

Hard-O-Dynamic System

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Hard-O-Dynamic (HOD)

Generally speaking, in conventional batch freezers, the freezing stage is carried out using the combination of a refrigeration cycle and mechanical mixing and scraping. The mixture is frozen at a variable temperature according to the type of process and the composition of the mixture itself (generally within the range $-11 < T (^{\circ}\text{C}) < -8$). This stage is characterised by the rapid cooling of the mixture as it is mixed, which allows for even distribution of the solid phase in crystals and the aerated phase throughout the structure of the product without separation of the solutes.

The limitations of the conventionally adopted solution are:

- long processing times
- problems of heat exchange with high-fat mixtures
- possible formation of a lump of product inside the freezing cylinder
- problems of defining the correct consistency
- high power and water consumption

The above-mentioned issues have been resolved by the HOD system. By means of a modified refrigerating circuit and mixing/scraping system, a process data recording system and an algorithm, the system is able to process said data in order to optimise the ice cream production cycle according to the quantity and type of mixture used and, in particular, to regulate the evaporation temperature automatically.

Previously the production cycle of a batch freezer was controlled depending on the temperature and hardness of the ice cream, said hardness being detected by mechanical means (e.g. Hard-O-Matic) or by recording the power consumption of the stirrer motor (e.g. Hard-O-Tronic).

These control systems do not take into due consideration factors such as:

- composition of the mixture
- quantity of mixture present in the freezing cylinder
- quality of the ice cream to be produced e.g. of the desired end product

The development of specific hardware and software and its integration into the refrigeration system and mixing and scraping system have made it possible to work out a method and an algorithm which allows the preparation, within a predetermined freezing time, of an ice cream with the desired characteristics as regards its consistency, temperature and the quantity of overrun, irrespective of the quantity and the type of product being processed in the freezing cylinder of the machine.

This result is obtained:

A. by recording the following process data:

- temperature of the refrigerant at the evaporator inlet
- temperature of the refrigerant at the evaporator outlet
- current consumption of the stirrer
- cycle stage times

B. by analysing the corresponding trends (e.g. temperature and current consumption curves) over time.

C. by suitably managing the operation of the compressor, regarded as a cold-generating source, of the stirrer regarded as a means for distributing cold throughout the mass of the product, and of the valve for injecting hot gas into the evaporator, regarded as a means for controlling the evaporation temperature of the refrigerant.

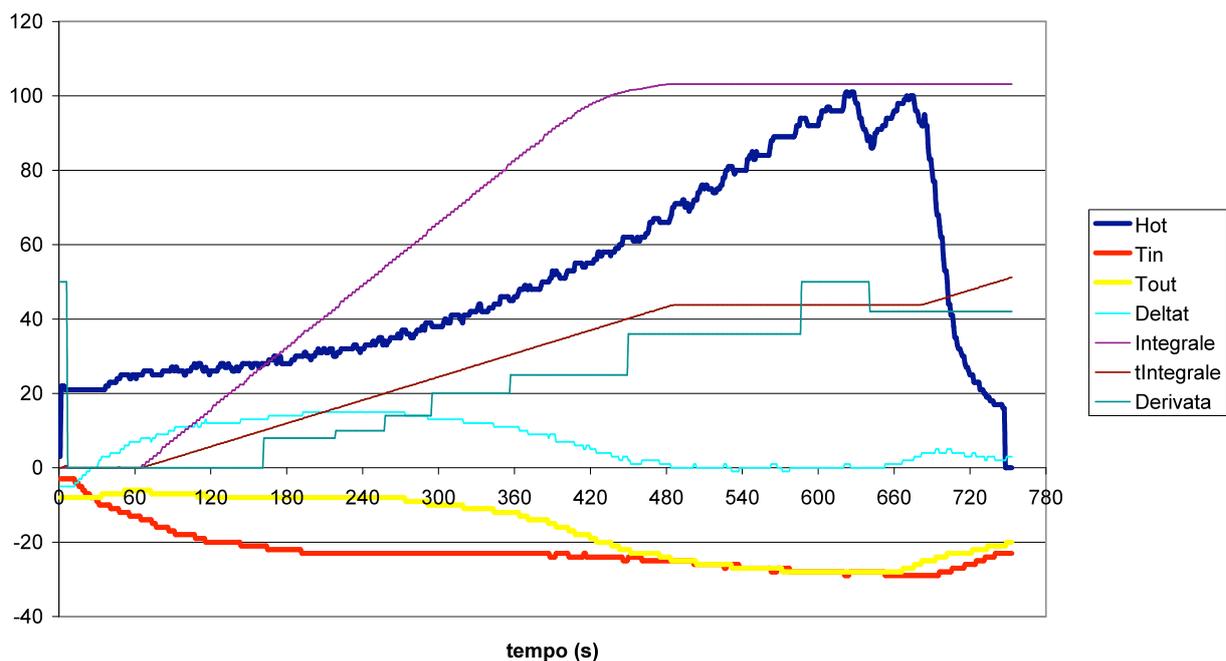


Figure 1: Schematic Diagram of HOD Cycle

The following patents have been applied for in relation to the above:

- Method and apparatus for the control of the flow rate of the refrigerating fluid in ice cream making machines (2002);
- Method for controlling and optimising the cycle for production of ice cream depending on the mixtures used (2002).