



Project Baltic

Executive Summary

June 2022

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An assessment of individual quick freezing & thawing technologies

Overview

The Irish seafood industry as we know it is in a period of transition, due to a multitude of factors. In recent years, the Covid-19 pandemic, Brexit, and climate change have created the perfect storm demanding the industry to change quickly and adopt an agile approach to their operations.

Brexit and Covid-19 continue to impact fishing quotas and markets; whilst climate change is driving widespread changes to supply chain policies. When combined, these factors are impacting access to available resources, shifting consumer demands and increasing operational costs. With so much disruption to business, processors need to seek out new and more innovative ways to stay competitive.

One area that seafood processors can control is the better utilisation of technologies that can assist with this which are the focus of this report.

Within the report both freezing and thawing technologies are discussed, alongside their advantages and disadvantages, costs, and feasibility - including the results of several Bord Iascaigh Mhara (BIM) run trials.

The aim is to provide an informative, useful, and detailed report for those considering investing in such technologies.

Retail and Consumer Trends

Macro forces such as shifting demographics, urbanisation and climate change continue to influence seafood consumer attitudes and behaviours. However, the Covid-19 pandemic of recent years was a seismic shock to the purchasing and consumption patterns of the global seafood consumer.

At the height of the Covid-19 pandemic, global food service sectors were shut down shifting seafood purchases to retail and seafood consumption to the home. This disruption led

to changes in seafood consumer behaviour and attitudes as they sought to replicate restaurant style dishes at home and/or purchase products with a longer shelf-life. The result of these changes could be seen at a retail level by the diverse types of seafood products purchased as well as categories such as frozen food attracting new shoppers.

To further understand these trends, the report looks at fresh and frozen categories in the four key retail markets of Ireland, the United Kingdom (UK), Spain, and France. Whilst the level of data available for each market varied, it is clear from the research that both consistency of supply and quality are key requirements for retail customers in these markets.

Freezing and Thawing Technologies

Both freezing and thawing are well established techniques within the seafood industry however, technologies continue to be developed to make these processes safer, more efficient and to allow for greater utilisation of raw material. The report discusses two types of Individual Quick-Freezing (IQF) technologies- mechanical and cryogenic freezing- as well as several thawing technologies. In addition, the report outlines the EU/other legislation that relates to such processing of food.

Freezing Technologies

Mechanical freezing uses a recirculating chemical refrigerant to cool down air, where air is the cooling medium, and it is regarded as an indirect cooling system. It can achieve operating temperatures of -20 to -50°C. Air blast freezers are once such system, and they use high air flow to decrease freezing time of products. Heat is transferred from the product being frozen (via air) to the refrigeration system. While they are diverse types of air freezing systems, the report focused on batch, continuous, belt, air impingent and fluidised bed freezer systems.

The cryogenic freezing process uses liquid nitrogen or carbon dioxide as the refrigerant, which is in direct contact with the food product- regarded as a direct cooling system. It can achieve temperatures as low as -78°C with carbon dioxide and -196°C with nitrogen. Freezing time is much quicker in comparison

to mechanical freezing. There are several types of cryogenic freezing systems including immersion cryogenic freezing. This system works with products being placed on a conveyer and carried into a liquid nitrogen bath. These types of applications may fully or partially freeze a product; where it is only partially frozen, the product continues to another freezer for a second step to fully freeze. Spray freezing is another type of cryogenic freezing, in which the refrigerant is sprayed onto the food.

Thawing Technologies

In general, seafood should be thawed quickly, within 0-6 hours. The growth of bacteria is increased in outer layers of the fish when the thawing time is too long, as the surface temperatures are high while the core is still defrosting. Temperature control is a crucial step when thawing frozen seafood and should be monitored throughout the thawing process.

In the report, the thawing technologies discussed include forced air, continuous immersion, batch immersion and radiofrequency. With forced air, powerful, reversible fans circulate warm, moist air around a chamber where the frozen fish are laid out on open mesh trays to allow for increased air circulation. Batch immersion systems are a form of water thawing system which transfers heat to batches of immersed frozen product continuously passing through a thawing system. However, they are more complex and involved seafood being immersed through a water tank, while also being sprayed.

Radiofrequency thawing involves microwave technology where the frozen seafood product is placed between two parallel electrodes, and alternating radio frequency energy is applied to the electrodes. Heat is generated rapidly and uniformly within the entire form of the product, regardless of its size, weight, shape, and thermal conductivity.

BIM employees put some of these technologies to the test and a summary of the results is discussed below with further detail included in the report.

Thawing Trials and Results

The aim of the immersion trials was to evaluate the suitability of immersion thawing for an industrial setting and identify optimal processing settings for use on a wide range of seafood products. In addition, a comparative investigation between immersion and conventional thawing (thawing in air under ambient temperatures) was conducted whereby the chemical and microbial quality, sensory quality, and level of drip loss from a range of product formats - which included hake, haddock, and whiting - were analysed. The main advantage of using an immersion system for thawing seafood is the time saving aspect. e.g. 800kg of mackerel can be thawed in 3 hours in comparison to traditional thawing methods that usually require 24 hours at a minimum.

The aim of the radio frequency (RF) trials was to assess the suitability of RF thawing for an industrial setting and identify optimal processing settings for use on a wide range of seafood products. In addition, a comparative investigation between RF and conventional thawing was carried out whereby the chemical and microbial quality, sensory quality, and level of drip loss from a range of product formats were examined. The main advantage evident with radiofrequency thawing, from the trials carried out, was that RF was more applicable to higher value whitefish and shellfish products. The volume demands for commodity pelagics means it is likely to be cost prohibitive.

Investing in Freezing and Thawing Equipment

When selecting what technologies to use, there are key considerations to bear in mind such as when dealing with equipment vendors and contractors, as a no “one size fits all solution” exists. Ancillary equipment such as conveyers need to be considered, as well as any additional freezing or frozen storage capacity. Any structural changes or water and power upgrades required, should be factored in too. When considering volume requirements, the seasonality of the catching sector must be considered as throughput requirements may fluctuate, as well as the option of capacity for new product lines.

In summary, the five key considerations should be: capital investment, operating cost, product quality, time, and footprint. Any available grants, or financing plans for the technologies, should also form part of considerations.

Conclusion

A wide range of technologies have been introduced to the seafood sector in recent times and these technologies have enhanced processing capabilities, particularly in mainland Europe. As customers seek better quality and more convenient products, the demand for Individual Quick Freezing (IQF) technologies have increased in recent years. In addition, new thawing technologies enable processors to save time and enhance product quality.

Such technologies have not been deployed as widely across the Irish seafood industry, for a variety of reasons. However, these technologies are likely to form a part of the innovative solutions that will enable processors to diversify their businesses and even target new markets.

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The project team would like to thank everyone who contributed to this report and hope that it proves to be informative and insightful.

If you are interested in discussing these technologies further or if you wish to seek support in developing a specific business case, contact the Seafood Innovation Hub at info@bim.ie or 01 2144100

