Method of Operation

A PIV Plant comprises of two or more Conches which are arranged in series. Each Conche has a batch capacity of 1000 kg. The flake is weighed continuously by a belt weigher and then diverted into the Conche.
A semi-continuous method of operation is achieved by feeding each Conche in sequence. Cocoa butter, lecithin and if required other ingredients, are automatically metered into each Conche by dosing pumps.
The PIV Conches are equipped with bottom discharge valves which can either be connected to a central high capacity pump or can be fitted with a separate discharge pump at each Conche.
Hot air blowers are provided to assist in the removal of moisture and other undesirable volatiles.
Basically, the PIV Conche is designed to operate batch-wise and thus be programmed separately and independently of the other Conches on the line. From one to six PIV 1000 Conches can be installed on a single conching line and these are referred to as PIV 1000...PIV 6000 Conching Systems.

Design features

The PIV 1000 Conche is suited for heating and cooling. The Conche

vessel is flanged directly onto the lower stirrer drive gearbox which doubles as the machine base.
The upper stirrer system comprises of a matched pair of parallel co-rotating intermeshing mixing screws which extend into the vessel from above. The screws are offset eccentrically from the center axis of the vessel. The lower anchor stirrer system is driven from below. This stirrer is equipped with scraper arms which reach up the sides of the Conche to wipe chocolate off the inside bowl wall surface.
These scrapers are also angled so as to push the chocolate downwards and through the intermeshing screw mixing station. The twin screws are driven from above by means of a synchronous drive.
To ensure a thorough disagglomeration and plastification of flake, it is necessary to treat the mass within a shear zone which is capable of transferring energy uniformly and efficiently to the mass.
Such a shear zone is realized when the mass is compressed in one direction and if it is concurrently sheared at right angles to the direction of compression.
Hence each scraper arm of the anchor mixing element can be viewed as a compression generating tool which feeds the flake radially to the

screws hence providing the necessary pressure and shear zones.
The two interleaving screws force mass downwards towards the base of the bowl, thus shearing it as it comes under the sideways directed compression pressure.
The way in which the two stirrer systems interact produces a continuous three dimensional tumbling of the entire contents of the vessel, with repeated passage of each portion of the mass through the principal shear zone.
Thus a very intensive disagglomeration of the flake is achieved while simultaneously ensuring rapid moisture removal from the mass.

Advantages over Conventional Conches

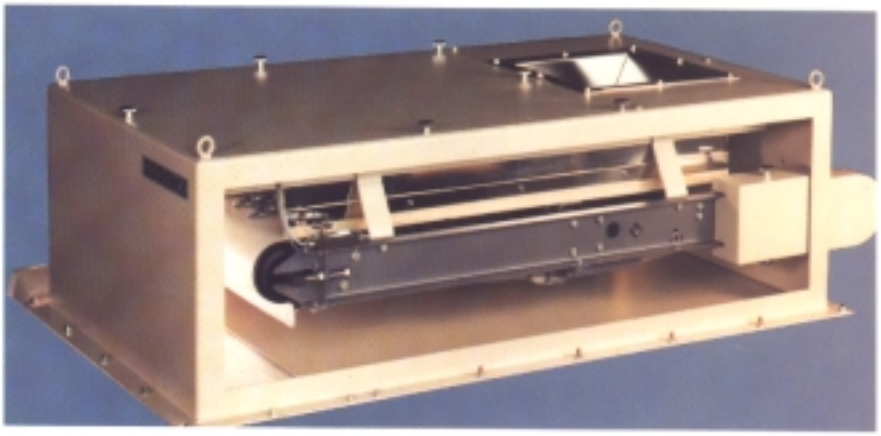
It is a generally accepted fact that the specific power draw (kW/t) of a Conche is the most predominant measure which influences conching times and costs. In comparison to a conventional Conche, it is possible to increase the specific power draw of a factor of 5, whereby the actual conching time can be reduced by a factor of between 8 to 14 times.

Dosing Pump

Precision piston pumps having a dosing accuracy of ± 0,5% are used to meter the cocoa butter and lecithin.
The dosing capacity is infinitely variable and set specifically for each recipe.

Belt Weigher

The roller refined flake is transported continuously to the Conches via in-line belt weigher.
The electronic weight measurement comprises an integral part of the complete process control which also monitors the feed belts and the respective ploughs.
The weighing accuracy provided by the belt weigher is in the range of ± 0,5%.



