

Figure 6.10 Schematic diagram of continuous vacuum band drier.

6.7.2.1 Vacuum or air band dryer processes

This method of treating kneader paste is probably closest to the original batch oven process. The dryer consists of a continuous belt, as depicted in Figure 6.10, running in a long cylindrical vacuum chamber (Minifie, 1977a). The paste can then be extruded as ropes onto the moving belt. The belt may run over a “bed”, steam heated internally, or heat may be supplied by radiant heat above. The length and speed are such that drying is completed by the time the belt turns over a spindle for return. The dried crumb breaks off in pieces and falls via an air lock into a chamber from where it passes to storage.

When the drying process is carried out under atmospheric pressure conditions, the equipment is simpler to design, and drying can be carried out using co- or counter-current hot air.

6.7.2.2 Vacuum roll dryer process

This process takes the approximately 90% solids kneader paste through two stages of drying (Powell, 1970). The first dryer consists of two internally steam heated rollers, counter rotating in a heavy gauge metal dome under partial vacuum. Partially dried crumb builds up and falls off as “sausages” located by scrapers mounted at about 60° from the top of both rolls. This material is mechanically conveyed from the base of the oven. The choice of partial vacuum, steam pressure and throughput is such that the paste can be aerated, dried and formed into pieces similar to the crumb obtained in the batch oven process, thus making it suitable for silo storage and bulk transport. The partially dried pieces discharge into air lock chambers and from there into hot air drying towers of large enough capacity to dry the crumb to 1% moisture after 5–8 h residence time. From these towers the finished crumb passes through a 2.5 cm (1 in) breaker and is pneumatically conveyed into storage silos.

6.7.2.3 Atmospheric Groen process (scraped surface heat exchanger)

This process was developed in the late 1970s and has been disclosed in a number of papers (see e.g. Minifie, 1977b; Christiansen, 1983). It has two unusual features which make the final product rather different from batch oven crumb:

- 1 All the ingredients, including the cocoa liquor, are dispersed in the concentrated milk before drying. This produces small droplets of fat.
- 2 Drying takes place under atmospheric conditions so that process temperatures are much higher than in the processes just described.

The ingredient pre-mix, containing condensed milk, sugar and cocoa liquor is passed into the dual jacketed vertical scraped surface evaporator depicted in Figure 6.11.

The bulk of the water is removed at this stage and the crumb paste exits the top of the evaporator at a temperature of around 125 °C (257 °F) and a moisture content of around 5%. This stiff paste is starting to crystallise and its exit into the crystalliser is mechanically aided. The crystalliser is a water jacketed vertical rotor stator arrangement of intermeshing blades in a progressively narrowing

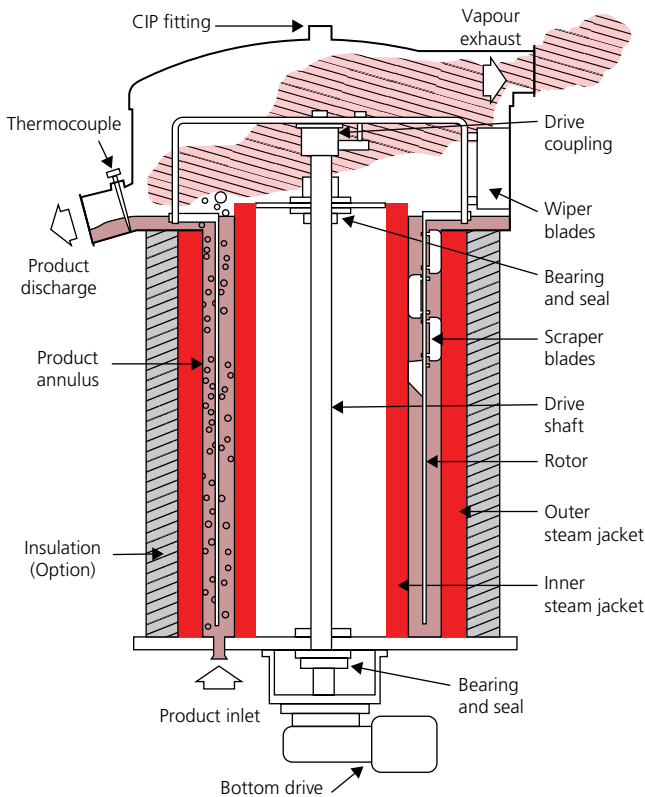


Figure 6.11 Groen DR series scraped surface evaporator.