The Application of the Celsius System in the food industry

Summary

The McQueen-Cairns Technology Celsius System can become an integral part of quantified quality assurance in any food processing/production, distributing, storing, preparing and catering operations. It can also be an essential tool to aid vendors maintaining government and departmental industry food safety guidelines. The Celsius system can make non-invasive checks and record core and average temperatures of food batches when food is being frozen, chilled, heated, thawed, cooked, re-heated as well when it is being stored, portioned, redistributed and other processes which lead to eventual consumption. The Celsius System has been proved to match the accuracies of other instrumental devices such as temperature recording Probes, thermometers and infrared, however the system is non-invasive and more practical with measuring core temperatures with frozen products. The continuous and accurate measuring of temperatures are essential for checking and maintaining food safety and quality can help prevent, food nutrient and vitamin deficiencies, losses of palatability, texture, flavour and acceptable appearance and can hazardous microbiological activity, which can all culminate in increased food waste.

Introduction

Measuring temperature in the food industry is essential with maintaining food quality and safety. There are a number of processes involved with manufacturing food including cooking, chilling, freezing, thawing, reheating, portioning, preparing, storing and redistributing to name a few. All of these processes involve some form of temperature control which is related to limiting the loss the quality in food, increasing safety for consumption (e.g. removing or stemming harmful microbiological activity) and limiting waste of spoiled product. The Celsius System is an effective and proven device for non-invasively measuring the core and average temperature on this food product. In this paper it will described how accurate temperature measurement is important to the food industry and why the Celsius is an important tool for meeting industry temperature goals (and regulations) and reducing waste applied to frozen, hot and chilled food in comparison to conventional temperature measurement devices.

Conventional temperature measurement devices

The measurements of temperature in the food industry are normally carried out by temperature probes (PRT probes), thermocouples, thermometers and infrared thermometers. “Successful temperature measurement using conventional probes requires a high level of skill and training to ensure meaningful and representative measurements” (Allerton 2005, p2). These devices can also affect product temperature, e.g. by transferring heat into or out of the product (Allerton, 2005). Using probes and thermocouples is also an invasive technique as the probes have to be inserted into the food to try and achieve a representative temperature which is not affected by surface or core temperatures; there is also some time before the probe equilibrates (sometimes taken several minutes and can be affected by human-error). Probes can also cause contamination to products and if the product is already packaged it become waste. Infrared temperature measurements only display surface temperature and do not give an accurate indication of internal and core temperatures. These measurements can also be distorted by surface properties and reflections from other temperature sources (Allerton, 2005).The Celsius is not affected by these limitations and can give repeatable readings in <3 seconds and minimises waste and human error.

Celsius System Overview

The MCT Celsius system is a non-invasive temperature recording device, which has a proven and official temperature range between (-30°C to 120°C) with a cited accuracy ±0.5°C with product size >100g. However, some informal undocumented tests conducted by McQueen Cairns Technology have shown accuracies at -100°C. The system can measure packaged products (e.g. packaged in plastic, cardboard, foil etc) (Allerton, 2005), however will not measure completely foiled products. It can measure a product within 3 seconds of entering the System's cavity, which have the dimensions 35 x 35.5 x 23cm. The system measures the microwave radiation emitted from the product, which signal is translated into a temperature output (Land, 2001; 2006). This output is displayed on the system touch screen. Measurement recordings are also time/date stamped and stored in the database. Products can also be traced by their barcode which is also read by the system while the sample is measured. The entire process is non-invasive and the food can be used again, which can minimise the waste.

The system has been utilised in the food industry for almost a decade, with more than 70 units exist in the food industry around the world. It is know for its easy-to-use operation, which requires minimal training. Overall, its user friendliness, accurate non-invasive measurements makes the Celsius system an essential application in the food industry in the freezing and chilling processes.

Application of the Celsius System to Frozen Products and Freezing Processes

It is well know in the food industry that freezing is an excellent method of preservation as it stems the growth of bacteria and slows down the biochemical reactions which occur in non-frozen food (British Frozen Food Federation, 1994). However, to increase and maintain food quality controls must be made with temperature throughout the frozen food production cycle (Department of Health, 1993; British Frozen Food Federation, 1994). The different temperature throughout the process can all be measured and verified accurately by the Celsius System. Importance with the controls with temperature outlined by the British Food Federation (1994) and Department of Health (1993) are outlined below:

1. Perishable raw materials (e.g. vegetables), which are related to the food quality, i.e. nutrient retention, should be kept at temperatures between -1°C and 10°C to maintain quality, texture, nutrients, vitamins and palatability.
2. Processed and cooked food should be cooled quickly to <10°C and afterwards frozen as soon as possible.
3. After cooking, if cooling cannot take place immediately, the temperature of the product should be maintained at >63°C, until it can be cooled (British Frozen Food Federation, 1994).
4. Immediately after cooling, the food should be frozen by a method which ensures that the temperature at the thermal centre (core temperature) passes quickly through the zone of maximum crystallisation. For most products this zone lies between -1°C and -5°C (British Frozen Food Federation, 1994).
5. The temperature food products, overall, (after stabilisation) is to be kept at temperatures of -18°C or colder with the following exceptions made for transport (temperatures should not exceed -15°C), in retail cabinets (no warmer than 12°C) and <-10°C for butter (Department of Health, 1993; British Frozen Food Federation, 1994);

