

The science and technology (*and art*) of dairy gelato-style ice creams.

Prof. H. Douglas Goff, Ph.D.
University of Guelph, Canada



Abstract

Gelato is an ice cream style that is characterized by compositions that are lower in milk fat and milk solids-not-fat but higher in sugar, compared to regular hard-packed ice cream. It is typically highly flavoured with fresh, high quality flavours, frozen in a batch freezer to low overrun and drawn into shallow pans that are tempered to a scoopable serving temperature and served fresh, without further hardening. These characteristics provide some unique opportunities but also some unique challenges compared to hard-packed or soft serve ice cream for artisanal producers and retailers. Gelato-style has also been replicated by large-scale manufacturers and made available through commercial (grocery store) channels. This presentation will focus on gelato-style ice cream and discuss these opportunities and challenges, with the focus being on production and delivery to the consumer of high quality products.



Celebrating 100 years of the University of Guelph's Ice Cream Technology Course in 2014



Since 1914, there have only been four Professors of this course (L to R):
Prof. Dan McMillan (1914-1922); Prof. Harry Smallfield (1923-1954);
Prof. A.M. (Sandy) Pearson (1954-1986); and Prof. Douglas Goff (1987 present).

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H. Douglas Goff
Richard W. Hartel

Ice Cream

Seventh Edition



 Springer

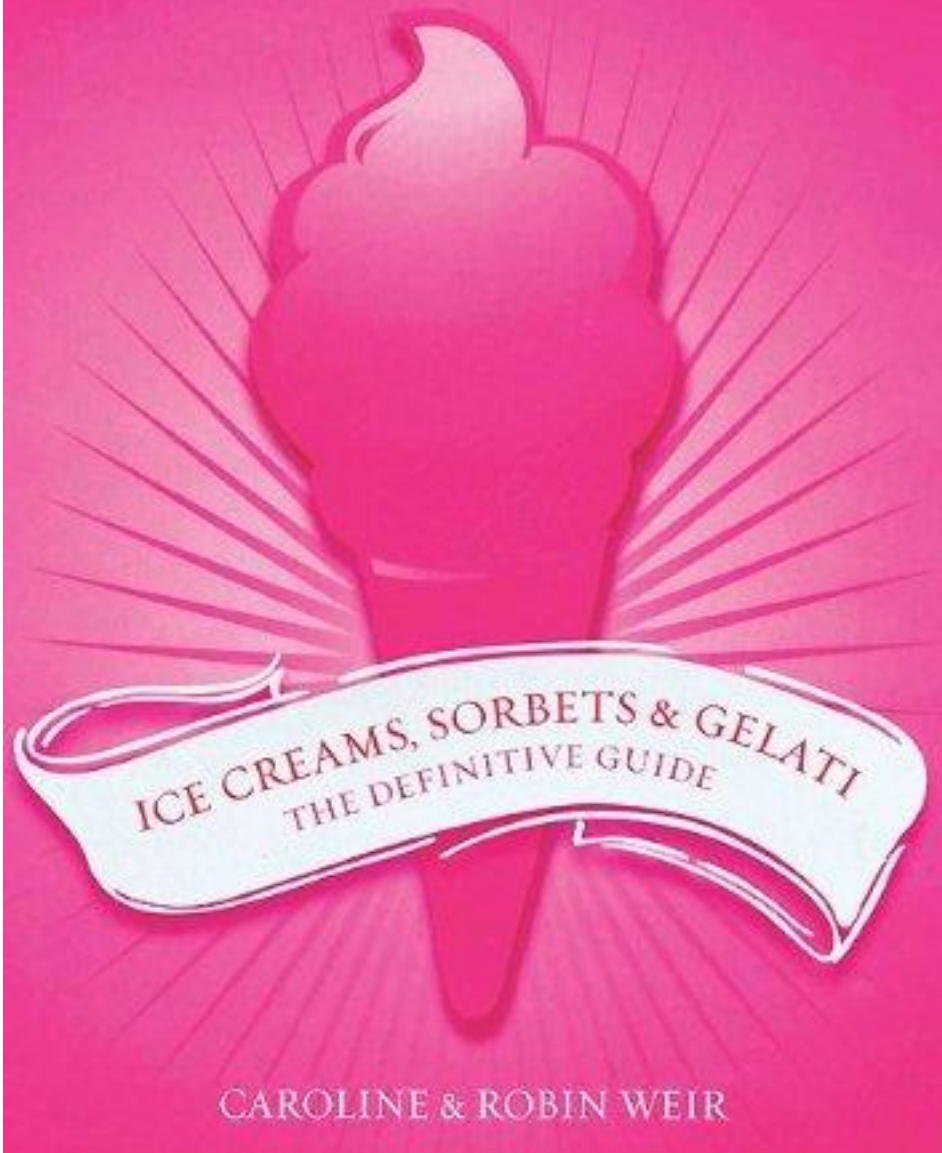
www.springer.com

(search for Ice Cream)

Feb., 2013

Robin Weir's relentless research and boundless passion have inspired me for years

