



frozen food packaging

key considerations for optimising your
packaging process



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Stefano is responsible for growing **tna's** customer network by ensuring they receive dedicated on-the-ground technical service. With over 25 years' business development experience, Stefano supports **tna's** sales team in Southern Europe to help customers find turnkey processing and packaging solutions that optimise their production efficiency and profitability.

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summary



» introduction

Global interest in frozen foods has soared in recent years, resulting in numerous growth opportunities for manufacturers. In fact, Technavio predicts the global frozen food packaging market will reach close to USD 9 billion by 2019, growing at a CAGR of approximately 5% during the period 2016-2020.¹ And while frozen ready meals was the leading product segment in 2015, other product categories such as frozen fruits and vegetables continue to gain momentum.²

There are several key drivers which are fuelling the frozen foods segment. Worldwide economic growth and coinciding rising incomes, as well as consumers' increasingly busy lifestyles, mean that more and more people are looking for convenient meal options that fit within their busy daily lives. Technological advancements have also played a central role, with new film types and improved packaging designs coming to the forefront, such as transparent and coloured films, tear-notch openings, hanging holes, sealable zippers and single serve packaging.

Vertical form fill and seal (VFFS) systems are the ideal solution to respond to the increasing demand for frozen foods as they can quickly and effectively bag a wide variety of products and operate well in the harsh environments of the frozen food industry. By optimising their VFFS packaging process, manufacturers can further boost productivity and food safety, while also increasing product shelf life and enhancing visual appeal to create a product that stands out amongst competitors.



¹ Grand View Research, Frozen Food Market Analysis By Product (Fruits & Vegetables, Fish & Sea Food, Potato, Meat, Soup, Ready Meal) And Segment Forecast To 2024, (September 2016), accessed here: <http://www.grandviewresearch.com/industry-analysis/frozen-food-market>

² Ibid.

1 the role of packaging

Packaging is essential to any food product. It contains, protects, promotes, informs and plays a key role in providing convenience for the consumer. Plastics are widely used for packaging frozen foods as their characteristics not only maintain the quality of the end product, but are lightweight and allow it to be readily accessible, as well as being able to withstand high temperatures during cooking. By using plastics, manufacturers also benefit from solutions which are flowable and mouldable, chemically inert and cost-effective.

1.1 preservation & protection

One of the main benefits of plastic is that it provides choices in respect of transparency, colour, heat sealing, heat resistance and barrier properties. In particular, the barrier properties of plastics are a vital consideration, as these will determine how well the material acts as a physical barrier to any external factors that could be detrimental to the product, such as light, oxygen or moisture. The right material can keep frozen food from drying out and helps preserve its nutritional value, flavour, texture and colour. Furthermore, plastic does not interact with food and can be easily integrated with packaging technology such as VFFS systems.

Good frozen food packaging materials should therefore be moisture-resistant, durable, leak-proof and able to prevent dehydration and degradation of the food during its entire shelf life. Excellent temperature stability is also vital as the material needs to withstand both the extremely low temperatures during transportation and storage, as well as extremely high temperatures should the product need to be re-heated in its packaging.

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1.2 promotion & communication

Despite offering a range of functional benefits, packaging also plays a significant role in consumer buying decisions, which are often instantaneous. Research found that 82% of shoppers make their purchasing decisions in store,³ while 54% of shoppers see product visibility as important.⁴ This highlights the significance of attention-grabbing packaging, which is particularly important to attract consumers that are on-the-go or 'time poor' – for example, some shoppers may look for what appears to be the most convenient 'easy-to-cook' option. On-pack messaging is therefore very important. Visually appealing packaging often encourages consumers who are not familiar with a brand to buy based on image, before potentially going on to become a product's loyal buyer.

These visibility statistics also illustrate the trend towards transparent packaging design as a means of consumer communication. In line with growing consumer demand for general product transparency, transparent packaging reveals the colour, shape and texture of the product inside, helping discerning shoppers to assess the quality of the item and raising consumer confidence in a brand. In doing so, frozen food producers give consumers greater visibility of the end product without having to rely on photography or images.

In addition, on-pack promotions, such as discounts and samples, are key visual influencers and a cost-effective way for manufacturers to communicate brand messaging to maximise sales, grow market share and increase consumer interaction.

Packaging format is another key factor behind the promotion and communication of a product, which often focuses on facilitating convenience. For example, consumer demand for convenient food products has led to the introduction of multi-packs containing individual portion sizes. As such, consumers no longer need to measure out exact portions of their food, saving time during meal preparation for time-starved consumers. Meanwhile, re-sealable packaging offers the ultimate convenience, particularly for single-person households. Here, the consumer can open a bag of frozen food with the peace of mind they can return the remaining contents to the freezer and the packaging will continue to offer protection throughout the product's shelf life, minimising waste food in the long term.

