

Introduction

- There are many application of centrifugal force in Dairy Industry:
 1. Skimming centrifuges (milk, whey, buttermilk, retentates)
 2. Standardization
 3. Clarification
 4. Separation of casein fines from whey
 5. Decanter centrifuges
 6. Quark/chhaka separators
 7. Removal of bacteria

Bactofugation principle

- Bactofugation is a process in which specially designed centrifuge called Bactofuge is used to separate micro-organisms from milk

$$v = r\omega^2(\rho_m - \rho_p) d^2/18\eta_p$$

v = sedimentation velocity of a bacterial particle, r = radius of rotation, ω = angular velocity, d = diameter of the particle, ρ_m = density of micro-organism, ρ_p = density of milk plasma, η_p = viscosity of milk plasma

- Bacteria especially the heat-resistant spores have a significantly higher density than the milk

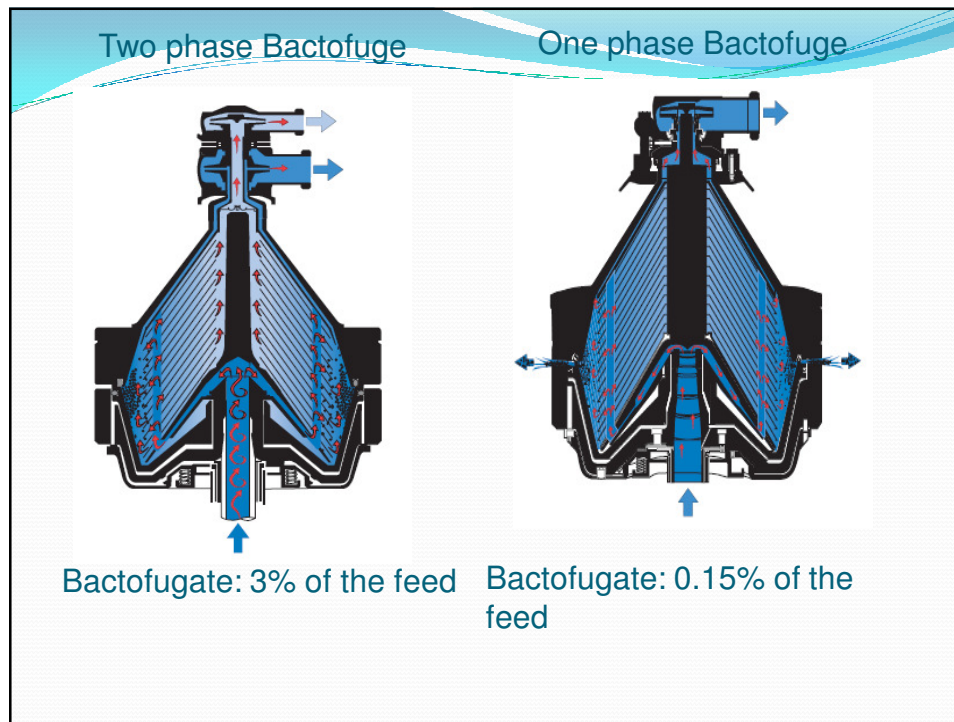
Component	Density (g/cc)
Milk	1.030-1.032
Skimmed milk	1.035-1.037
Bacteria	1.070-1.130
Heat-resistant spores	1.320

Bactofugation

- In the bactofuge, the milk containing bacteria and spores is pushed outwards and collected outside the bactofuge
- Bactofuge: Centrifugal machine used for bactofugation
- Bactofugate: Bacterial concentrate and spores collected outwards to the periphery of the bowl
- Bactofugated milk: From which bacteria have been removed
- Bactofugate has always high dry matter than the feed

Bactofugation

- There are two types of bactofuge:
 1. The **two-phase** Bactofuge has two outlets at the top: one for continuous discharge of bacteria concentrate (bactofugate) via a special top disc, and one for the bacteria-reduced phase – the bactofugated milk
 2. The **one-phase** Bactofuge has only one outlet at the top of the bowl for the bacteria-reduced milk. The bactofugate is collected in a sludgespace at the periphery of the bowl and discharged at pre-set intervals