HESTON BLUMENTHAL



ICE CREAMS, SORBETS & GELATI
THE DEFINITIVE GUIDE

CAROLINE & ROBIN WEIR

**Grub Street, London
2010**

Outline

- **Gelato vs. Ice Cream**
- **Gelato Mix Formulations**
- **Gelato Mix Manufacture**
 - **Hot process vs cold process (powders)**
- **Gelato freezing and flavouring;
hardening(?)**
 - **Serving Gelato**



Gelato versus Ice Cream

- “Gelato” : Italian-style ice cream (or light version, depending on legal definition)

	Gelato	Hard-pack Ice Cream
Fat content	4-8%	>10 – 16%
Sugar content	15-24%	10-15%
Freezer	Batch, low shear	Continuous, high shear
Overrun	15-30%	(25-) 90-115%
Flavourings	Stronger and bolder; traditional Italian	Endless
Serving temperature	Not hardened; -10 -to - 12°C	Hardened; -12 to - 15°C
Serving style	5L Napoli pans; served fresh, highly decorated; “Artisanal”	10L tubs; hardened, tempered and scooped

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Gelato Mix Composition

- **Milk Fat** 4% - 8%
- **Milk solids-not-fat** 9% - 12%
- **Sweeteners**
 - **Sucrose (>75%)** 14% - 24%
 - **Glucose solids** 0% or 4% - 5%
- **Stabilizers** 0% - 0.4%
- **Emulsifiers** 0% - 0.25%
- **Total Solids** 32% - 42%
- **Water** 58% - 68%

Gelato Mix Composition

■ Milk Fat

4% - 8%

- Generally from cream (32 – 40% fat)
- If you don't homogenize the mix, homogenized cream (up to 20% fat) could be used
- Butter can be used but must have a homogenizer
- (Note: if whole milk (3.25% fat) is used to balance the mix (*i.e., supply the water*), then it also contributes fat, which has to be accounted for)

(Note: some gelato recipes use whole milk (3.25% fat) only, no cream. In that case, fat content in gelato would be 2 – 2.5%, very low. That needs to be compensated in recipe with higher levels of milk protein and stabilizers.)

Gelato Mix Composition

- **Milk solids-not-fat** **9% - 12%**
 - Contains milk proteins, lactose, minerals and vitamins
 - Generally from condensed skim (25-40% SNF, *balance is water*) or skim milk powder (97% SNF, 3% *water*)
 - Some also from cream and potentially also from milk (skim or whole), if used to balance the mix (*i.e., supply the water*), which must be accounted for in recipe

(Note: MSNF in milk or cream can be calculated as 9% of (100-fat content), e.g., cream at 35% fat, SNF would be $.09 \times 65 = 5.85\%$; milk at 3.25% fat, SNF would be $.09 \times 96.75 = 8.7\%$; skim milk = 9% SNF. Also note, $100 - \text{fat} - \text{SNF} = \text{water content}$.)

Gelato Mix Composition

■ Sweeteners

- **Sucrose (>75%)** **14% - 24%**
- **Glucose solids** **0% or 4% - 5%**

- **Critical balance for freezing point depression, sweetness, body/texture, and cold-eating sensation; provides soft, sticky texture**
- **Glucose solids from hydrolyzed starch, adds body/texture/viscosity; not as sweet as sucrose**

(Note: Sugars can be obtained either dry or as liquid syrups. If liquids, then the solids needs to be known (typically 65-80%) and the balance is water, which needs to be accounted for in the recipe.

Gelato Mix Composition

- **Stabilizers** 0% - 0.4%
- **Emulsifiers** 0% - 0.25%

- Stabilizers act as thickeners, help maintain ice crystal size, longer shelf-life; traditionally (in Southern Italy) cornflour/cornstarch; typically guar, locust bean gum, carrageenan
- Emulsifiers provide a dryer, smoother texture, melting resistance; typically egg yolks (>2%) (traditional to Northern Italy), mono- and di-glycerides
- Stabilizer/emulsifier blends can be purchased specifically for gelato recipes

