



**Condensed Whey, Types  
and Their Specification,  
Manufacturing Techniques**

- **Whey is a highly perishable and its use in liquid form is limited to only small quantities.**
- **Preserved by removing its water and so concentration and drying of whey assumes a special significance.**
- **Membrane technology: Concentrate whey using reverse osmosis (RO) to 28% TS retaining all functional properties of whey proteins.**
- **Further processing done for manufacture of whey powder, whey protein powder, demineralised whey powder and lactose.**



# Whey concentration: Objectives



**Volume reduction for transport to other processing facilities**

**Pre-concentration for drying into whey powder**

**Manufacture of condensed whey: plain or sweetened**

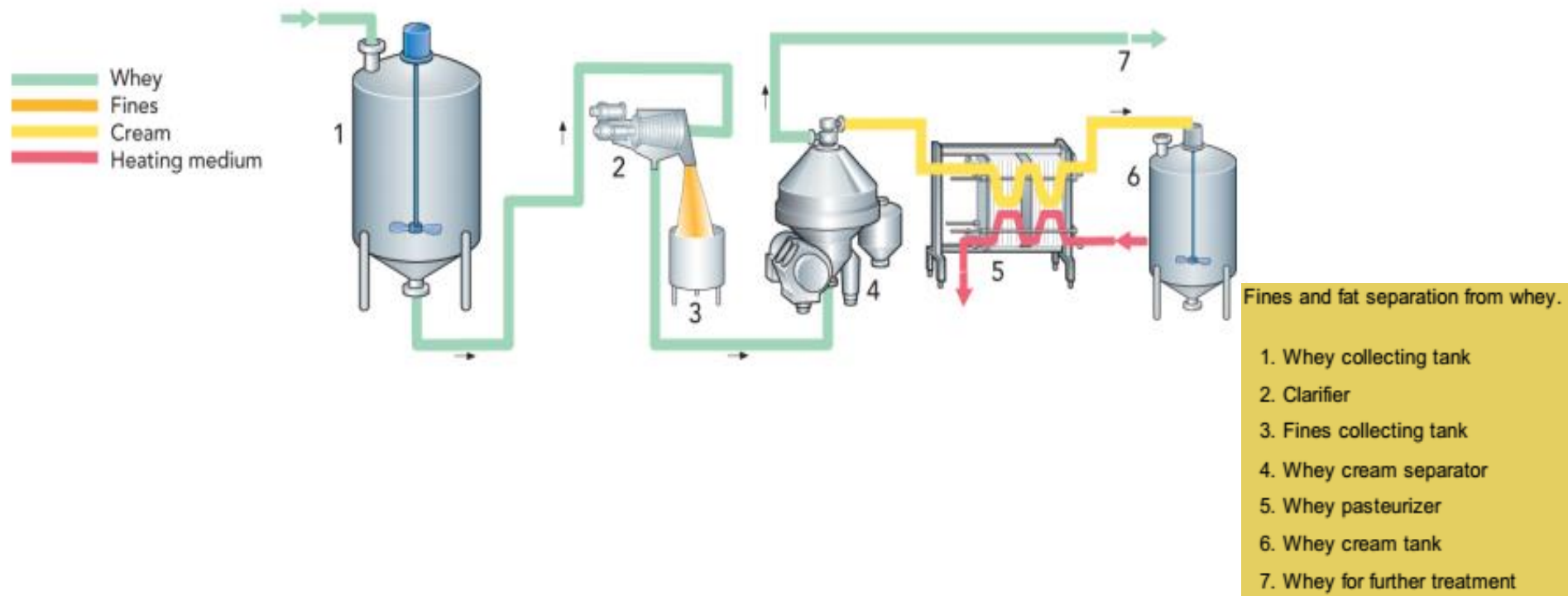
## **Production of Concentrated Whey**

### **Clarification:**

- **Whey always has curd fines, which confer serious risk of blocking heat exchangers channels or fouling RO membranes.**
- **Curd fines adversely affect solubility properties and flavour of end product.**
- **Curd fines usually removed by combination of treatments (settling, screening and clarification).**
- **For large-scale operation, it is usual to employ self-discharging clarifier with an enlarged solid -holding capacity.**
- **Hydrocyclones used for recovering curd fines from whey.**