³ POPAI, 2014 Mass Merchant Shopper Engagement Study (November 2014)

⁴ Mintel, Food Packaging trends – US (July 2014), accessed here: http://store.mintel.com/food-packaging-trends-us-july-2014?cookie_test=true



2 packaging equipment considerations

Vertical form fill and seal (VFFS) systems are widely used to package frozen produce due to their flexibility, high sealing performance, hygienic design and reliability in harsh environments. However, there are several considerations for manufacturers when specifying a frozen food packaging system.

2.1 food safety

Food safety is paramount in the frozen foods industry and processors need to prevent thawing and cross-contamination during the entire duration of the packaging process to reduce any potential risks to the product or consumer. Meanwhile, frozen food packaging equipment is exposed to some of the harshest environments and cleaning procedures, which can affect the system's performance. Frozen food operators must therefore implement as many measures as possible to ensure the safety and performance of their processes.



2.1.1 regulations

The frozen food industry has some of the highest safety standards, particularly concerning sanitation and cleaning procedures. It is therefore vital that food processing and packaging machinery can withstand the sanitation requirements and cleaning procedures frozen food applications require, as well as the processing environment. IP, or Ingress Protection, ratings are commonly used across the food industry to measure the protection level of equipment against solid objects, liquids and mechanical parts. The rating consists of two digits that represent different forms of environmental influence - the first digit signifies protection against the ingress of solid objects, while the second digit denotes protection against liquids. Essentially, the larger the value of each digit, the greater the protection. Frozen food packaging technology should typically be IP65

protected. Such machinery offers total protection from dust ingress and harsh washdown procedures, including low pressure water jets (from any direction).

Individual components of the packaging system are often required to meet regulatory requirements too. The National Electrical Manufacturers Association's NEMA 4x rating for instance, stipulates that control systems must be protected against the ingress of solid foreign objects, such as windblown dust, as well as harmful effects on the equipment caused by water or ice. Typically more corrosive-resistant than standard NEMA 4 units, NEMA 4x enclosures are regularly used in food processing facilities to offer protection of controls systems, where total washdowns with disinfectants occur frequently.

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2.1.2 operating procedures

Regular operating procedures, such as cleaning and system inspections, are critical to ensuring food safety. Frozen food packaging equipment that regularly comes into contact with frozen meat, poultry or fish, for example, needs to be thoroughly cleaned to prevent bacterial contamination. If not, this could have a disastrous effect on the safety and quality of the end product and ultimately the brand image.

To maintain high levels of food safety, cleaning of packaging equipment should be carried out at least every day when operators are processing the same product. In some cases, particularly when packaging meat or fish, manufacturers have more frequent cleaning procedures, working for approximately ten hours, then washing the equipment for four hours, before re-starting production for another ten hours. However, high cleaning standards are a necessity whatever the product, and every company has its own standards according to its KPIs, local regulations and production levels.

A further reason to regularly examine frozen food packaging equipment is to avoid equipment failure and, in some cases, contamination. Planned maintenance schedules and monitoring systems' power usage can ensure that potential equipment failure is identified before it impacts production, as well as operator and consumer safety.

2.1.3 machine design

A hygienically designed packaging system is one of the best ways to optimise food safety and quality. While numerous regional regulatory agencies, such as the FDA and the British Retail Consortium (BRC), have established standards for equipment design to help promote food safety, there is no global comprehensive legislation or regulatory standard for design. To help manufacturers meet various food safety standards, however, equipment providers are increasingly offering several options to enhance the hygienic design of processing and packaging machinery.

Easy cleaning is intrinsic to hygienic equipment design which is why VFFS systems, for example, are a popular choice when it comes to frozen food applications.

Designed to leverage the benefits of gravity to transport products, a VFFS system's sloping surfaces make it is easier to prevent food residues from collecting on the equipment, which can cause cross-contamination. Meanwhile, easier access to machine parts further simplifies cleaning procedures. Ideally, cleaning is accomplished without removing components; but if components need to be removed, it should have a tool-less design with no loose parts. In addition, crevices, corners and other areas where food can build up are open invitations to cross contamination. The packaging system design should therefore be free of features that create recesses, gaps and areas that are typically hard to clean.

Product application and type of cleaning procedure often determine the best construction materials for the packaging system. When using harsh cleaning agents or frequent high-pressure washdowns, stainless steel is a must. It offers a smooth, defect-free surface to prevent product residue build-up, as well as easier cleaning. Alternatively, if dry cleaning is applied, food producers can consider other alternatives, such as an aluminium.