Gelato Powders

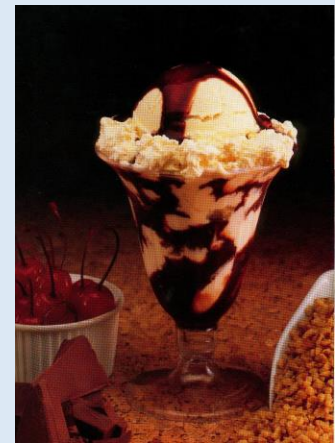
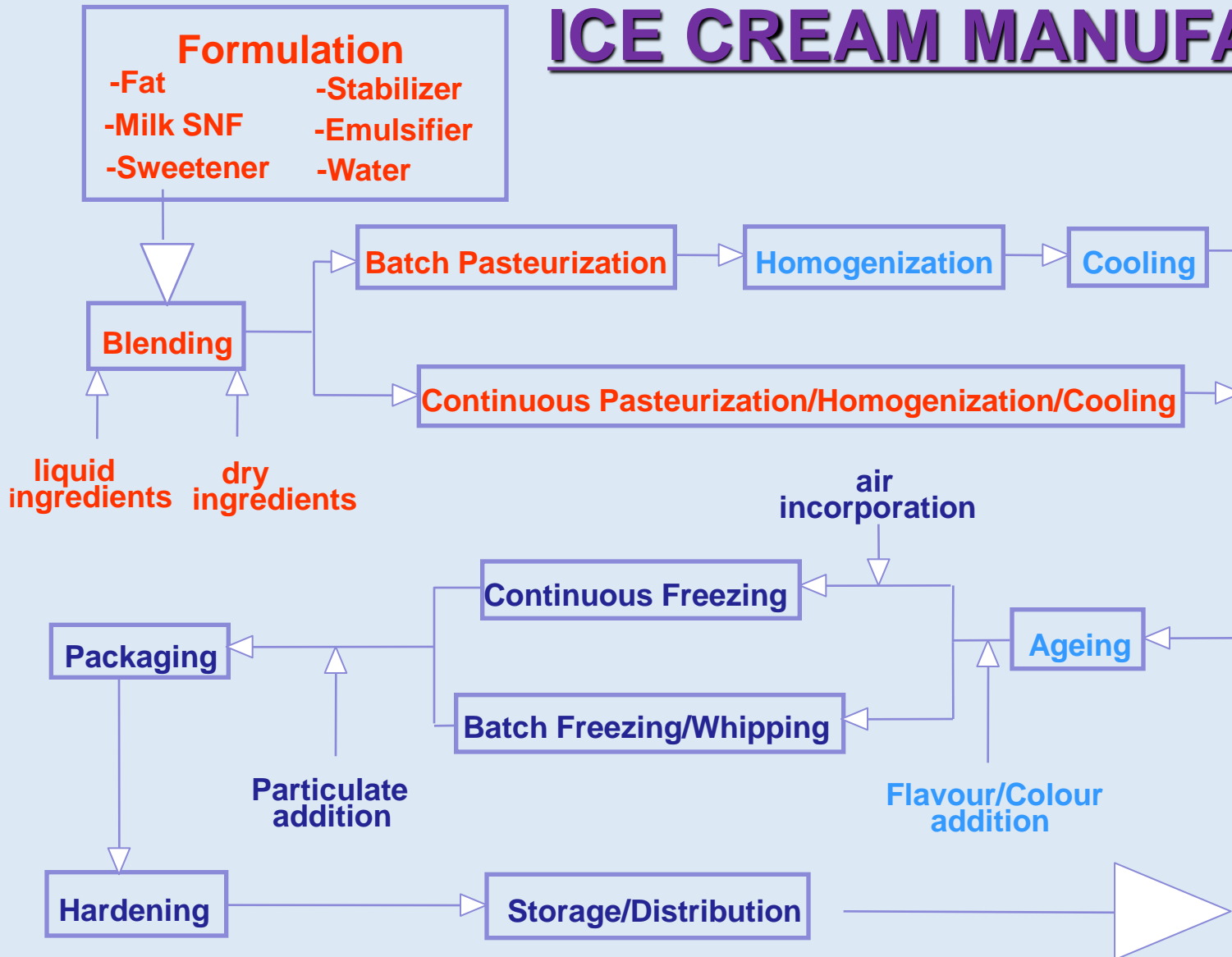
- Could be stabilizer/emulsifier blend, which is then added to all other ingredients that you source yourself
 - **Hot process**
- Could be stabilizer/emulsifier blend, sugars and milk powder, which is then added to cream and either milk (skim or whole) or water
 - **Hot or cold process**
- Could be stabilizer/emulsifier blend, sugars, milk powder and pre-emulsified fat (i.e., most or all the Total Solids ingredients), which is then added to milk (skim or whole) or water
 - **Cold process**

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ICE CREAM MANUFACTURE



Pasteurization

- **Batch : $\geq 69^{\circ}\text{C}$ (156° F) / ≥ 30 min.**
- **Kills pathogens if raw milk, cream or eggs are used; 'guarantee' of food safety**
- **Reduces total bacterial numbers**
- **Melts fat for proper dispersion, if solid fats are used**
- **Hydrates proteins & stabilizers, if dried ingredients are used**



Double boiler

- Over a gas hot plate
- 8-20 L



Steam Kettle

- 20-50 L

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Steam Jacketed Kettles



Tabletop Models

The power and flexibility you need at a size that makes sense - choose from a full range. Equipment stands can also be found within this category.

- [All Products](#)
- [Gas](#)
- [Electric](#)



Floor Models

23 models, available in gas or electric, a full range of capacities - Cleveland is the steam leader and known for quality, reliability and efficiency.

- [All Products](#)
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MIXPASTO 120/60



www.technogel.com



Mix pasteurization tanks (with "emulsification")

Gelato Ice Cream / Milk Pasteurizer



HIGH PERFORMANCE MIXER

Hydraulic jet sheer high speed mixer, achieve homogenization by strongly discompose solid, help improve pasteurizing and ageing. Short period homogenization could be programmed as request.

