

A GUIDE TO A PRODUCTION UNIT OF CASEIN AND CASEINATES

1 - PRESENTATION

1-1 Nature of Activity

Powdered casein and caseinates (that is to say soluble casein salts) are produced from pasteurized skim milk. The process consists of acidifying the milk, thus causing the casein to rise so that it can then be purified and dried.

The skim milk used is a by-product of butter production. It contains (per liter) an average of :

50 g of lactose

30 g of casein

5 g of soluble proteins

1 g of other dry materials (salts)

The skim milk can be consumed as such or after desiccation.

We can also extract casein (which is a protein).

The casein and the caseinates are used principally as nutritional additives (side dishes, cold cuts, ice cream, dietary products, dairy products, substitution products) and in paper manufacturing.

1-2 Alternatives

* Finished Products :

Rennet casein, acidic casein, and lactic casein are manufactured, according to the method of flocculation used : in the last two cases, the finished products are identical, whereas for the rennet casein there is a specific market.

There is a variety of qualities sold depending on the granulometry, the purity, and the bacteriological quality.

Special caseins (with low viscosity...) and coprecipitates can also be manufactured. The caseinates obtained by dissolving caseins in an alkaline solution gives the industry a soluble product.

Sodium caseinates and calcium are also sometimes produced.

*** Technology:**

Today, only units that produce continuously are constructed :

- Acidic casein, lactic casein, or rennet casein : with acidic casein, the acidification is rapid and achieved in a mixer. Lactic casein and rennet casein require fermentation tanks.

In mixed units, the fermentation tanks can be adjoined to existing units.

- The process can end with dried casein, with caseinates retransformed from dried casein (outside the period of full production), or with the direct use of non-dried casein to produce caseinate.

- The manufacturing of caseinates can occur :

- . from curd, by adding soda to a tank : it must be done at a low concentration and dried with a spray dryer. This is beneficial if an atomizer is used, but can be cumbersome and may require redilution of the casein if working out of season and using dried casein;

- . from casein pre-dried on a fluidized bed, or dried casein, using extrusion cooking followed by grinding dryers : a unit that is more flexible, more compact, and energy efficient (one grinding dryer may be used for both the casein and the caseinate).

- Finally, machinery used for the valorization of milk serum can be adjoined to the casein factory.

1-3 Types of Possible Units

Today, casein factories process between 10,000 and 50,000 l of milk per hour.

The description of 3 units of casein production is as follows :

Unit A : average unit of 25,000 l of milk per hour with production of caseinate.

Unit B : unit of 10,000 l of milk per hour with production of caseinate.

Unit C : unit of 10,000 l of milk per hour without production of caseinate.

2 - TECHNICO-ECONOMIC GUIDE

2-1 Description of the Unit

2-1-1 Finished Products

LINE CAPACITY	A 25 000 l/hr	B 10 000 l/hr	C 10 000 l/hr
Product	50% caseins 50% caseinates	50% caseins 50% caseinates	caseins
Packaging	- Sacks of 25 and 50 Kg - containers of 1 t (export)	Same as A	Same as A
Production - daily - annual	15 t 4000 t	6 t 1600 t	6 t 1400 t

The yearly production will depend on the availability of milk : we have estimated 8 months of work in 3 groups for the casein and 9 months of work in 3 groups for the caseinates (20 hours per day of production).

2-1-2 Technological Choices

UNIT OPERATIONS	TECHNOLOGICAL OPTIONS	SOLUTIONS		
		A (25 000 l/h)	B (10 000 l/h)	C (10 000 l/h)
Mix-acidification	- Acid : mixer - Rennet : fermentation tank	mixed	mixed	mixed
Heating	- Vapour injection - Direct heating by resistance - Indirect heating on heat exchangers	vapour	vapour	vapour
Coagulation	- Discontinuous in tanks - Continuous in tubes	tubes	tubes	tube
Separation of serum	- Reclined strainer - Centrifugal decanter - Discontinuous in successive tanks	strainers	strainers	strainers
Cleaning	- Continuous in cleaning tower	Cleaning tower	Cleaning tower	Cleaning tower
Wringing	- Centrifugal decanter - Press (cylinders, screw...)	Centrifugal decanter	Centrifugal decanter	Centrifugal decanter
Casein formation	- High concentration : from predried casein on a fluidized bed, by extrusion or dried casein extruded by adding water - Low concentration : from pressed curd by adding soda to tank	High concentration	High concentration	-
Drying	- Casein : crush dried or on fluidized bed - Caseinate : crush dried or spray dried	Fluidized bed Crush dryer	Crush dryer	Fluidized bed
Packaging	- Hopper and automatic or manual packaging	automatic	automatic	automatic

