

WHEY CONCENTRATOR with COLD EVAPORATION

As in those countries where the environmental aspects are always matters on the agenda, also in Italy the problem related to the employment of the cheese dairy whey has become a discussion argument that gets the interest and attention for its solution.

That is due to the fact that today its employment for the feeding of the pigs has decreased a lot thanks to the balanced diet used for livestock.

Moreover, due to the contamination matter, it is not more possible to discharge the whey anywhere. It is necessary to deliver it to companies specialized in its concentration, division and drying as consequence of high transport costs and very low economic proceeds.

Considering to all these topics and the great experience in the production of low temperature concentrators for grape must in the oenological field, Reda S.p.A. has designed a modular equipment suitable for the thermal concentration of whey, with a concentration effect of 5 times: that in order to reduce the transport costs and give to the whey division and drying companies a first quality intermediate product. This has a high value and allows to amortize, during an average time of four years, the due investment for installation of the concentrator.

The plant is composed by an evaporation equipment in three effects that works with a maximum temperature of 65/70°C, obtained by means of heating with hot water at 70/75°C, in the first effect, where a reduced mass of whey in strong recirculation evaporates to this temperature under vacuum, with a quick replacement of the product and, for this reason, with a minimum thermal damage of the whey-proteins.

The strong speed of the flow, the low temperature of the whey under concentration and of the heating water, and besides, the low temperature difference between the two fluids (dT of the sides), allow a long production autonomy, without problems of scale due to the high temperature of the heating steam that occur in other types of similar plants.

The second effect works at 45/50°C using the heat coming from the condensation of the steam generated in the first effect.

In the third effect the concentration temperature is of 35/40°C and the condensation of the steam is carried out by tower water at 25/30°C.

To restore the water necessary to the evaporating tower it is foreseen the use of a part of the evaporated water in the concentrator itself: in such way that the total water consumption is very reduced.

The evaporated and discharged water has a very low value of B.O.D. (Biochemical Oxygen Demand) and C.O.D. (Chemical Oxygen Demand) which allow its use for other necessities (for example first CIP rinses) and to discharge it without passing through the purification plant.

Other characteristics of the plant:

- Compact construction with maximum height of 4 meters, which allows the assembling of the plant and testing of the same in the workshop with remarkable reduction of the times for installation and start-up by the Client.
- Total recovery of the product inside the plant at end production.
- The plant has its own CIP with automatic control of phases, temperatures, concentration; CIP is also needed to the evaporating tower, integrant part of the plant carried out to support the temperature of 80°C.
- The final concentration of the whey is controlled by means of a refract-meter that, in function of its data, regulates the capacity of the extraction pump of the concentrated.

- The plant is completely automatic controlled by a PLC with supervision that allows to the operator to control all the process phases, temperatures, capacities, concentration, with the possibility to change these parameters according to the needs.
Alarms and production diagrams are recorded and filed in the memory of the Operator Panel and can be transferred to a centralized supervision system of the company.
- The plant needs a minimum maintenance, mainly based in the periodic replace of the gaskets of valves, connections, pumps.
- Concerning to the energy consumption (*) being the plant in 3 effects, each kg. of steam can evaporate 3 kgs. of water.
In Italy the cost of gas is 0.34 USD/m³ and electric power of 0.14 USD/kwh: so the energetic cost to evaporate 1 kg. of water is of USD 0.013.

(*) The plant we considered is a plant that can process about 62,500 daily liters of whey (10 working hours), with a hourly capacity of 6,250 liters: 5,000 l/h of evaporated water and 1,250 l/h of concentrated. The plant is installed in a cheese dairy in the South of Italy and is working, since last year, by processing whey for fresh mozzarella.
Thanks to this plant we can give all the constructive, consumption, performance and analysis data of the obtained product.

The plant is composed of:

- **Balance tank**
With max and min. level feelers.
- **Centrifugal pump**
For recirculation of whey and cleanings.
- **No.3 evaporation chambers**
Cylindrical with conical bottom and distributor to separate liquids and steam.
Level feelers for the control of charge and discharge valves. Complete with steam traps and centrifugal pumps suitable for a quick product recirculation and to work with concentrated products and advanced vacuum.
- **Vacuum production system**
Made up of no.3 pumps for the vacuum production up to 30 mbar, for the evacuation of water evaporated/condensated and used for the cleaning solutions during CIP
Moreover it is foreseen a buffer tank for the separation of water/gas and a pump to evacuate the evaporated water from the buffer tank.
- **Hot water producer**
Complete of water/steam heat-exchanger, hot water pump for the first effect.
- **No.2 Plate heat-exchangers**
One is to heat the whey at 65/70°C by means of hot water and one to cool the concentrated from 30°C up to 10°C.
- **Electronic Refract-meter**
To measure the concentration of the whey and regulate in automatic the capacity of the outlet pump.
- **Board of pneumatic valves**
ON/OFF and modulating type for the level control in the evaporation, process and CIP chambers.
- **No.5 Flow-meters**
No.2 for the whey and no.3 for the evaporated water.