MIX-OUTLET VALVE

Integrated with humanity design, this stainless steel mix-out valve can control the mix-out speed accurately. guarantee hygiene and no residual of mix . Easy to discharge and clean, save labor.



RECORD PRINT (OPTIONAL)

Production time and temperature data print function.



ANTI-SLIPPING MAT

Anti-slipping mat provided, easy operation.



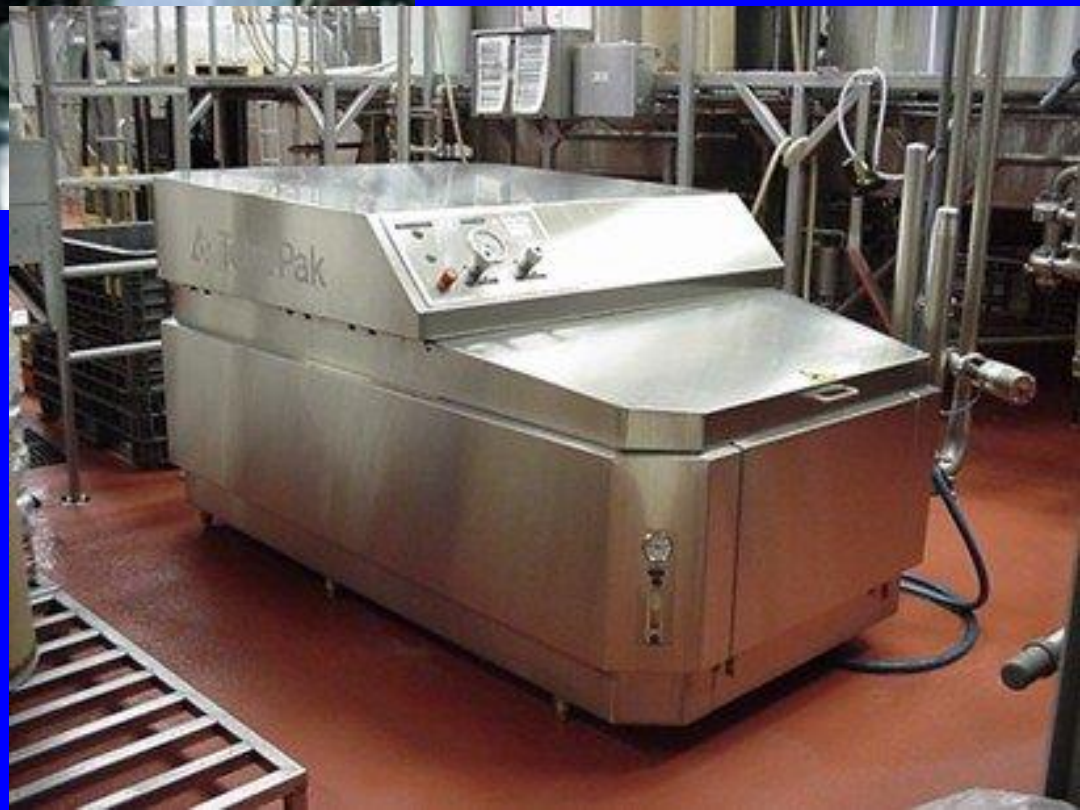
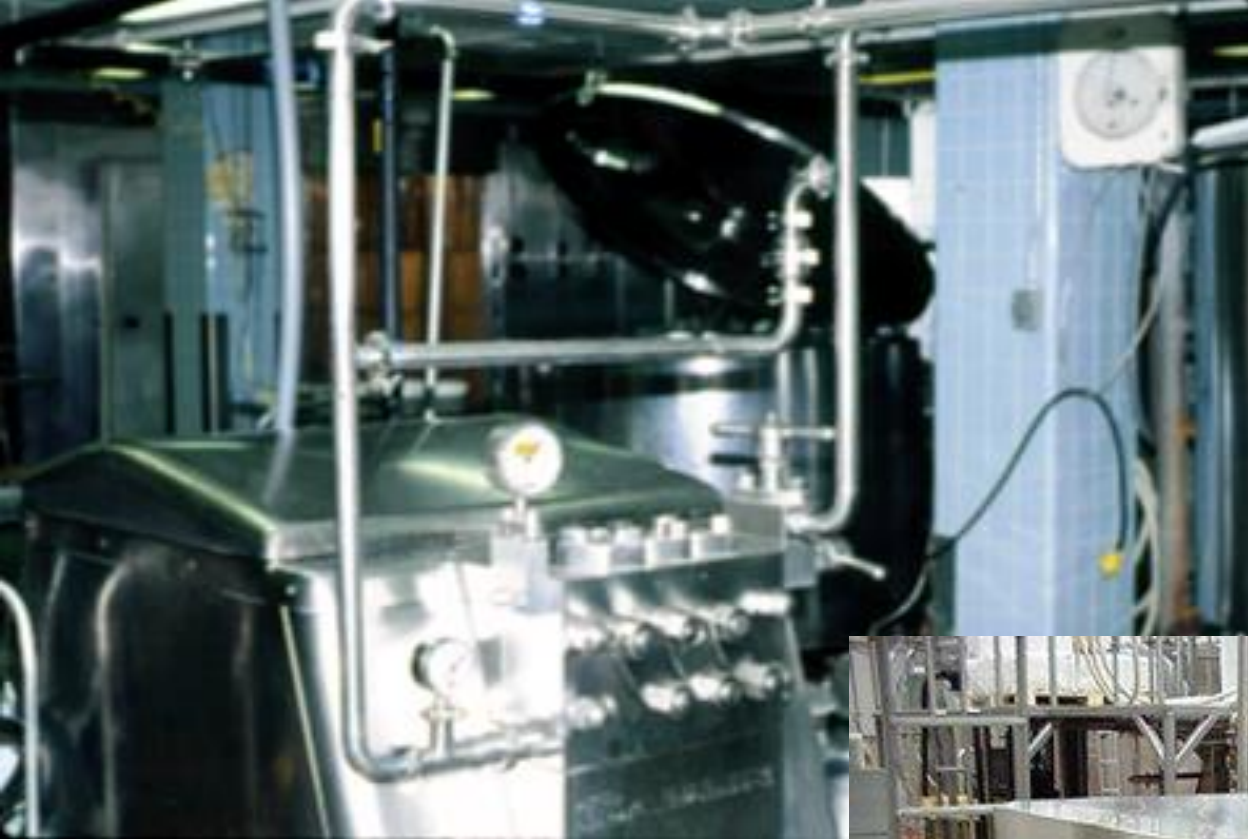
Mehen, China

