Food Refrigeration & Process
Engineering Research Centre

THE GRIMSBY INSTITUTE
of Further & Higher Education

# ColdRoom - Improving food temperature control in chilled and frozen storage rooms

A research project funded by DEFRA under the AFM 115 programme.

## Partners

frperc at the University of Bristol

BMPA - British Meat Processors Association

CCFRA - Campden and Chorleywood Food Research Association

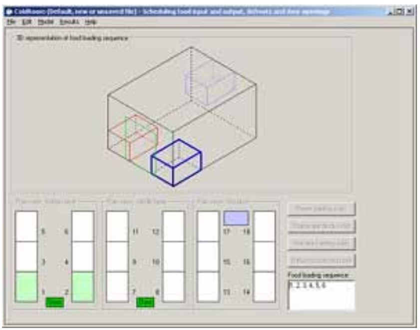
J&E Hall

Foster Refrigerator

P.A.Hilton

Atkins

## Background



There are over 7,000 food manufacturers in the UK. At least 50% of these manufacturers operate refrigerated storage areas. In addition, all food retailers and most catering establishments also operate cold stores.

One, if not the most important, change in food refrigeration in the last 10-15 years has been the realisation of the interdependence of the different refrigeration operations and the concept of the 'cold chain'. It is essential, if food quality and safety are to be maximised, to attain:

the optimal rate of temperature reduction in primary chilling and freezing, and

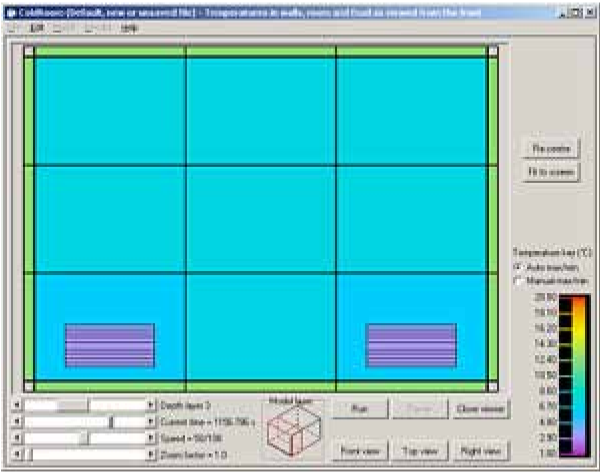
maintenance of the correct temperature throughout storage, processing, distribution and retailing

The main project objectives were to improve the safety, quality and economics of chilled and frozen storage by closer control of food temperature. This was achieved by developing a user-friendly model to predict food temperatures in chilled and frozen storage rooms under real operating conditions. This model would allow:

Cold room operators, contractors, and manufacturers to specify and design cold rooms to keep food at optimum temperatures under actual working conditions.

Users to rapidly predict the effect of operating conditions and loading patterns on performance and identify how they can avoid unacceptable food temperatures.

## Project results



The core of the mathematical model consists of an iterative solution method that steps through time in the model, simultaneously sorting all the heat flows in the room at each time step to produce temperatures in the walls, room air and food. The heart of the model is the air within the cold room. This air is subdivided into finite blocks, which exchange heat with each other by convection and with solid surfaces they are adjacent to by surface heat transfer. Blocks representing the cold room walls are layered around these room air blocks. Different foods can be placed within the air blocks. Features that add or subtract energy from the room, such as the refrigeration system, air infiltration and moisture ingress through door openings and people and machinery in the room, are incorporated.

The front end of the program that the user enters data into is written in Visual Basic© 6.0. The structure of the Graphical User Interface (GUI) is written so that the room dimensions, its structure and thermophysical properties, the size of doors, the refrigeration plant, boundary conditions and food movement in and out of the room can all be entered via the GUI. Screenshots of some of these are shown in the images on the right. Scheduling of food loading into and unloading out of the room, food thermophysical properties and loading density are input via a scheduling window in the GUI.

The user can display a graphical output from the model. This shows the temperatures of the wall and room blocks and food items and layers in two ways. Firstly, there is a temperature scale that is linked to a range of colours, so that differences in temperature between blocks can be visualised instantly by differing colours. For a more accurate temperature, the mouse can be hovered over any of the blocks to show the temperature to 2 decimal places. The viewer has the facility to zoom in on any blocks that are too small to see when all the blocks are fitted to scale on the screen (such as thin wall claddings) and centre or resize the representation to fit the screen using simple controls. The room block representations can be dragged across the screen to pan the view across the room.

The model was verified against data for a chilled cold room operating at temperatures of between 1 and 10°C. The verification trials included simulated cold room breakdown and extended door openings during loading. The overall mean difference between the predicted and experimental centre and surface food temperatures were found to be less than 0.7°C.

## Contacts

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