a) the mass of crystallisation solution is spread out in the spatial domain in COBC with a very small fraction of it cooled at any given time;
b) while both the start and the end temperatures are the same as that of batch operations, temperature zones are firstly created along the length of COBC;
c) a small fraction of the solution goes through the temperature zones from tropic summer to summer temperature; from summer to autumn, then out of the crystalliser in one pass fashion.

There are new concepts as well as methodologies that can be used to extract real growth rates, steady state characteristics *etc.* in COBC, which will be discussed later.

3.4.1 Linking the Design and Operation With Science

The above statement is common sense, but it is however difficult to follow through in practice in large batch vessels, even though this is routinely achieved in lab scale crystallisation. Figure 3.11 below is a typical diagram showing the metastable zone width (the temperature difference between the supersolubility and solubility curves); the thick black line represents the optimal operational path. The primary aims are to avoid crossing the supersolubility curve where spontaneous nucleation takes place and to operate as close to the solubility curve as possible, since the supersolubility is not well defined and depends on a number of parameters that are scale dependent,[128] such as temperature profile, the rate of generating supersaturation, solution history, impurities and fluid dynamics. When seeds are used (this is the dominant methodology in industry), it is desired to add seeds at the start of the metastable zone.

It reads simply, but this is intrinsically hard to do in industrial crystallisers! Firstly, thermocouples are not long enough and can only be located near the walls of industrial crystallisers, so the temperatures are thus local,

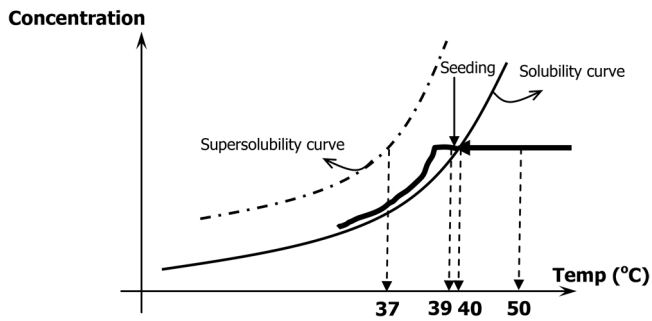

Figure 3.11 Cooling crystallisation profile linking science with design and operation.