Homogenization

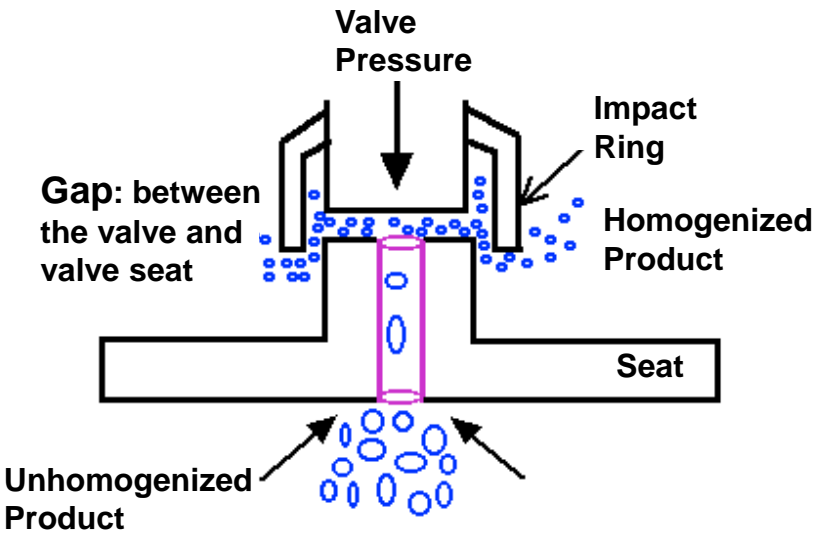
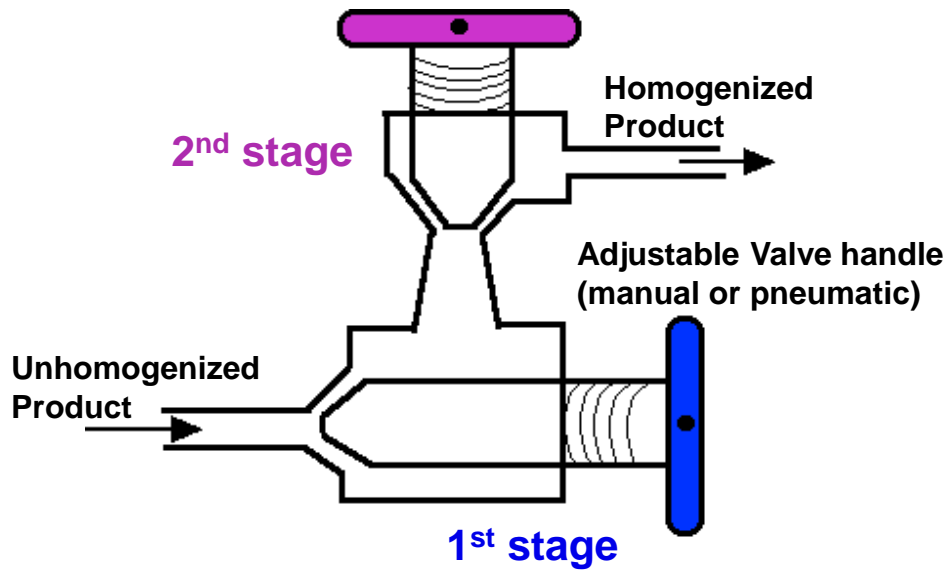
- **The purposes of homogenization of mix:**
 - **Reduces the size of fat globules from cream so they won't separate out during whipping**
 - **Makes possible the use of butter, frozen cream, solid non-dairy fats, etc.**
 - **In ice cream, helps to establish fat structure, which provides a smoother texture and slows down the melt (structural collapse) rate.**