In a frozen food environment, packaging line speed is also key to maintaining food safety. If products are not transferred quickly and efficiently, they will defrost, which not only affects food quality and safety, but also increases wastage. Maintaining optimum throughput speeds across the entire packaging process, from the weighing through to the bagging stages can therefore help ensure products are processed as quickly as possible.

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2.2 film choice

Film choice is a key consideration for frozen food manufacturers. It not only increases visual appeal and informs consumers what is inside, but it also plays a key role in protecting the contents and can even improve the convenience of the product. However, there are a number of considerations that influence what type of film is the most suitable.

2.2.1 product requirements

To ensure contents are packaged safely and effectively, manufacturers need to be aware of their exact requirements. Frozen food products have very specific characteristics, which will affect packaging material choice. Besides a frozen product's possible sharp edges, the packaging must be able to withstand the pressures of sealing, freezing, storage, transportation, thawing and in some cases, even cooking.

During freezing, for example, most foods expand. The extent of this expansion will depend on the amount of water content, which in its purest form can increase by up to 9% when transformed into ice. Frozen food packaging therefore needs to be strong and flexible to account for these changes in product characteristics. As with all foods that are stored for significant periods of time, packages should be protective against light and air to prevent product degradation. Failure to do so may result in loss of nutrients from the product, as well as "freshness" or perceived quality. And when it comes to thawing, packaging materials should be liquid tight to prevent leakages. The choice of packaging material and the thickness of the packaging film are therefore important attributes when packaging these types of goods.

Many frozen food producers package their products using Polyethylene (PE) film as it offers high durability standards and elongated product shelf life, while also maintaining film property when frozen. PE films deliver a high mechanical strength and puncture resistance, even at temperatures as low as -40°C , which is required for transportation, handling and storage.

Although, single layer films are available, packaging films in the frozen foods industry are typically based on multiple layers of different polymers. By combining different laminates it is possible to achieve specific film functionalities depending on what is required in terms of barriers properties, sealability, printability and overall appearance and feel of the bag. For example, some manufacturers may want to present their product in opaque or coloured bags to protect the contents from the fluorescent lighting in some freezers or hide the ice crystals typically surrounding frozen foods.

Products which not only require freezing, but also need to be reheated in the bag for ultimate consumer convenience must be packaged in materials that are able to maintain their integrity when boiled or microwaved, as well as during storage. For "boil-in-the-bag"-type products, manufacturers tend to use laminates of polyester or polyamides with PE or polypropylene film.

PET (Polyethylene terephthalate) film is one such example, which possesses a heat sealable layer of PE so it can withstand exceptionally high temperatures.



2.2.2 machine compatibility

The film's compatibility with the chosen packaging system is equally important. For example, on VFFS systems the coefficient of friction (COF) is a significant consideration as it will directly affect the performance of the machine. A packaging film's COF provides a relative indication of frictional characteristics. Controlling the COF therefore means maximising performance and avoiding issues in forming, transporting and storing frozen food products.

When foods are packaged using VFFS systems, too much friction of the sealant side of the film can cause poor film feeding, inconsistent package sizes and slows down the packages' progress through delivery chutes. This presents a potentially serious problem for frozen food manufacturers as inconsistent package sizes

decrease consumer confidence in a brand, while poor film feeding results in undesired wrinkles and creases, reducing visual appeal. On the other hand, too little friction on the outside can cause packages to slip or fall off inclined conveyor belts.

Operating temperature has a direct impact on COF. In harsh frozen food packaging environments, which are often cold and/or wet, condensation in the air reduces the COF. This challenge can be overcome by protecting the film from possible moisture.



2.3 sealing technology

The type of sealing technology employed by manufacturers is crucial when trying to achieve an efficient packaging process. A high quality seal ensures that the contents are fully protected against the intrusions of unwanted external materials or gases, and is also important for the overall visual appeal of the bag. Which type of sealing technology is the most suitable depends on the film material used.

Constant or direct heat sealing, for example, is a common method that uses two jaws with a constant high temperature to seal the opening or loose ends of a wide range of plastic packaging materials. This method is particularly suitable for thicker films with a high melting point, such as coated Polypropylene for example, as constant heat sealers are able to reach higher controlled temperatures than other forms of sealing technology.

VFFS systems with high thermal conductivity jaws provide additional benefits as these can be up to 10 times more heat conductive than regular jaws, delivering optimal seal performance even on thick laminate films. They're also better at maintaining a set temperature profile, mitigating potential temperature fluctuations that could affect the seal integrity when the cold film hits the hot sealing jaws.

