

# Control and Utilisation of Viscous Heating in Ice Cream Flow

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During processing, ice cream has to flow down pipes when it is made in factories. This can tend to destroy the structure that has been carefully created in previous unit operations. This because the ice cream gets warmer due to internal friction when flowing, which also has known as viscous dissipation or viscous heating. However, it does offer two interesting and potentially valuable possibilities: limit the viscous heating to only a very thin layer of highly sheared material at the pipe wall and the bulk of ice cream will flow as an unsheared plug; measure the extent of viscous heating and convert this into a measure of product viscosity and hence quality. The microstructure of ice crystals, air bubbles, fat droplets and matrix is central to the physical and sensory properties of ice cream. This project will take action to control the viscous heating in ice cream flow. It will develop novel experimental equipment in order for a robust study of these ideas to be conducted.

## OBJECTIVES

- Assemble a novel pipe rheometry rig
- Instrument the rig to enable the measurements of the temperature and pressure gradient under various conditions
- Control the effects of viscous heating in ice cream flow
- Improve the processing performance of ice cream

## INGREDIENTS



WATER



PROTEIN



SUGAR



STABILIZER

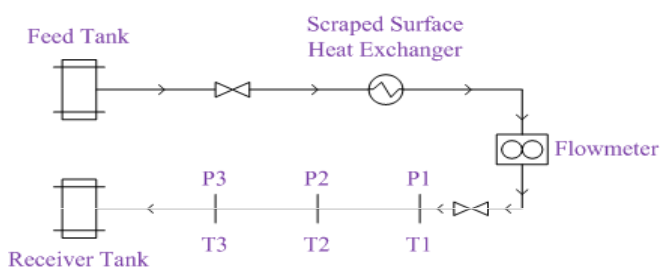


EMULSIFIER



OIL

## FLUID FLOW RIG



### MEASURE:

- Pressure drop
- Temperature
- Volumetric flow rate

## Ice Cream Processing:

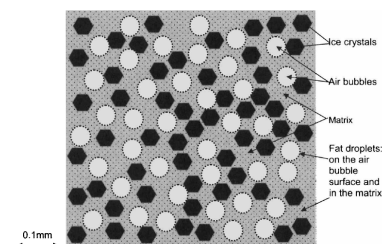
- Mixing - blends together, disperses & hydrates the ingredients
- Pasteurization - melts the fat
- Homogenization - reduces fat globule diameters
- Ageing - causes protein displacement on the fat globule
  - promotes fat crystallization
- Freezing - forms ice crystals
  - shears large air bubbles & breaks the air into many smaller ones
  - causes some of the fat droplets to collide & coalesce



Ice Cream (istockphotos.com)

### FURTHER WORK:

Microstructure observation



Microstructure of Ice Cream (Clarke, C. 2004. The Science of Ice Cream.)

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