst one with too much could potentially burst if, for example, it were stored in a hot automobile.

Although the company has found that high-speed filling lines tend to be rarer in Europe than they are in the US and the Pacific Rim as the markets are more fragmented, it's not prevented a non-carbonated beverage filler in the UK from commissioning an HSV system for use on its products filled on a SIG system.

The same model is being shipped this month to the new Rauch filling plant in Switzerland for Red Bull. Although Red Bull is lightly carbonated it still benefits from nitrogen dosing, especially when it's cold as the carbonation doesn't build up enough internal pressure.

So what's next? "We could probably do higher speeds," suggests Büsing. "There's no reason why a dual head system couldn't do 2,400 units a minute. We're watching customer demand and looking at the capacity of the fillers' lines and try and keep up with the capabilities of modern equipment." Adds Charbonnier: "Speed creeps up with experience."

So it's a case of investing in technology. According to Vacuum Barrier more bottled water manufacturers are starting to look into the dosing technology — it's currently the number one liquid nitrogen injection application worldwide. But it's a matter of weighing up the potential cost savings in reduced PET long-term against the price of investment.

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