

F₀, A₀ and PU Calculations

What is F₀?

This is a brief introduction to the F₀ Concept as applied to sterilisation. It is by nature brief and simplified. Customers are recommended to do their own additional research.

F₀ is the sterilisation time to ensure that whatever micro-organisms are contained within the process sample are reduced to an acceptable limit. This is a function of both time and temperature and, historically, the sterilisation temperature has been 121.11°C (250°F). However in a real process, the temperature is never ideal and never exactly at 121.11°C. This would not be a problem except that the sterilisation time is extremely sensitive to temperature deviations e.g. 0.1 °C causes approximately a 2% change in the time required, 1°C causes a 24% change in time. It is possible, of course, to cater for worst case but this means that there is generally over sterilisation which, in the case of food, can result in a degradation of flavour and in any event more energy will be used than is necessary. F₀ is a way of calculating the sterilisation time equivalence for temperatures other than 121.11°C. If the temperature is lower then the time needs to be extended and similarly, if it is higher that time may be shortened. The F₀ calculation requires two parameters which can be entered in the Options>Configuration>graph screen. These are t₀, the minimum temperature at which you start to sterilise (Default 90°C) and Z which is a constant determined by the micro-organism targeted and the ultimate Lethal Ratio which is deemed acceptable (Default 10).

How it is used?

Suppose that we are looking for a F₀ of 12 minutes i.e. to obtain the required Final Lethal Ratio the sample needs to be held at 121.11°C for 12 minutes. A Signatrol data logger is used to plot the actual sterilisation cycle. With the graph on the screen, click on 'Show Measure' on the LHS. Two vertical bars appear that can be moved by clicking the curser on them and then dragging. The start bar should be placed at the start of the cycle, the right hand bar can then be dragged across the graph and the F₀ at the point of placement is shown in the table. As you can see F₀ is in minutes and increased as the bar is dragged to the right until the temperature falls below 90°C and which no further sterilisation takes place. (Note the F₀ value only updates when the mouse click is released). When 12 Minutes is seen, the sample will have been sterilised to the required level. This can be considerably less time that waiting for the sample temperature to rise to 121.11°C and holding it there for 12 minutes and allowing it to cool, thus saving time and energy and hence costs.

What is A₀?

A₀ is exactly the same as F₀ but in this case instead of the equivalent temperature being normalised to 121.11°C it is normalised to 80°C. This is used in lower temperature systems such as washer sterilisers etc.

And PU (Pasteurisation Units)

The same equation can be used to quantify the amount of micro-organism reduction during a pasteurisation process. Some products, especially dairy products, are heat treated at much lower temperatures to eliminate bacteria. The most common method is to use a process known as Pasteurisation (named after the method's inventor, Louis Pasteur). The amount of pasteurisation (Time-Temperature) is quantified in Pasteurisation Units. One Pasteurisation Unit (PU) is defined as 1 minute of applied heat at 60°C. The number of PU's required for a particular product depends a great deal on the product, specific bacteria, its packaging and anticipated shelf life etc.

The pasteurisation process starts at 50°C and therefore our defaults are start at 50°C calculate PU's at 60°C with a Z=7 but all these parameters can be changed.

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