Food Refrigeration & Process Engineering Research Centre

THE GRIMSBY INSTITUTE of Further & Higher Education

YOGHURTAIR;

A novel environmentally friendly and cost-effective technology for thermal and refrigerated processing of yoghurt and fermented milks by air cycle-based heat pumps.

Funded under the EU CRAFT programme

Partners

- FRPERC at the University of Bristol
- ARNS Dairy, The Netherlands
- ATO Agrotechnological Research Institute, Wageningen, The Netherlands
- BALKAN Special Ltd, Bulgaria
- BULSHRAE, Bulgaria
- CEMAGREF, France
- GR Instruments BV, The Netherlands
- LLS Velis, Russia
- National University of Ireland, Dublin UCD, Eire
- Technical University of Sofia, Bilgaria

Background

There is widespread concern about the environmental effects of the refrigerants and the energy used by vapour-compression refrigeration systems. One of the first industrial means of refrigeration, the air cycle system, has potential to provide an environmental and energy efficient alternative. A typical open air cycle operates by compressing ambient air (which heats the air), removing heat from the high temperature air, expanding the air to a lower pressure, while it does work on the environment (which cools the air), and then releasing air back into the ambient space. The compressed air on the hot side of the system provides useful heating, while the expanded air on the cold side provides cooling for refrigeration.

More information about air cycle technology can be found on the frperc air cycle research topic page.

The aim in this project is to develop air cycle-based heat-pump equipment to enhance the quality, efficiency and environmental friendliness of yoghurt production. The project will implement this promising technology to improve the quality and shelf life of the

final product. Energy efficiency will be increased by employing a combined heating and cooling system to achieve greater control and to ensure the production of consistent high quality yoghurts. Such equipment will offer greater reliability, reduced maintenance costs and increased productivity, along with lower wastage of processed product through improved process control.

Current dairy refrigeration systems in many European SMEs are based on low technology equipment which suffers from low cooling rates and poor temperature control. These in turn have detrimental effects on the yoghurt throughput and quality. Hence, the implementation of a reliable and cost-effective system, which uses a natural and environmentally benign refrigerant (air) will strengthen the competitiveness of the European dairy sector.

Project information

The major objectives of the collaborative research will be:

1. To develop and optimise an alternative air cycle-based pasteurisation-fermentation-chilling process for the production of safe yoghurts and associated fermented dairy products with improved nutritional and sensory quality.

2. To generate new knowledge and encourage a broader use of alternative thermal and refrigerated processing in the dairy industry by creating a public awareness of the method's availability, engineering capabilities, economics and potential advantages over the traditional methods for yoghurt production.

The project will operate for a 2 year period starting in April 2006. During the project optimal processing modes, control strategies and specifications will be identified, which ensure optimum food quality and safety in real situations for industrial yoghurt production. Useful data will be obtained on the yoghurt sensitivity under highly dynamic ambient conditions present in dairy manufacturing and distribution systems. Extensive experimental studies will be carried out to complement the data gathered from the published literature. Existing and novel equipment for cooling and heating will be reviewed and assessed both theoretically and experimentally to meet the requirements of the yoghurt specification.

Mathematical models will be developed to evaluate a large number of heat transfer, fluid flow and microbiological scenarios as well as equipment options. Modelling based on Computational Fluid Dynamics (CFD) will be employed to optimise the processes of milk pasteurisation, fermentation, subsequent yoghurt chilling and resulting design of processing equipment and heat exchangers. More information about CFD can be found on the frperc CFD research topic page.

Energy and cost efficiency will be of primary importance during the design stage. A semi-industrial pilot plant is to be constructed to examine the operation of the system against the specification for product quality and shelf life. This will demonstrate the system capabilities and encourage a wider use of the air cycle to provide high-quality yoghurt products with environmentally benign working fluids.

Contacts

Please contact us on +44 (0)1472 582400 or email us on frperc@grimsby.ac.uk