The type of chocolates to be manufactured, is another consideration. Some manufacturers make very large amounts of a single recipe, whereas others may only need a few tonnes, before changing it. The former is likely to use relatively large conches and the latter prefer concepts such as Refiner Conche or ball mill applications in combination to "conching" schemes.

The size of the conche to purchase is another factor. Small conches may be better for frequent recipe changes but are relatively expensive in terms of capital cost. Large volume conches, although cheaper to purchase, have the disadvantage that they frequently have long filling and emptying times, during which no processing is taking place. In addition, in general only a small proportion of the chocolate within the conche is being mixed at any one time.

In conclusion, just as there are many different chocolates, so there are many different conching requirements and a wide variety of machine designs to try to meet these needs.

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CHAPTER 11
Chocolate flow properties

Bettina Wolf

11.1 Introduction

The flow properties of molten chocolate are important for two reasons. First, if the chocolate's viscosity is incorrect then a poor quality product will be made, which may have to be sold cheaply as a mis-shape or perhaps have to be reworked (Chapter 17). For example if the viscosity is too low, the weight of chocolate on an enrober-coated sweet will be too low. When it is too high, "feet" may form (Figure 11.1) or bubbles not come out of a moulded tablet.

The viscosity also affects the consumer's eating experience of chocolate during its complex oral processing (Carvalho-da-Silva *et al.*, 2011, 2013). While it is easily conceivable that the mouthfeel is affected by chocolate viscosity, it may not be so obvious that the flavour of a chocolate in the mouth is also affected by it. The reason for this is that the mouth contains a lot of different flavour receptors, each capable of detecting a single type of flavour. As the chocolate melts it comes into contact with these receptors. The perceived taste depends upon the order and rate of contact, which is related to the viscosity and the rate of melt. This can be demonstrated by placing part of a chocolate in the refrigerator and the remainder in a warm room. If the two are eaten consecutively, then they appear to have very different flavours.

The flow behaviour of chocolate is very complicated because the viscosity is not a single value and is what is known technically as non-Newtonian. This means that, if we measure its viscosity, it will vary depending how fast the chocolate is flowing. In some ways it resembles non-drip paint, which is very thick when stationary in the tin but becomes very thin when it is brushed onto a surface. This will be discussed further in Section 11.2.

What is important is that we measure chocolate viscosity at a similar rate of movement to that at which it is used. When the product is being deposited into a mould, this is very fast, but when chocolate is running down the side of a coated sweet it is doing so very slowly. It is therefore important to measure the viscosity at more than one flow rate. The results can be presented as several

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