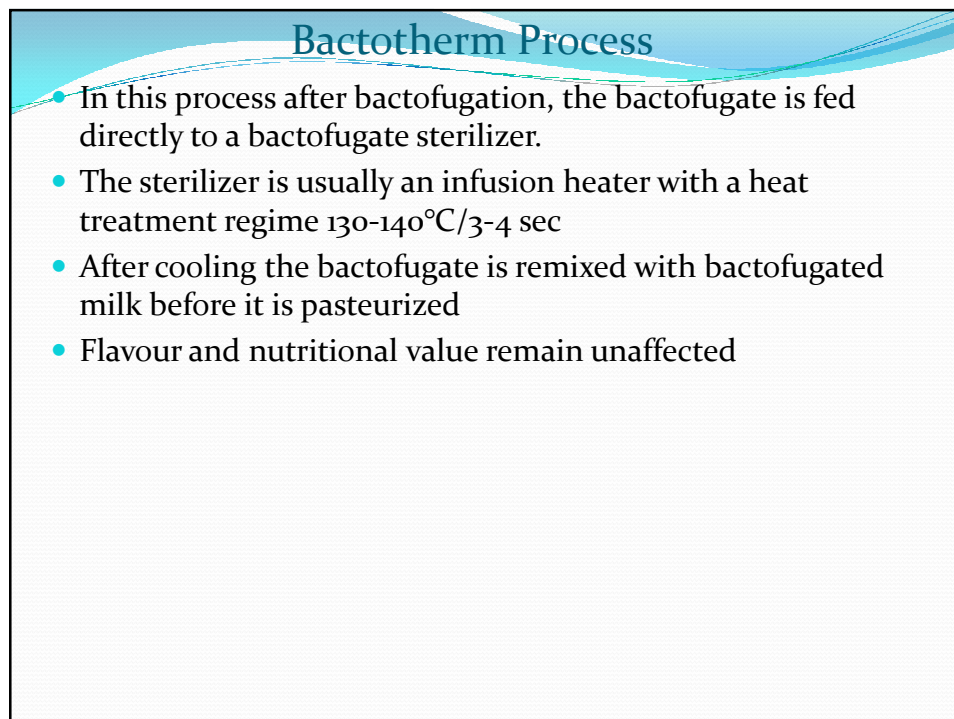
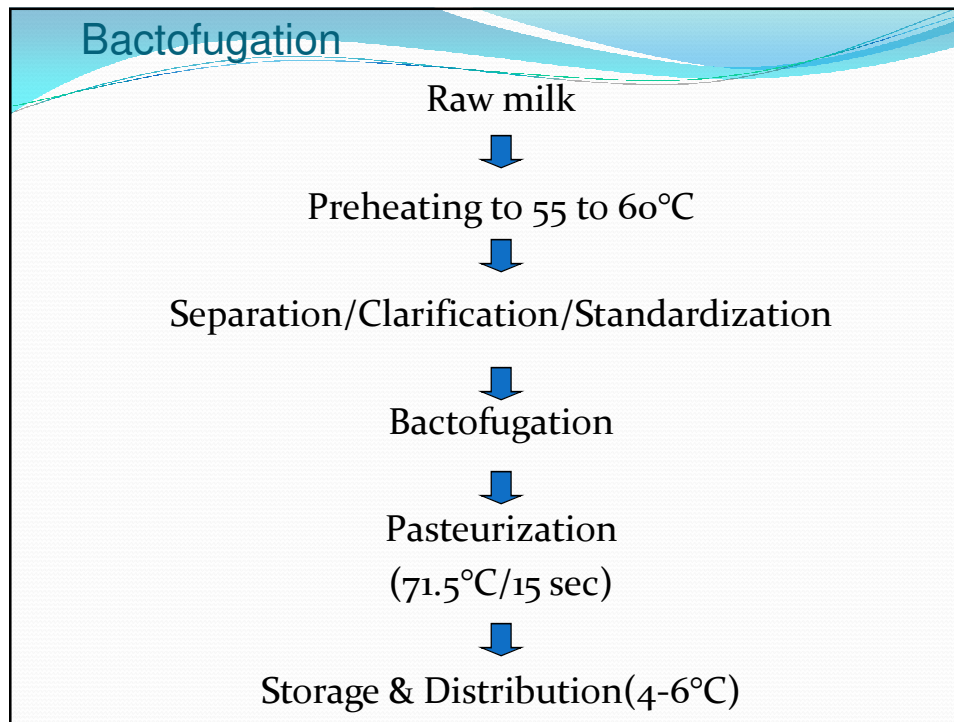


