RD&T Case Study

Improving performance of food freezing

Company: apetito

Background

apetito approached RD&T when they wanted to expand their food freezing operation at their factory in Trowbridge. apetito offers a wide range of frozen meals and desserts suitable for hospitals, care homes, local authorities and private home delivery. They wanted to ensure that all the frozen food they produced complied with exacting industry standards. These stated that the food should reach an average temperature of -5°C within 90 minutes and -18°C in less than 240 minutes (NACC and BFFF requirements).

At the Trowbridge factory apetito operate 3 spiral freezers that produce savoury meals and desserts. These freezers are operated by 2 refrigeration plants both operating on ammonia as the refrigerant.

Temperature and energy survey

RD&T were given full access to the apetito refrigeration plant and spiral freezers and were asked to assess the current freezing regime and how apetito could expand their production of meals.

Data on the performance of the 2 refrigeration systems were collected from onsite data loggers and data loggers that were placed on the evaporators and plant of each cold store. Manufacturers' performance data were obtained for the refrigeration system components. Manual readings were taken to back up the above readings and pressure readings were taken from the gauges fitted to the plant. The electricity consumed by the plants was measured by 3-phase power meters.

A survey was also carried out on the freezing performance of the spiral freezers. Temperature sensors attached to data loggers were inserted in meals before they entered the spiral freezer and temperatures measured as the meals passed through the spiral freezers.

Mathematical model

To examine how apetito could increase their throughput a mathematical heat transfer model was used to calculate cooling times using varied process conditions. The model was initially verified using data from the temperature survey using mashed potato as an example product as this was found to be the slowest cooling product examined. A number of scenarios were modelled including different ambient air temperatures, 2-stage freezing, the use of ambient cooling (many of the meals were frozen immediately after cooking) and changes to production scheduling.

Results

Several issues with the performance of the current plants were identified that could improve performance. Also several scheduling options were identified that would enable apetito to increase throughput but would require a change to the current methods of operation.

To fully achieve the exacting freezing standards and expand production to the levels required by apetito was impossible using the existing plant. To achieve the NACC and BFFF requirements and retain the existing residence times the air temperatures in the spiral freezers would have had to be reduced to well below -51°C. This was not possible using the existing plant and would also be extremely energy inefficient.

A number of proposals were made to enable apetito to achieve their future expansion in throughput. This will enable apetito to specify new plant having the detailed knowledge of the required heat loads and conditions required to achieve their freezing specifications.

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