Homogenization

- **Do you need to homogenize mix?**
 - Maybe not, if you are using fresh cream, are using “low-shear” batch freezing, and don’t have any meltdown or texture issues.
 - Homogenized cream? (Usually maximum 18-20% fat)
 - Gelato pasteurization machines or combination machines “emulsify” rather than homogenize (*i.e., not as efficient*), fine for cream, not for solid fats



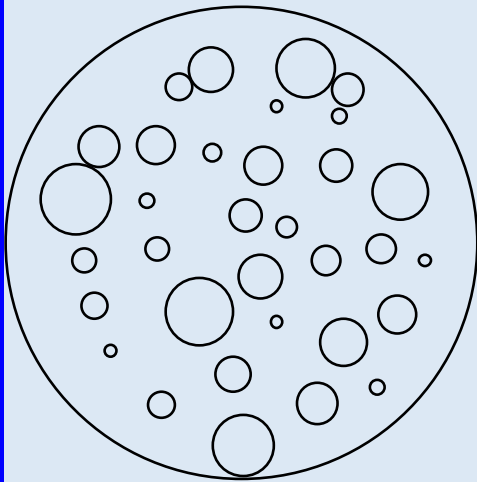
**Commercial dairy
homogenizers**



Homogenizing Valve

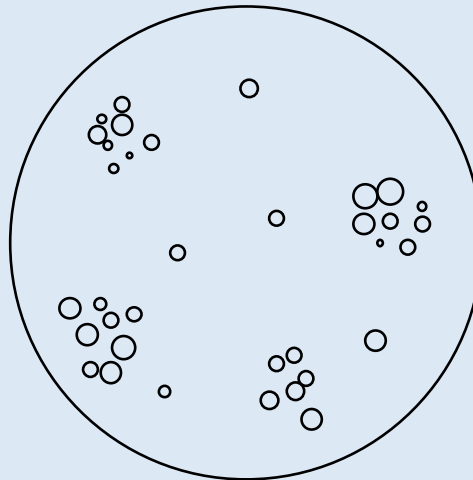
The Effects of 2-stage Homogenization on Fat Globule Size Distribution as Seen Under the Light Microscope

unhomogenized



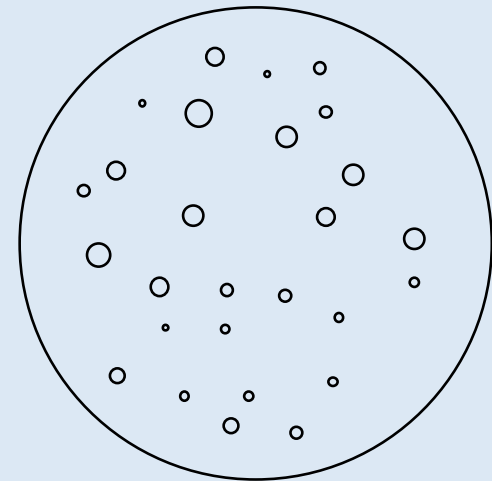
**mean 2 μm
range 1-10 μm**

**1-stage
(2500 psig)**



**mean 0.5 μm
range 0.2-2 μm
much clustering**

**2-stage
(2500/500 psig)**



**mean 0.5 μm
range 0.2-2 μm
no clustering**



**Mix processing plants
from Technogel, Hoyer,
etc.**

➤ **Large-scale**



AGETWIN 55+55/120+120



www.technogel.com



Mix ageing tanks

"Cold" Process Gelato Mix Manufacture

- **Gelato powders added to cream, milk or water (depending on composition of powder)**
 - **Good dispersion needed, implies high-shear blender, but not so much as to create too much foaming.**
 - **Ageing time required, suggested 2-4 hours at 4° C or lower, or as per instructions; in ageing tanks or could be as simple as pots in the refrigerator**

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Gelato Batch freezers

- **3-40 L**
- **Air or water cooled condensers**
- **Low dasher speeds**
- **10-20 minutes/batch to achieve -5 to -7° C draw temperature and 20-40% overrun**