## Separation and pasteurization:

- For flavour stability in concentrated whey, whey is separated to remove fat.
- It is followed by whey pasteurization for optimum microbiological quality, to inactivate rennet and ensure storage stability.
- Stored at 5 C till concentration and drying



Energy per tonne of whey	Efficient evaporation				RO Concentration		
	1 Stage	2 stage	7 stage	MVR	12%TS	18%TS	28%TS
Steam (tonnes)	0.62	0.14	0.09	0.03	-	-	-
Electricity (kWh)	0	3	3	25	3.6	8.8	9.6
Total equivalent (kWh)	387	90	60	44	3.6	8.8	9.6
Equivalent energy	192	46	31	35	3.6	8.8	9.6

Initial total solid in whey = 6%

MVR - Mechanical vapour recompression

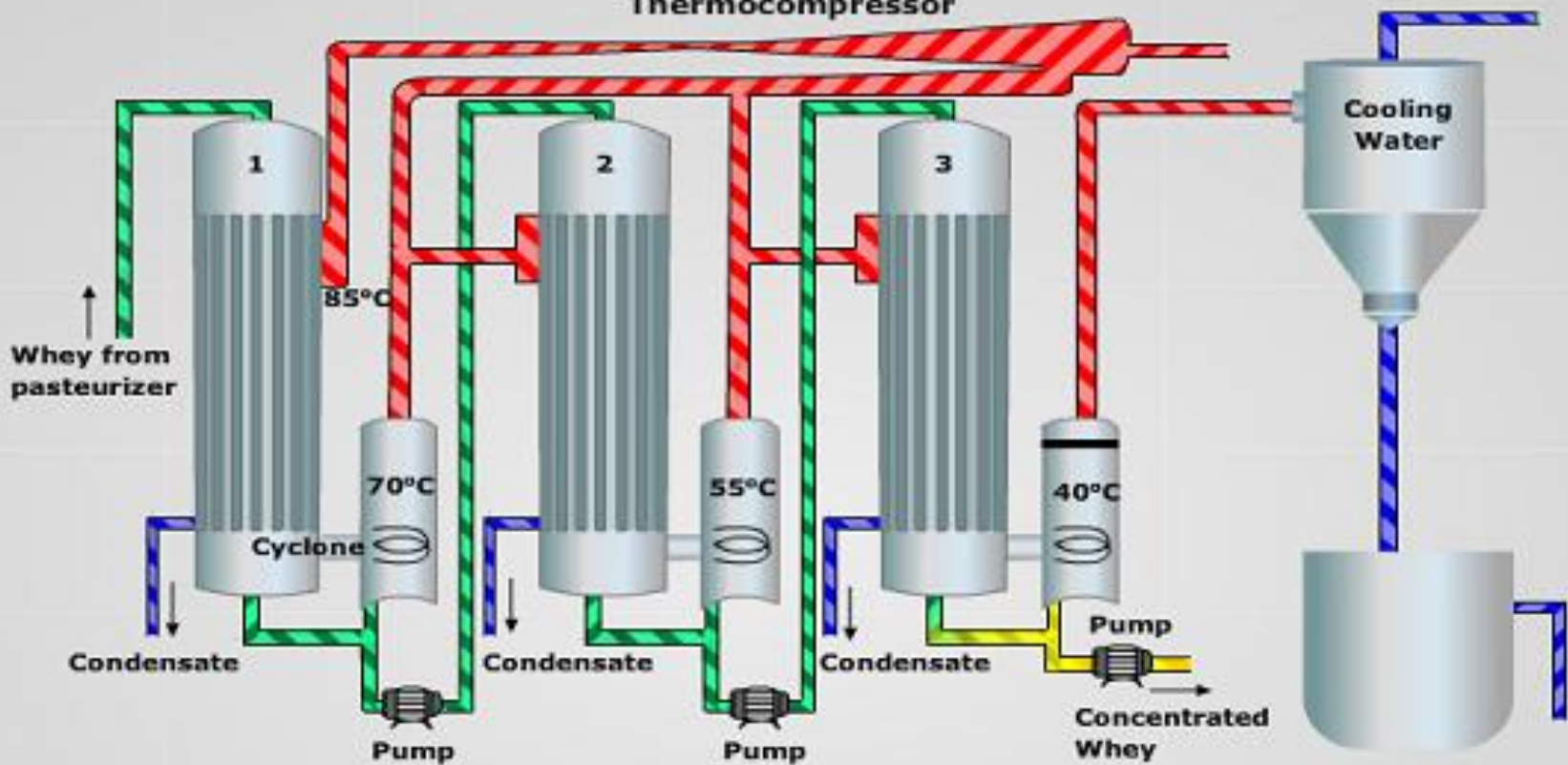
TS - Total solids

## Concentration :

- Clarified and defatted whey concentrated economically with integration of RO for pre-concentration and multi-effect evaporator.
- **Difference between evaporation and RO:** Evaporation removes water by application of heat, which turns water into steam followed by condensation of vapour, whereas RO is simple filtration process requiring mechanical energy.
- RO takes place at low temperatures and consumes less energy.
- However, RO concentration is limited by osmotic pressure of concentrated solution and for whey, maximum level is approx. 25-28% TS.
- TS levels in RO concentration are 21% for sweet whey and 17% for acid whey.

- **Evaporation is only limited by solubility of solutes at evaporation temperature and TS level of 60-65% is obtained.**
- **Modern concentration installation consists of 5-7 stages evaporation system. By adding more stages to evaporator, specific steam consumption is reduced.**
- **A seven-stage plant consumes 50% less steam than three-stage plant.**
- **Acid whey foams less during evaporation in evaporators than does sweet whey. When sweet whey is difficult to manage in evaporator, a small quantity of acid or a little fat may be added to break the foam.**
- **There is spontaneous lactose crystallization in vapour separator while concentrating whey to levels >55% TS.**

### Thermocompressor



Whey from pasteurizer

Condensate

Pump

Condensate

