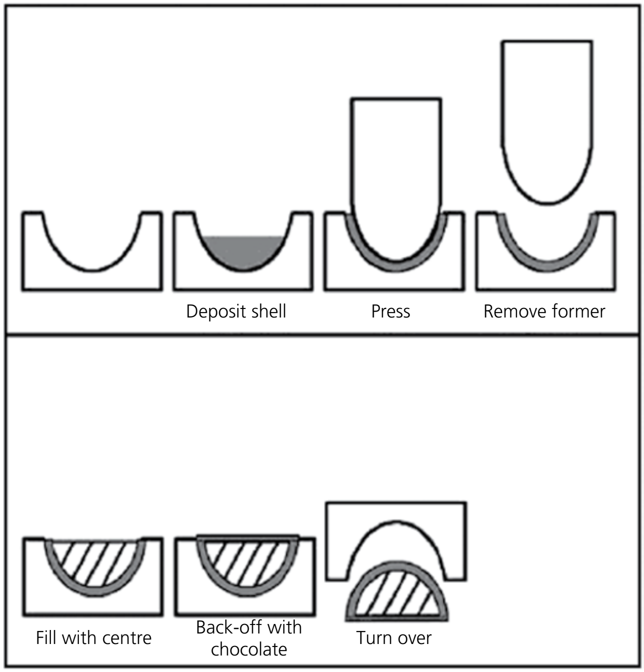

Figure 15.21 Schematic diagram of cold forming process. Reproduced with permission of Bühler AG, Switzerland.

up through part of a non-symmetric mould) and also there will be small differences in sizes between different moulds.

A frozen plunger, with the shape of the inside of the shell, is then inserted into the chocolate. The liquid chocolate is thereby squeezed up around the plunger and forms the shell (see Figure 15.21). It is necessary for the air to escape and not form bubbles or surface marks (Kniel 1997) and so the rate of entry of the plunger into the chocolate can be important. Aasted have developed a system in which the final millimetre of the insertion is relatively slow.

The length of time the plunger stays in the chocolate depends upon its temperature. The Aasted system operates at –15 to –21 °C (+5 to −6°F) (Aasted, 1997) and it only takes about 2 s or less for the chocolate shell to be hard enough for the plunger to be removed. In the Bindler system, the stamp is only at –5 °C (23 °F), which means that it must be kept in the chocolate for 4 or 5 s.

Once the plunger has been removed a scraper removes the excess chocolate from the mould and the centre is deposited in the shell. The products are then backed-off with liquid chocolate, as for traditional shell moulding, and the mould and product cooled, before de-moulding and wrapping.

As with Eriksen rolls it is necessary to keep cold stamping units in a humidity-controlled environment to prevent the formation of ice on the cold surfaces. Bindler have suggested that this is easier with their system, since it is operating at a slightly higher temperature than other designs. Where the chilled cone or cold plunger fails to separate satisfactorily, it is possible to spray it with an alcohol/glycerol mixture. This lowers the freezing point and appears to give satisfactory results with, for example, ball-shape moulds which have previously caused problems.

As was noted earlier, it would be expected that the very cold temperature of the plunger would cause the fat to set in its unstable crystalline form and so rapidly form bloom. This has been shown not to be the case, with even the inside of the products remaining glossy after long periods. It is assumed that this is because the surface of the shell is setting as a glass during the rapid cooling and only crystallising in the cooling tunnel as the heat generated by the crystallisation of the remaining liquid fat in the chocolate passes through this surface layer. Dr. Ziegleder, of the Fraunhofer Institute in Freising in Germany, has confirmed that the fat crystal forms found in cold-formed chocolate are similar to those from conventional processes. The surface of the shell may reach temperatures below 11 °C, but only for a few seconds (Boehme *et al.*, 2003) whereas chocolate crystallisation rates peak at 15 °C (59 °F) and requires some 7 min for solidification (Ziegleder, 1995). This supports the idea that fat crystallisation is occurring entirely in the cooling tunnel.

As would be expected, during storage trials traditionally produced and cold-formed shells show more or less similar stability against migration and bloom. In some trials, however, traditionally moulded pralines were found to develop fat bloom earlier than cold-formed ones, probably because the migrating filling oil penetrates faster through the thin areas of the shell that can be produced during conventional shell forming (Boehme *et al.*, 2003; Ziegleder, 2004). In other trials, cold-formed pralines were found to be less stable, possibly because of their accelerated production speed (Hinterberger *et al.*, 2007). The bloom stability of pralines is strongly dependent on the production speed and cooling time. If the time in the cooling tunnel before filling is too short, shells from all types of moulding technique have a reduced resistance to fat migration and bloom.

15.8.3 Advantages of cold forming technologies

15.8.3.1 Greater consistency

Shell thickness is controlled by the shape of the mould and plunger rather than chocolate viscosity and the mechanical forces on the mould (from shaking and gravity). Consequently there can be greater consistency of shell thickness and shape across the mould providing increased scope for product optimisation.

15.8.3.2 Controlled shell thickness

This improved control also makes it possible to produce shell shapes unattainable on conventional shell plants. Shells can be thicker at points where they are most likely to break (e.g. the neck of a Santa Claus figure). They can also be produced with very thin rims to facilitate backing off or joining two halves in a book-moulding process.