Advantages

- **Small quantity; more flexibility**

Disadvantages

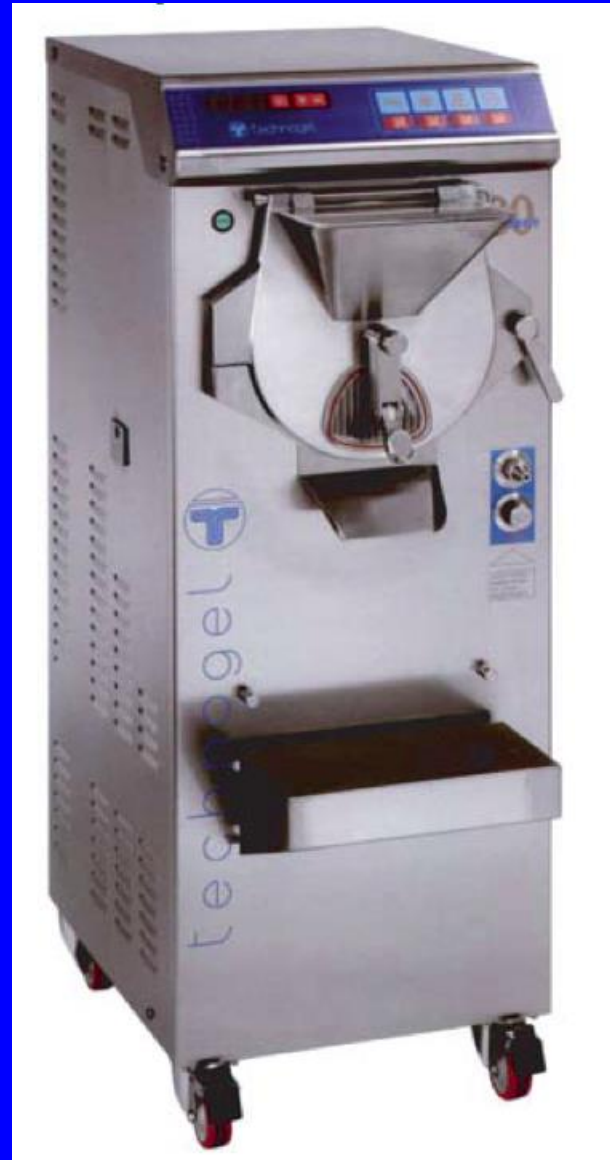
- **Limited quantity**
- **Incorporation of ripples and particulates can be difficult**
- **Hand packing**



Dasher and scraper blades in a batch ice cream freezer



Carpigiani 20 L



Technogel 40 L

New

MANTE

15-45

20-60

30-100



MANTECE 20



Technogel

Taylor Freezers



Model 220
20L barrel



Model C118
12L barrel
Automated operation



Model 104
3L barrel
Table-top



Emery Thompson 40 L



Saniserv 10 L



**Stoelting 25 L
with vertical
barrel**

MIXGEL 30E 50E



MIXGEL 30E



MIXGEL 50E

Technogel

➤ Combination machine

3IN1 LCD GENYO

TP3
TP4
TP5
TP7

COMBINATE



MOD

TP3 TP4 TP5 TP7

- Produzione oraria (Kg.)
- Hour production
- Production horaire

Kg. 10/30 Kg. 15/45 Kg. 20/65 Kg. 40/95

- Capacità vasca superiore (Lt.)
- Upper tank capacity
- Capacité de la cuve supérieure

Min. Lt. 2 Min. Lt. 2 Min. Lt. 2 Min. Lt. 2
Max. Lt. 14 Max. Lt. 14 Max. Lt. 14 Max. Lt. 14

- Capacità vasca inferiore (Lt.)
- Inferior tank capacity
- Capacité de la cuve inférieure

Min. Lt. 2 Min. Lt. 3 Min. Lt. 4 Min. Lt. 6
Max. Lt. 4 Max. Lt. 6 Max. Lt. 8 Max. Lt. 15



IceTech

➤ Combination machine

**Combo (Heat-freeze machine)
Pasteurizer+Batch freezer in one**

M5C 5+5 liter

M10C 10+10 liter

M15C 15+15 liter



Mehen

➤ Combination machine

Flavouring

- **Goal: Sufficient high-quality ingredients for good flavour and balance**
- **Traditional versus novel: need high turnover to keep product fresh**
- **Flavourings (liquid, concentrated), syrups, fruit purees, juice concentrates and nut pastes work best.**
- **Particulates and ripples: hand mixing during or after extraction.**

Ideal scenario is to make one white base mix and one chocolate base mix (with a combination of chocolate liquor and cocoa powder in the base) and add all flavourings to those at the desired concentrations. If that changes the composition of the base too much, depending on the type of flavouring added, then adjustments to the base for that flavour (or group of flavours) may be required. Do not, however, develop a *separate base mix for every flavour, that becomes too labour intensive.*