As shown from these guidelines maintaining temperature controls is essential for food quality and safety. However, it is virtually impossible to penetrate frozen food and record accurate temperature measurements with temperature probes and thermometers and also not spoil the product as mentioned earlier. Freezer temperature controllers on freezers, air conditioner

can show an accurate reading of the environment conditions, i.e. temperature of the air, but this seldom reflects the core temperature of the product. The Celsius system can accurately measure average temperatures of a product from -30°C to +120°C allowing the user to meet the guidelines and regulations for all parts of the processes and give accurate non invasive reading in the freezing range. This is also true for the chilled range.

Application of the Celsius System to Chilled Products and Chilling Processes

The Celsius System can also aid and maintenance food safety and quality in the chilled food industry. At chilled temperatures and during the processes to produce a chilled product i.e. cited by the UK Department of Health to be in the range of 0°C to 3°C and are designed to be stored at refrigerated temperatures at or below 8°C, targeting 5°C (CFA, 2008). Chilled products can rapidly lose quality and become vulnerable to hazardous microorganism activity. Maintaining quality and safety in food is therefore linked to temperature controls during processing, storing, distributing and up to consumption. According to the Chilled Foods Association (CFA, 2008), “Temperature is the principal controlling factor for the safety of chilled foods. Temperature is particularly important to slow or inhibit the growth of pathogenic bacteria”.

The UK Department of Health (1994) and the Chilled Foods Association (CFA) website offer a number of parameters and guidelines for Chilled Food production:-

1. Pre-cooked chilled food should be cooked to 70°C for no less than 2 minutes to remove and reduce all vegetative pathogens e.g. *Listeria monocytogenes, Staphylococcus aureus, salmonellae, verocytotoxigenic E. coli.* (CFA, 2008).
2. Heated to 90 C for 10 minutes to remove vegetative pathogens, spores of psychrotrophic (cold growing) *Clostridium botulinum* (Department of Health 1993; CFA 2008).
3. Heated product should be cooled as quickly as possible through the temperature range 63 to 5 C or less to minimize risk of spore germination and outgrowth. The time taken for cooling will vary from product to product, but as a guideline, should be no more than 4 hours (Department of Health, 1993).
4. Food portioning is dividing food into smaller quantities. After cooking food portioning should be completed in within 30 minutes for any product in a controlled environment room with the temperature <10°C (Department of Health, 1993).
5. The temperature of the cooked food after chilling is maintained below +3°C throughout the entire storage and distribution until reheating (Department of Health, 1993).
6. The maximum storage life of chilled products does not exceed 5 days, including both the day of cooking and consumption. This also applies to where pre-cooked chilled products are purchased from outside suppliers (Department of Health, 1993).
7. Should the temperature of the cooked food in storage exceed +5°C, but not 10°C, and before reheating, the food should be consumed within 12 hours or destroyed (Department of Health, 1993).
8. Should the temperature exceed +10°C, during storage the chilled cooked food should be destroyed (Department of Health, 1993).
9. Food intended to be eaten at cold or at ambient conditions should be consumed within 30 minutes from removal from chilled storage (Department of Health, 1993).

Therefore temperature is very important to maintain the quality and safety of Chilled products; especially with the reduction and elimination of noxious microorganisms. The Celsius System has been used extensively and employed successfully in the Chilled food industry measuring the temperatures of chilled food during the full production process. The measuring system can track and recording the temperature of a sample by date/stamping temperature and product details into its database. This would be important in tracing the life

and redistribution of the product, showing if the 5 day life span has been exceeded; which is crucial for chilled product. The system's non-invasive measurement capabilities mean that chilled product can remain in packaging and will not become contaminated; this in turn limits waste. Overall the non-invasive measurement decreases product the susceptibility to human error and bias is minimised and safety of food production and inherent quality is enhanced over the full process with keeping record of all temperature changes, benign and malignant.

Conclusion

Overall, the Celsius System can be applied in most of the processes involved with producing Frozen and Chilled food. Compared to other temperature measurement devices the Celsius system is easier to use, more accurate at freezing temperatures, less prone to human error and can guarantee product representation and repeatability. This is very important when maintaining food quality and safety in the food industry, as the factors are strongly related to temperature. Controlling the temperature accurately with the Celsius system will therefore help prevent food nutrient and vitamin deficiencies, losses of palatability, texture, flavour and acceptable appearance and can hazardous microbiological activity and reduce waste.

References

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Links:

British Frozen Food Federation
http://www.bfff.co.uk/
http://www.bfff.co.uk/guide_storage_handling.pdf

Chilled Food Association:
http://www.chilledfood.org/resources/food-safety.htm#Storage

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