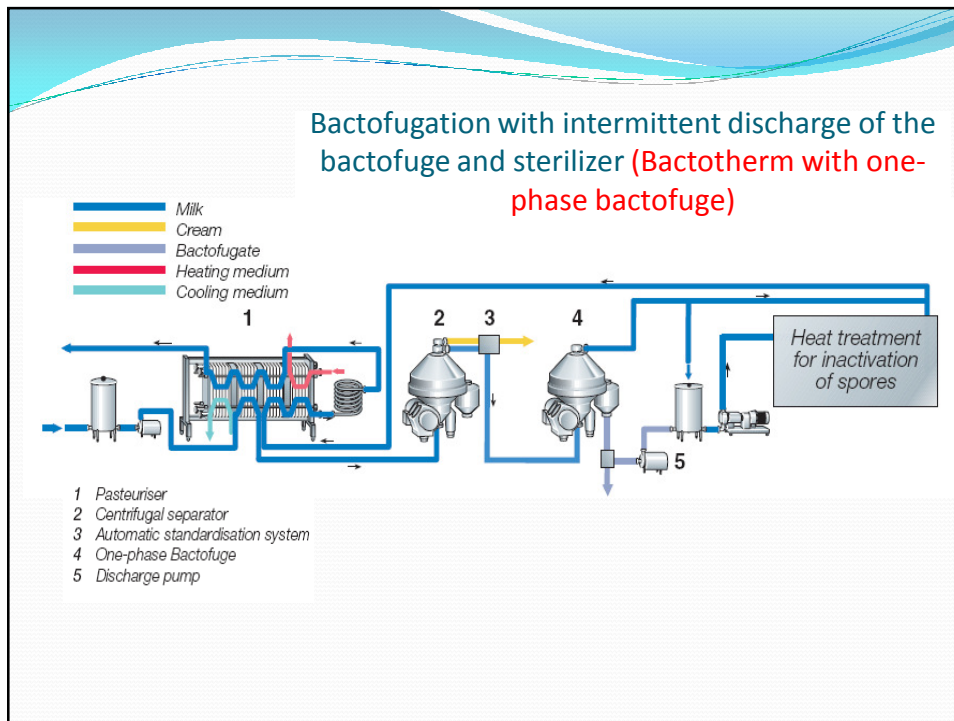
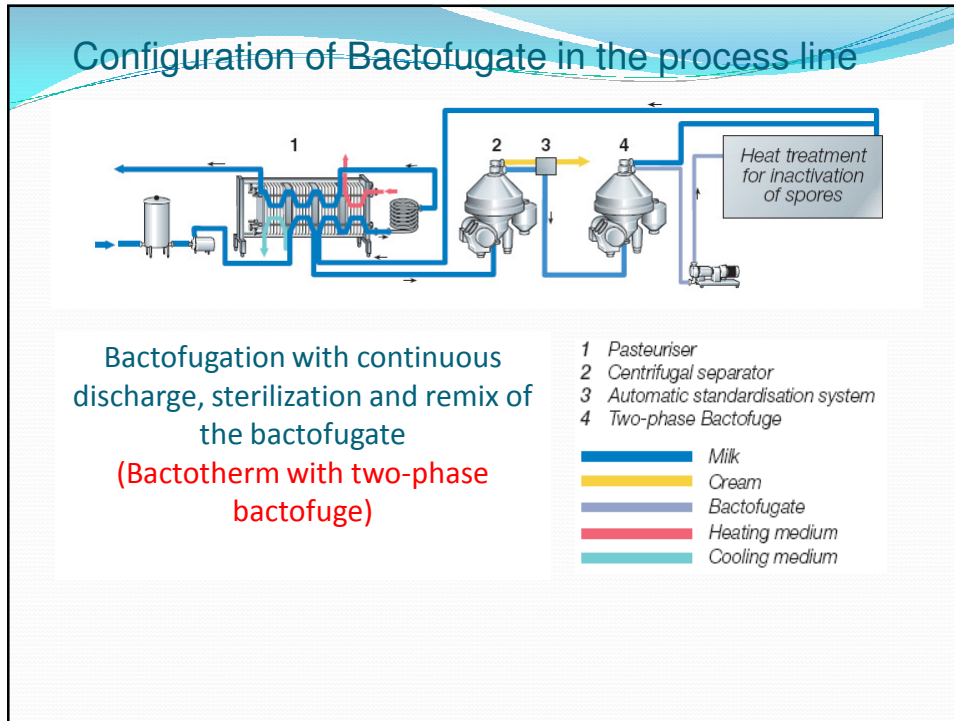
Bacteria removal by Bactofugation