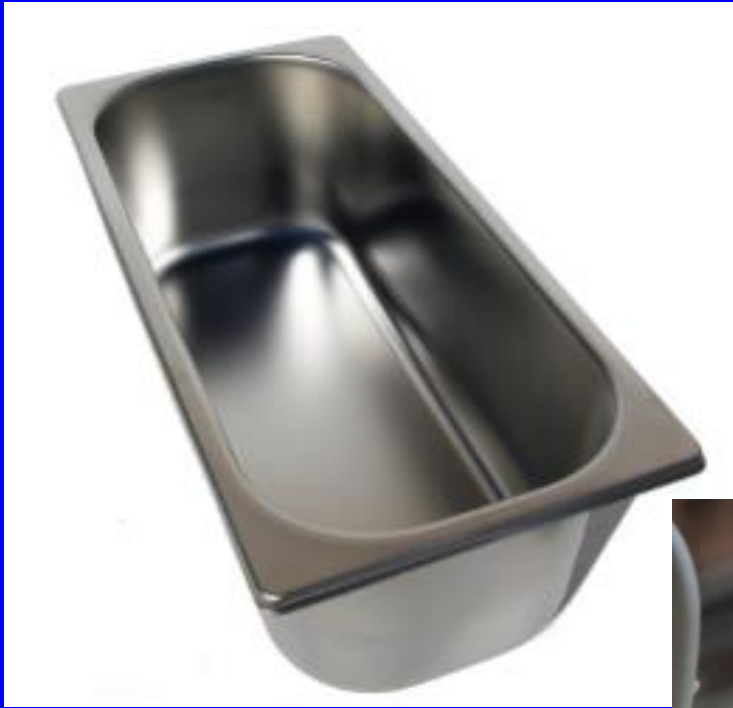
Classic Gelato Flavours

- Fior di latte / Crema (Unflavoured/ Egg Custard)
- Vanilla
- Crème Fraîche
- Caffè Espresso
- Stracciatella (Vanilla Chocolate Chip)
- Nocciola (Hazelnut)
- Gianduja (Chocolate Hazelnut Paste)
- Bacio (Chocolate Hazelnut Paste with Hazelnuts and Chocolate Chips)
- Pistachio
- Banana
- Black Tea
- Cocco (Coconut)
- Cannella (Cinnamon)
- Mandorla (Almond)
- Cardamom
- Amarena Cherry
- Tiramisu
- Mango
- Pineapple
- Cioccolato all'arancia (Chocolate orange)
- Cioccolato con Pepperoncini (Hot Pepper Chocolate)

Note: Usually also sorbetto's are included in a flavour line-up, sweetened fruit or syrup ices with stabilizer, no dairy components.

Packaging

- Manual with the spatula
- 5L napoli pan widely used



Decoration:

Waves (*"spatular"*),
toppings and garnishes



Hardening

- **Hardening requirements depend on storage life.**
- **If hardening required, the faster the freezing, the smaller the ice crystals and the smoother the texture. That typically implies both a hardening freezer and a storage freezer.**
- **Typical pattern:**
 - **fill pans from "batch" freezer at -5 to -7°C**
 - **rapid freeze in "hardening" freezer to -12 to -15°C**
 - **hold in "storage" freezer at -12 to -15°C**
 - **serve from "display" freezer at -10 to -12°C**



* If you can sell all the gelato "fresh", within a day or two.

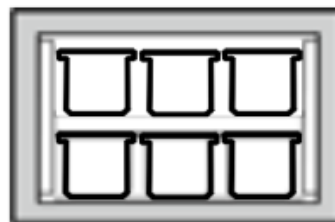
Hardening freezers



Very low temperature with air circulation fans, designed to remove heat. Residence time of a few hours only to achieve desired end-point temperature. If hardening is needed, then the faster the hardening rate, the smoother the texture of the ice cream (smaller ice crystal size).

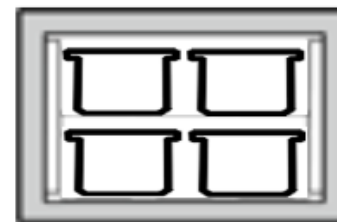
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**COOL SOLUTIONS
FOR PROFESSIONALS**



**CAPACITY IN
GELATO TUBS**
360x165x120mm

6



**CAPACITY IN
GELATO TUBS**
360x250x120mm

4

<http://www.italiangelato.com.au>



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MASTER ICE

Freezer specifically for the workshop, with static-RS or ventilated refrigeration-RV, for storage (static refrigeration version) and for hardening and storage (ventilated refrigeration version) of ice cream and frozen dessert products.

[More information](#)

Storage freezers



Designed to hold product at a specific temperature, when placed in the freezer at that temperature (typically lower than serving temperature). Not designed to remove heat from fresh-made product: freezing rate would be too slow. Can store gelato pans for hours-days.



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Display freezers (*"curb appeal"*)

Serving temperature. Shelf-life at this temperature is only 1-2 days. Product may need to be tempered, depending on where it is coming from (i.e., directly from batch freezer or from hardening or storage freezer).







gelatopro





OLIMPICA

pag.9

NEW



PAGODA ARIA

pag.16



PAGODA ICONA

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KALEIDO

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MITO POWER

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MILLENNIUM

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GELATO MIX

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B MIX

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ZERO

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HORIZON

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GELATO SHOW 2

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GELATO SUPER SHOW

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MY2014



MITO WINNER

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IL CARRETTINO

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IL GELATAIO

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NEW



PANAVISION

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NEW



CRISTAL TOWER

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MENTA
REFRESHING MINT GELATO
WITH DRIZZLES OF PURE
BELGIUM CHOCOLATE
DOLCE

PISTACCIO SICILIA
The purest form of pistaccio
you will ever taste, leaving a
wonderful smooth finish on
your Palate











Commercial Gelato





Hand filling of gelato
without and with ripple
(Technogel)





Continuous freezers

- **> 700L/h**
- **Off-site manufacturing**
- **Hardening/distribution**

What does it take to make good gelato-style ice cream?

- **Good quality ingredients and balanced formulations**
- **Highly desirable and high-quality flavours**
- **Rapid turnover, minimal shelf-life**

What can go wrong?

- **Coarse/icy textures**
- **Surface dehydration (*'freezer burn'*)**

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Questions and Discussion ??