2-2 Economic Analysis

2-2-1 Investments

Equipment	OPTION A	OPTION B	OPTION C
	FOB Price US \$	FOB Price US \$	FOB Price US \$
- Complete line of casein production	\$ 1,6 to 2,3 M	\$1 to 1,3 M	\$ 1 to 1,3 M
- Caseinate production	\$ 0,4 to 0,6 M	\$ 0,3 to 0,5 M	-
- System of cleaning in place	\$ 0,3 to 0,6 M	\$ 0,25 to 0,5 M	\$ 0,25 to 0,5 M
Total material	\$ 2,3 to 3,5 M	\$ 1,55 to 2,3 M	\$ 1,25 to 1,8 M
Building			
- Building	600 m2	500 m2	400 m2
- Land	3000 m2	2000 m2	2000 m2
Other investments			
- water	150 m3/hr	60 m3/hr	60 m3/hr
- vapour (maximum cost)	2,5 t/hr	1 t/hr	1 t/hr
- electrical power	1200 kw	500 kw	300 kw
- storage of milk (1 day)	500 m3	200 m3	200 m3
- supply of natural gas (or fuel) for the dryer	250 m3/hr	100 m3/hr	100 m3/hr
- supply of compressed air	125 m3/hr	50 m3/hr	50 m3/hr
Total investment	\$ 4 million	\$ 3 million	\$ 2,5 million

2-2-2 Functioning

	A	B	C
Labour			
- Production (qualified personnel)	1 x 3	1 x 3	1 x 3
- Warehouse personnel	2	1	1
- Laboratory	Time-sharing personnel		
- Workshop chief	Time-sharing personnel		
Annual consumption			
- Milk	130 000 m3	50 000 m3	45 000 m3
- vapour	10 000 t	3500 t	3000 t
- natural gas	1.5 000 000 m3	6 000 000 m3	5 000 000 m3
- electricity	4 000 000 kwh	1.6 000 000 kwh	1.5 000 000 kwh
- soda (or lime)	80 to 100 t	30 to 40 t	-

3 - KEY FACTORS TO THE PROJECT'S SUCCESS

3-1 Supply

Such a project is committed to the valorization of milk : a casein unit should not be considered without a sufficient supply of skim milk. This means the existence of the butter, cream and cheese industry.

Given the competitive nature of the market, an essential factor in the success of a casein factory is the price of skim milk.

The length of the work season is determined by the seasonality of milk production. The casein yield varies according to the quality of the milk and the process it undergoes : it is essential to have good control of the supply system (1 to 2 days of storage maximum to prevent the risk of proteolization).

3-2 Technology and Equipment

This type of unit uses a variety of robust and often quite sophisticated equipment (centrifugal decanters, extruders). This necessitates a maintenance workshop, in conjunction with a milk factory.

3-3 Personnel

The unit needs only one person (in 3 shifts) to watch the machinery (automatic bagger). The individual must be qualified and must undergo very specific training (we have assumed that the casein factory is installed as an annex to a milk factory that will handle administrative services).

3-4 Quality Control

The following should be analysed regularly :

- dry extract of the casein/caseinates,
- uncontrolled acidity of the casein/caseinates,
- bacteriologic quality of the casein/caseinates.

A small control laboratory is necessary.

3-5 Distribution and Commercialization

Casein is an intermediary product sold by specialists who are familiar with the technical qualities required by industrial clients : a production unit can either sell its products according to specialized international needs, or find a local market (traditional food industry or other specific demands like protein-filled biscuits made for lactose-intolerant individuals).

3-6 Financing

Casein is a dry product that travels well, and is sold with low marginability. The expenses can vary extensively depending on the level of automation, and the method of marketing. Foresee financing of an adapted stock of finished products.

3-7 Other Specific Problems

- Heavy consumption of water to produce the casein : 0.6 to 0.8 liters of water per liter of milk processed.
- Plan for the processing of the serum : spreading or valorization.

4 - INDUCED ACTIVITIES

This project is directly linked to the presence of a milk fat (butter, cream, cheese...) extraction workshop that will produce the necessary skim milk.

- It will supply the local food industry.

The valorization of serum can allow :

- the production of lactose,
- the production of alcohol from fermentation,
- the production of livestock fodder.