Pump

Condensate

Pump

Concentrated Whey

Cooling Water

- Red Steam
- Green Whey
- Blue Water
- Yellow Concentrated Whey

Concentration of whey with three effect evaporator



## Plain Condensed Whey

- Prepared by pasteurizing whey and drawing hot liquid into vacuum pan.
- Desirable degree of concentration of plain condensed whey is 35 -50% total solids.
- Whey condensed to higher solids content (>55% TS) forms a gel after cooling (**not recommended to be used in any food or feed products due to its coarser texture and low solubility**).
- Plain condensed whey is also prepared as an intermediate product for whey powder making. Whey is concentrated to about 40-60% solids and lactose pre-crystallized before drying.

- For lactose crystallization, concentrated whey is cooled rapidly to 30°C using flash coolers and seeded with fine-grained  $\alpha$ -lactose monohydrate crystals (crystal size of approximately 10  $\mu$ ) at level of about 1 kg per tonne of concentrate.
- Seeded mixture is stirred for 1-3 h in a crystallization tank at 30°C for mass and forced crystallization of lactose to size <25  $\mu$ .
- Lactose crystallization may be continued by cooling up to 10 C for higher level of lactose crystallization.

## Sweetened Condensed Whey

- Sweet cheese whey is mixed with sugar equal to wt. of solids in whey (about 6.7 kg sugar for 100 kg whey).
- Mixture is concentrated using multistage evaporators to at least 76% TS.
- Specific gravity of SCW at 50°C is 1.360.
- For controlled lactose crystallization that is necessary for producing smooth texture product, concentrate is then subjected to lactose crystallization by cooling up to 10 C.
- Lactose crystal size must be kept  $<25\ \mu$  to produce smooth rather than sandy texture.



- Packed in barrels or cans.
- Product does not require any refrigeration for storage.
- Sweetened condensed whey is salty and has characteristic whey flavour.
- Desalting of original whey by RO can improve flavour and utilization in certain foods.
- Sweetened condensed whey darkens and thickens in storage.
- Must be utilized within one year of production.