Contrary to constant sealing technology, an impulse heat sealing system only applies an electrical current 'on impulse'. For this, a small piece of wire is heated instantly and then immediately cooled once the sealing process is complete, lowering operating costs as the sealing jaws are not required to be heated constantly. Additional benefits of impulse heat sealing technology include faster heat-up times and improved sealing accuracy on films with low melting points, like PE for example – making this technology a widely-used choice within the frozen sector.



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3 system integration

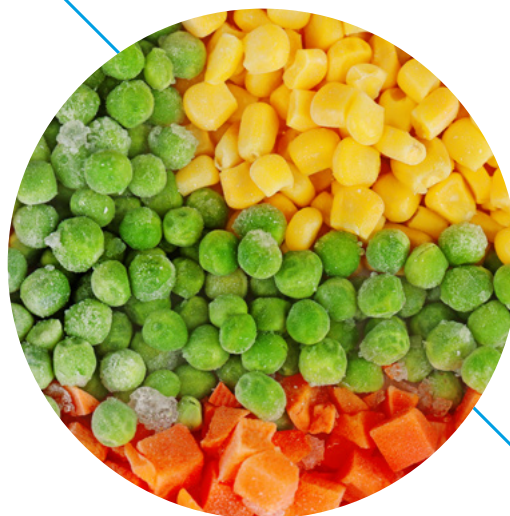
One of the key requirements for an efficient production line is communication. When looking at a complete production line, VFFS systems have traditionally been the bottleneck, having the potential to significantly throttle or optimise the output of the entire line. System integration is therefore the first step towards operational efficiency as it ensures that each component communicates effectively with the others for optimum performance. Full up and downstream integration of equipment ensures all components will work efficiently with one another to maximise production. For instance, a VFFS bagmaker can be fully integrated with a multi-head weight scale and programmed to operate at the same performance levels, while also offering a single point of control for operators.

Integration of inserting and labelling technology is particularly important for frozen food manufacturers, because many flexible packs contain an oxygen absorber to maintain pressure. Using an inserter, the oxygen absorbers are able to enter the packaging at the same time as the product, for manufacturers to ensure continual operation. But with some packaging equipment reaching up to 250 bags per minute, inserting and labelling technology must be able to perform effectively at these high speeds to achieve maximum productivity. Manufacturers should therefore take time to consider the most suitable place to integrate the additional equipment. Since these systems tend to be quite small, it is possible to directly mount the inserter onto the packaging system. That way they do not require any additional floor space and are easily configured and controlled via a single control screen for a full turnkey packaging solution.

Furthermore, individual machines regularly employ different software, making it difficult to evaluate reports and run detailed diagnostics. This limits the ability of

operators to effectively monitor any unusual activities and react quickly should an incident occur. The integration of a standalone supervisory control and data acquisition system (SCADA), however, can help frozen food manufacturers gather information from the entire line and store it in a central database, delivering comprehensive diagnostics for each machine. By adopting a standardised approach for all systems within the production line, new machines can be added with minimal effort and key performance indicators (KPIs) can be set for the entire production line. Lines can be operated and maintained in the most efficient way, reducing downtime and saving costs.

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summary

With the boom in the frozen food market, it is vital that manufacturers can react quickly to meet the growing levels of consumer demand, while also providing a safe product that is attractive and stands out amongst competitor products. High-performance systems, which offer flexibility, ease of use and a hygienic design can help them achieve just that.

The **tna** arctic® 3 is the ultimate solution to meet the performance and regulatory requirements of the frozen food packaging sector. Manufactured in anti-corrosive, solid stainless steel housing, and with an Ingress Protection rating of IP65, this machine meets the most stringent sanitary regulations. Offering both constant and impulse sealing, the **tna** arctic 3 also offers enhanced sealing performance and accuracy on a wide range of packaging films, including laminated polypropylene and PE films like linear

low-density polyethylene (LLDPE) to create attention-grabbing packages.

Furthermore, it can be integrated into wet and cold environments, such as frozen food production facilities, and seamlessly integrated with a wide range of systems, from multi-head weighers, conveyors and date coders to inserters and labellers. As a result, **tna** is able to support frozen food producers with complete turnkey solutions from a single source.





About tna

tna is a leading global supplier of integrated food packaging and processing solutions with over 14,000 systems installed across more than 120 countries. The company provides a comprehensive range of products including materials handling, processing, coating, distribution, seasoning, weighing, packaging, cooling, freezing, metal detection, verification and end of line solutions. **tna** also offers a variety of production line controls integration & SCADA reporting options, project management and training. **tna's** unique combination of innovative technologies, extensive project management experience and 24 /7 global support ensures customers achieve faster, more reliable and flexible food products at the lowest cost of ownership.



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