

**Afrox thought leadership series: Liquid nitrogen and cold chain**

Afrox application specialist for the food and beverage markets, Hendrik Pretorius, looks at nitrogen and its use in modern food chilling and freezing applications.

**Food safety: nitrogen, an ideal clean gas**

By volume, dry air contains over 78% nitrogen and nearly 21% oxygen. So in any cryogenic air separation unit (ASU), the largest liquefied gas being produced is nitrogen.

Nitrogen has no taste, colour or odour and it is non-toxic. We breathe it in and out all the time, without any negative effects. It is also mostly inert, making it ideal for use to exclude moisture and oxygen from the likes of pillow packaging for products such as potato crisps.

As a normal constituent of air, nitrogen also has no global warming potential and so there are neither pollution nor emission problems associated with venting 'used' nitrogen into the atmosphere. In the context of food chilling and freezing, therefore, nitrogen is an ideal clean gas.

Being non-corrosive also means that nitrogen can be used in pressurised systems manufactured from a wide range of cost-effective common materials; the only proviso being that the material can withstand the process pressures and temperature involved.

**Flash freezing**

Liquid nitrogen is at a temperature of -196 °C, so on contact with an item of food, it freezes it very rapidly. Compared to freezing food using mechanical chillers, cryogenic freezing using nitrogen is up to four times faster. This results in smaller ice crystallisation, because the water inside and outside the cells of the food all freeze at the same rapid rate, keeping the cells intact and retaining the natural freshness, flavour and texture of the product.

This process is called flash freezing and it better preserves the nutrients, taste and texture of the frozen food, so that when defrosted for cooking, it is nearly indistinguishable from its fresh equivalent.

This technology represents a hi-tech departure from the traditional approaches of mechanically freezing food products on a conveyor belt or immersing them directly into a pool of liquid nitrogen.

Instead, with the flash-freezing process, food on a conveyor is completely surrounded by a stream of high-velocity, extremely cold nitrogen vapour. Food frozen in this way is called individually quick-frozen (IQF) and, through Linde and its state-of-the-art Cryoline® CW multi-purpose cryogenic freezing technology, Afrox can offer a variety of IQF poultry, meat and seafood solutions to African markets.

**Cleaner cold chain**

In Europe, cold food transportation, which includes the mechanical power and refrigeration necessary to keep the cargo chilled or frozen, is estimated to be responsible for nearly 2.0% of total emissions. Road transport refrigeration equipment, which usually runs off a diesel-powered truck engine, is required to operate reliably in a wide range of operating conditions and temperatures, and

it is generally much less energy efficient than the systems in supermarkets or cold storage warehouses.

As an alternative to relatively slow mechanical refrigeration, total loss systems using liquid nitrogen are now available.

Where staff might take some time to load or offload, it is important to have a system that can quickly establish and keep the cold chain temperatures required. The use of nitrogen avoids having to keep the truck engine running while loading and offloading produce. In doing so, instead of diesel exhaust fumes being released into the atmosphere around the area, nitrogen gas is emitted, which is harmless to the environment and to the people loading the vehicle.

Linde's FROSTCRUISE® indirect cryogenic refrigeration system is purpose-designed for the food trucking industry of today, overcoming the environmental challenges associated with diesel consumption and eliminating potentially harmful refrigerants used in mechanical systems.

Advantages include rapid cooling with very stable temperature control; reduced carbon footprint through diesel savings; the elimination of hazardous refrigerants (e. g. R404A); low-noise design for easy deliveries at night time or to residential areas; longer service life compared with mechanical solutions; and cost efficiencies due to ease of service and maintenance.

Using nitrogen-based systems such as FROSTCRUISE® for food transportation enables the food industry to better monitor and control chilled and frozen food safety and quality. It raises the creditability of food and supermarket brands, while protecting the environment.

As well as its abundant supply of nitrogen and its extensive distribution network, Afrox's value proposition in the food arena comprises equipment supply and rental for all of the leading cryogenic freezing technology being developed by its parent company, The Linde Group.

More importantly, however, Afrox offers the expertise necessary to implement customised solutions tailored to the needs of the African food industry.

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