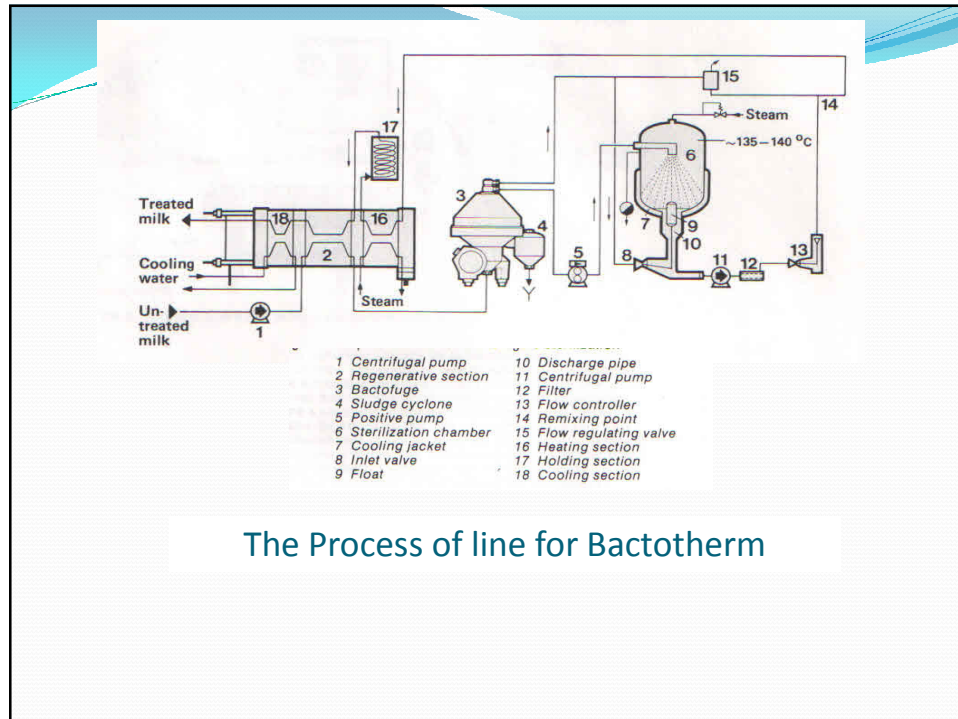
- Bactofugation, employs forces 5,000-10,000 g, is installed down stream in series to cream separation because heavier fraction i.e., skimmed milk contains the majority of spores and bacteria
- Bactofuge reduces Approx. 98% of anaerobic spores, 95 % aerobic spores and 93% lactobacilli

Count	Reduction in count (%)	
	Pasteurized milk	Pasteurization after bactofugation
Total bacterial count	99.17	99.83
Aerobic spore count	13.00	95.00
Anarobic spore count	0.0	98.00
Leucocytes		40.00

- The process is only supplementary to pasteurization & it is still necessary to destroy bacteria not removed by bactofugation







Application of bactofugation

- Cheese milk: Bacteria belonging to the genus *Clostridium* – anaerobic spore-forming bacteria – are among the most feared by cheesemakers, as they can cause late blowing of cheese, even if present in small numbers. This is why cheese milk is bactofugated.
- Whey, if intended for production of whey protein concentrate as an ingredient in infant formulae, should be bactofuged after recovery of fines and fat
- For the manufacture of milk powders intended for infant formula
- Market milk: Extended storage-life 1-2 days

