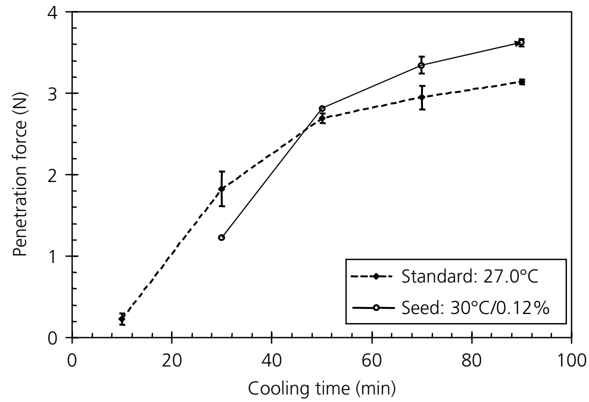


**Figure 13.26** Effect of the type of tempering on the snap/hardness of milk chocolate as measured by needle penetrometry (Zeng, 2000) – during cooling (12 °C, 54 °F).

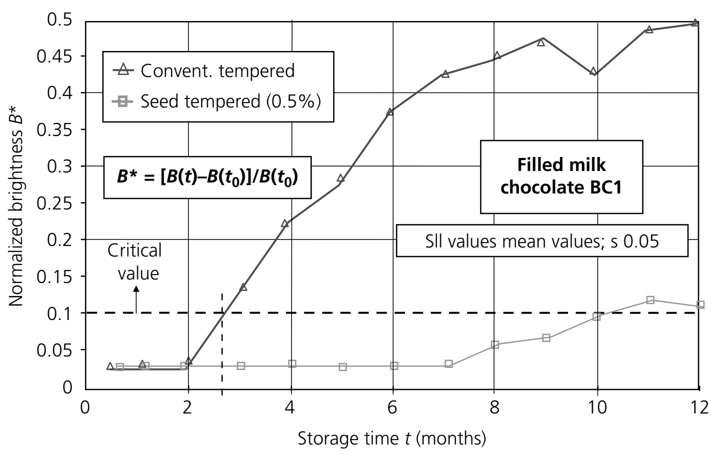


**Figure 13.27** Effect of the type of tempering on the surface gloss of a filled milk chocolate product; surface brightness measurements by LAB-colormeter (Zeng, 2000) – brightness versus storage time (19 °C; 66 °F).

The improved size distribution of the seed crystals also explains the characteristic increase of hardness and improved "snap" for seed-tempered products (Figure 13.26) and their significantly improved bloom stability. The latter is particularly pronounced in the case of filled products for which both the filling and the coating have been seed-tempered (Figure 13.27). Here the liquid fats in the centre (e.g. trioleins) find it harder to diffuse through the more dense, structured fat phase produced by the seed tempering.

A tendency for increased final contraction (density) for seed-tempered systems particularly when cooled more rapidly, is assumed to indicate the overall solidification in the stable $\beta_V$ polymorph form, compared with 10–20% of less

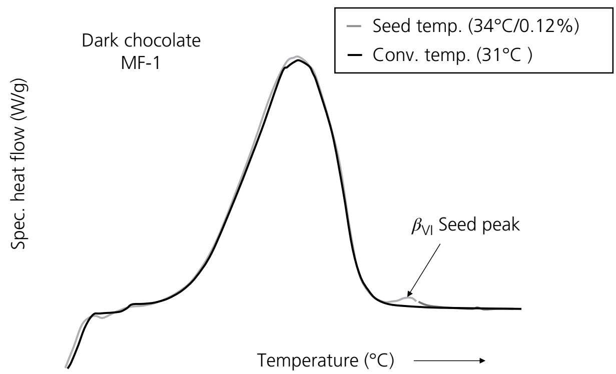


**Figure 13.28** Melting behaviour of conventionally and seed-tempered dark chocolate as measured by DSC.

dense $\beta_{III}$ or $\beta_{IV}$ polymorphs forming in conventionally tempered chocolates. However, it might also be due to a systematic difference in micro-dispersed gas between the two types of tempering.

Research on long-term storage trials with seed tempered chocolates of different fat composition indicates that the local inclusion of finely dispersed $\beta_{VI}$ crystals improves stability of the chocolate system against further $\beta_V \rightarrow \beta_{VI}$ transformation, which could cause the undesirable structure effects known (but not yet clearly understood) as the non-controlled $\beta_{VI}$ bloom (Van Mechelen, 2006a, b) with visible re-crystallised $\beta_{VI}$ crystals.

In Section 13.6.3 it was explained how the seed contained a high proportion of $\beta_{VI}$ crystals and yet the chocolate was almost entirely $\beta_V$ because of the relatively slow transformation to $\beta_{VI}$.From Figure 13.28 it can be seen that both conventionally and seed tempered dark chocolate samples show a very similar type of melting behaviour, which is typically dominated by $\beta_V$ crystals. For the seed-tempered chocolate, a small peak at 36 °C (92 °F) can still be seen, which is the melting peak of the $\beta_{VI}$ seed crystals. The fact that the chocolate solidifies largely in the $\beta_V$ state explains why the sensorial perception – no waxy mouthfeel as would be expected for $\beta_{VI}$ crystals – of the seed-tempered chocolate is practically equivalent to the conventionally tempered chocolate.

## 13.7.3 Industrial process layouts

The first SeedMaster Compact® machines were able to handle one (single version) or two (twin version) chocolate process streams with a single shear crystalliser. For example, the twin version can feed two different moulding lines (Figure 13.29) or two different depositor heads on the same moulding line.

In more complex cases such as the moulding lines for filled products, one SeedMaster Compact® unit is able to handle the seeding of the chocolate masse for the shell making and bottoming, whereas the second stream may be dedicated