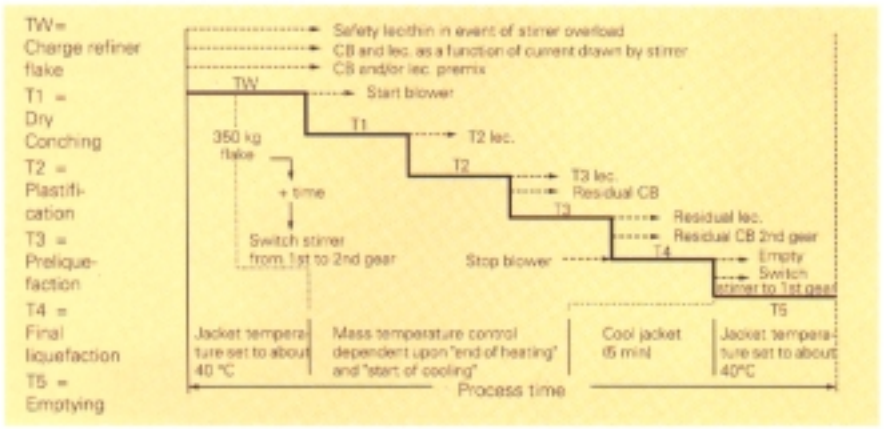
Heating and Cooling System

Heating and cooling is effected via tempering of the double jacket by means of cold respectively warm water with free overflow. Alternatives are of course also possible such as for instance closed tempering circuits with heat exchangers. Saturated steam is used as primary heating source, while cooling is achieved using available chilled water. The energy and water consumption is thus kept to a minimum.

Plant Control and Operation

The plant is operated from a process control station with operator guidance and a control cabinet that handles coordination and supervision of all basic cabinets.
The control station's screen provides the operators with all current process data in neatly arranged, easy-to-understand form.

All of the process parameters required are stored and processed for the individual recipes.
The plant runs fully automatically with self-monitoring, i.e. any malfunctions are signalled and printed out automatically. Maintenance intervals are also signalled and printed out. For production control purposes, a record can be printed out at preset intervals showing material consumption, quantities produced, etc. And a shift record is printed out automatically at the end of each shift.

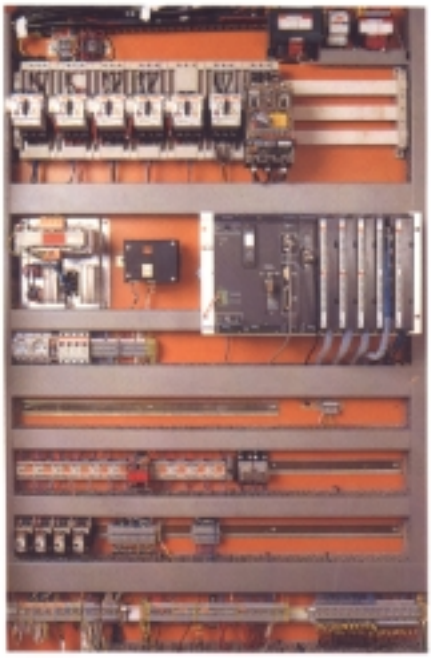


Time Process Phase Diagram

The time/process phase diagram defines the precise production stage for the chocolate mass in the Conche. At each point of intersection between the time and process phase lines, the Conche receives a specific command to perform the next processing function such as, for example, the addition of cocoa butter, or to change to a higher rpm.
All processing times and quantities of additional ingredients metered are directly related to the throughput capacities of the roller refiners and the respective recipes.
The analytical data determined by testing a given product serve as the basis for establishing these parameters (optimization).

Control/Basic Cabinet

Each Conche has its own matching basic control cabinet. The modular design makes it possible to add Conches later on until the process control station is coordinating as many as 6 Conches.
The basic cabinet contains the heavy-current switchgear and a programmable logic controller (PLC) for the operation of one Conche.
The main control cabinet is also equipped with a PLC, which communicates with the Conche control systems in the basic cabinets and with the process control station via a bus system.
Any of the leading makes of control system can be employed, provided it is firmly established in the market and ensures dependable user support.