■ **Evaporating tower**

Suitable to evaporate 1,000,000 kcal/h complete of water tank and recirculation pump for the water of the third effect.

■ **Control board, control and power**

Construction in stainless steel, complete of:

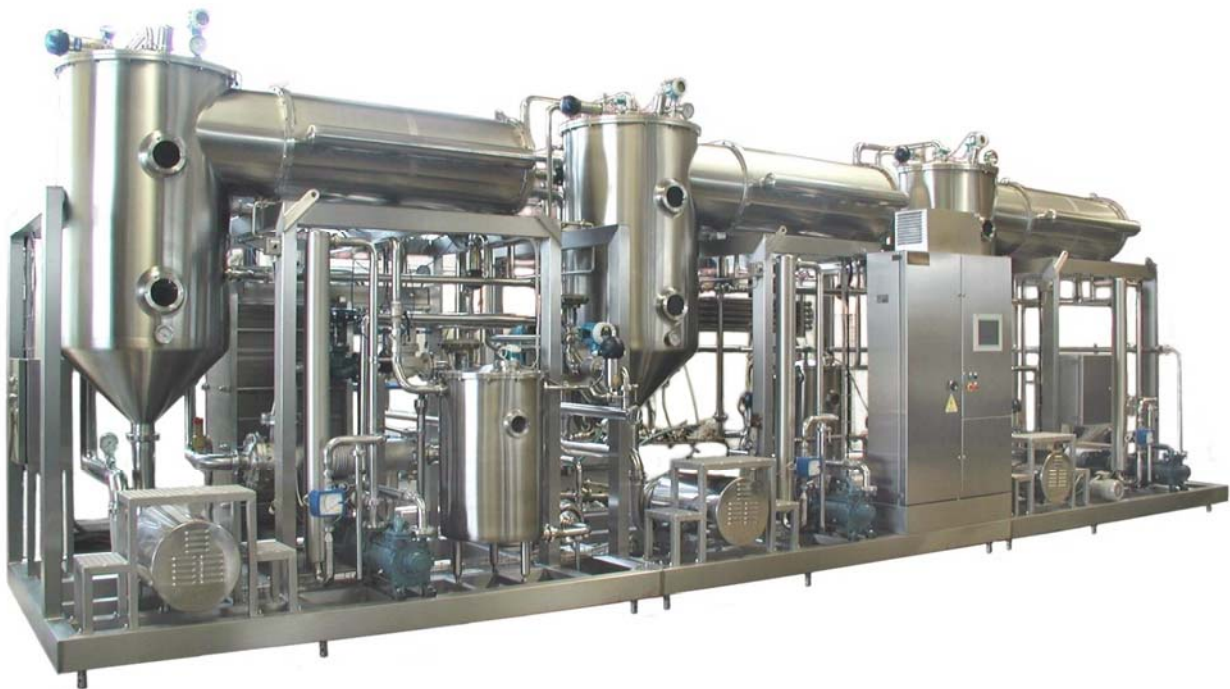
- PLC (series S7 Siemens).
- Operator Panel "Touch-Screen" type for the vision of the flow-sheet and of the process parameters.
- Visual page to set the process parameters and memory of the alarms and important data.

The whole plant is pre-installed pre-connected on 3 platforms, one for each effect, with centralized board.

Consumptions:

- Installed power: 85 KW at 380V, 3 phases, 50 Hz.
- Steam: 1,660 kg/h to 6 bar (stabilized).
- Water: 2,000 l/h for the tower evaporativa.
- Compressed air: 6 bar min.

Dimensions of the plant (tower excluded): mt. 10.0 x 2.2 x 3.5 (h)



ECONOMIC ACCOUNT for A PRODUCTION OF 62,500 L/DAY

Economic account:

To bring the dry content from 5% to 30% it is necessary to evaporate 50,000 l/day of water with a cost of: 50,000 x 0.013 USD/lt. = 650 USD.

Profit from the concentrated product:

The concentrated product at 30°Bx costs in Italy 0.104 USD/lt. For this reason the profit coming from the concentrated sale is of: 12,500 x 0.104 USD/lt. = 1,300 USD.

Daily operative margin:

1,300 USD PROFIT -
650 USD COST =

650 USD OPERATIVE DAILY MARGIN

The daily margin considered for 300 working days per year bring an annual margin of **USD 195,000.00**, which enables a total amortization in 4 years.

ANALISYS OF INLET WHEY AND OUTLET CONCENTRATED

	WHEY AT THE INLET	CONCENTRATED AT THE OUTLET
FAT CONTENT	< 0.1% P/V	0.0% P/V
PROTEINS	0.80% P/P	4.00% P/P
LACTOSE	4.52% P/P	27.00% P/P
PH	5.64	6.21
CINDERS	0.6% P/P	2.7% P/P
DRY CONTENT	6.1% P/P	33.7% P/P
MAGNESIUM	100.00 MG/LT	338.00 MG/LT
POTASSIUM	1610.00 MG/LT	433.00 MG/LT
SODIUM	497.00 MG/LT	361.00 MG/LT
CALCIUM	534.00 MG/LT	1680.00 MG/LT