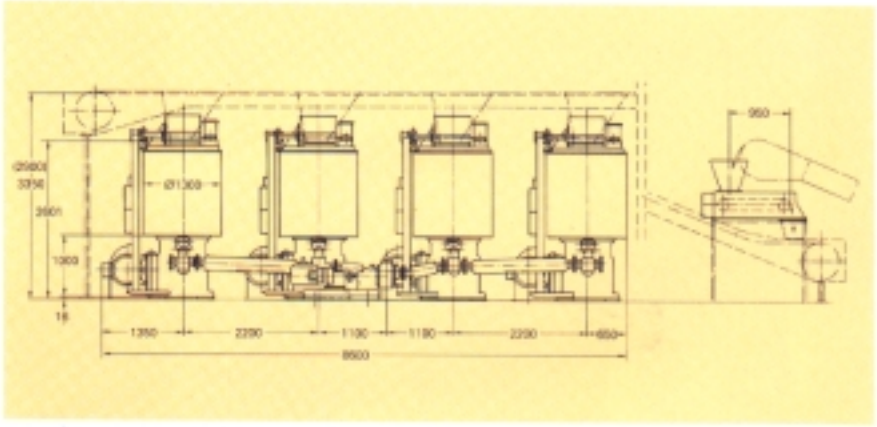
Power requirements

Connected load per Conche	
Drive of anchor stirrer	70,0 kW
Drive of screws	30,0 kW
Water circulating pump	0,5 kW
Hot air supply fan	0,2 kW
Air heater	8,0 kW
2 metering pumps each 3 kW	6,0 kW
Total connected load	114,7 kW
Mass discharge pump	11,0 kW
Belt weigher	0,4 kW

On typical PIV 2000...6000 installations, the peak running load is normally about 50% of the installed maximum load.

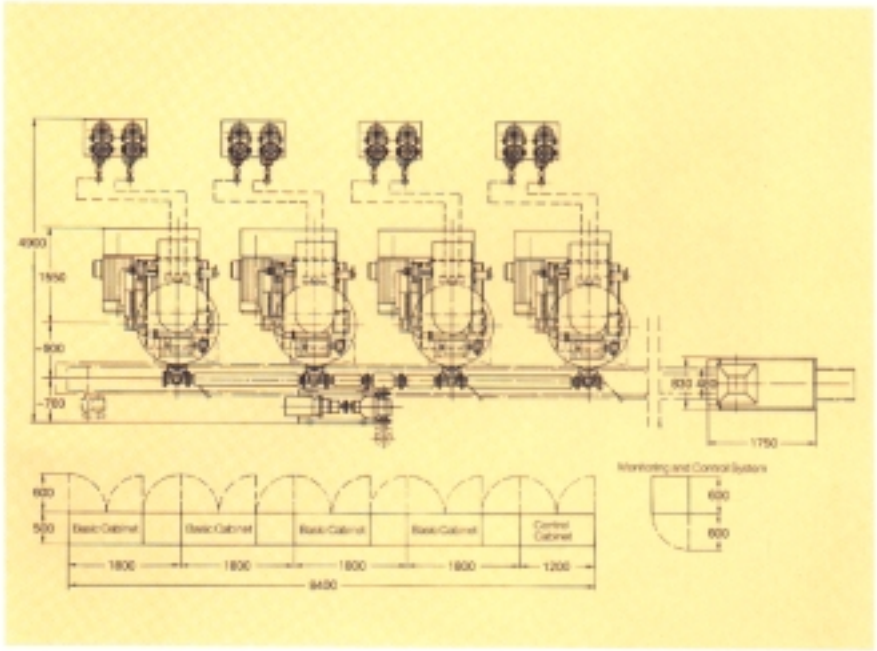
Floor space requirement

Our cross section diagram shows the principal dimensions of a PIV 4000 plant. The approximate size of any other type of PIV plant can be derived by appropriate scaling from this diagram.
Both the switch cabinet and the metering pumps can be placed differently, should local considerations require this, but they must remain reasonably close to the plant itself.



Weights

Weight of one Conche incl. dosing pump	appr.7200 kg
Switch cabinet unit	appr. 450 kg
Monitoring and Control System	appr. 100 kg



Energy Consumption and Conching Results

By comparison with conventional 24 hour dry conching installations, improved sensory, organoleptic, and rheological values can be expected with an average economy of 1-2% fat content.
In case of water content of ≤ 1,2% in the refiner flake, conching time is approx. 1 hour with an electric power consumption of about 74 kWh/ton. When the cocoa liquor was not pretreated, conching time will increase to 1,5 - 2 hours, and energy consumption will be approx. 85 - 100 kWh/t. On the average, the moisture content in the finished product will be approx. 0,7 %.