Pasteurisation

KEEPING THE BALANCE | Pasteurisation is the process of heating food temporary to temperatures of 60–90 °C for the purpose of killing harmful organisms such as bacteria, viruses, protozoa, molds and yeasts. The effect of the treatment over a certain time period is expressed in pasteurizing units (PU).

THROUGH PASTEURISATION, the amount of micro organisms in beer, soft drinks and other alcohol-free beverages is reduced, extending the product's shelf life. One of the most commonly used methods is the tunnel pasteuriser, through which beverages after bottling or canning travel while being sprayed with heated water. To safeguard taste, flavour, turbidity and colour, pasteurisation should be a gentle process. It is important to exceed the minimum times and temperatures required to reduce the quantity of biological contaminants to an insignificant level whilst not over-pasteurising and thereby imparting 'off' flavours and using excessive amounts of energy. Careful control of the pasteuriser in conjunction with continuous, accurate monitoring of the temperature inside the containers allows for this.

Pasteurisation units

The pasteurisation unit (PU) is defined as measuring the sterilising effect observed when the product is held for one minute at a temperature termed the base value (60 °C). Once this temperature is maintained for one minute, 1 PU is achieved.

The same definition of the PU (base value 60 °C) that is used for beer is often used for soft drinks and other beverages such as juices or wellness drinks.

The PU is defined at a steady temperature but intuitively we would expect that PUs are additive in their effect in situations where the temperature is changing. Experiments have shown this to be the case in processes such as tunnel pasteurisation.

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Target PU values

A target PU value must be set for each product and each container and will normally be determined in conjunction with micro-biological testing.

There are many factors that must be taken into account when determining the severity of pasteurisation required for any product. For beer the main factors are the degree of contamination prior to pasteurisation, type of micro-organisms present, alcohol/sugar/pH level and level of dissolved oxygen and carbon dioxide.

The parameters of PU measurement will be examined in the following .

Tunnel pasteurisers

The tunnel pasteuriser can be described as a conveyor built into a housing with a water spray system (Fig. 1). In order to monitor and evaluate the pasteurisation process efficiently, the temperature of the product in a test container needs to be measured while it passes through the pasteurisation process. This is what the electronic PU monitor can do, as the pasteurizer control system normally does not measure the effect on the product within the container but predicts it.

The portable PU monitor may also measure other parameters such as the spray water temperature and the pressure inside the container.

PU monitors

PU monitors are special purpose electronic temperature recorders; battery powered and housed in watertight enclosure with a means of supporting the test container and holding a temperature sensing probe in position in that container. The monitor is capable of travelling through the pasteurizer tunnel with the product and operating correctly and accurately under conditions of high temperatures, moisture and vibration,thanks to its robust construction.

The Haffmanns RPU 353 monitor (Fig. 2) can automatically calculate and display the total number of PUs achieved by the product during pasteurisation according to the definition set out above. It also allows the user to select base value and Z value to suit the type of product being pasteurised.

TECHNICAL DATA RPU 353

Container	**Bottles or cans**
PU calculation factors	Programmable
Measuring	2 x temperature, 1 x pressure
Recording interval	Recording interval setting (2–60 s)
Storage capacity	4 recordings, max. 4h per run
Measuring range	
Temperature	–5 to 105 °C
Pressure	–0.5 to 18 barg
Pasteurizing units	0–9999.9 PU
Accuracy (in range 40–80°C)	
Temperature	< 0.25 °C
Pressure	< 0.08 bar
Pasteurisation units	< 8%

Temperature probes

The temperature probe is one of the most important parts of the equipment. It must be accurate and respond quickly to temperature changes. The T90 response time of the probe (the time taken to achieve 90 % of any change in reading) should be shorter than the time interval between all recordings. Due to the small and compact construction of the sensors the pasteurisation effect is not affected and it is possible to transfer the data.

The Haffmans RPU 300 range probes are adjustable in length and easily interchangeable when changing container sizes. The probe should be sealed where it enters the container so that there is neither loss of pressure nor any leakage of product while the test container travels through the pasteuriser.

PU cut-off temperature

At product temperatures below 50 °C it is doubtful whether any significant sterilising effect is achieved even though from a strictly mathematical point of view the correct PU total could still be obtained, given enough time in the pasteuriser. For this reason is it desirable to set a temperature level below which no PUs are added to the total calculated by a PU monitor. This is termed the PU cut-off temperature.

Generally, the cut-off temperature is set at least 5 °C lower than the planned product temperature in the holding zone of the pasteurizer. Higher values will give a very conservative figure for PUs achieved and will reduce the repeatability of the result because the product temperature will be changing only slowly as it crosses the cut-off temperature threshold.

Pressure

A RPU 353 monitor allows also the pressure within the container to be monitored during pasteurisation and this can help to identify where any problems are occurring. Because pressure is highly dependent on the head space volume, the pressure sensor must be designed to make as little change to the headspace as possible.

Gauge pressure (above atmospheric pressure) should be measured over a range that extends to above 10 bar or 150 psi. Pressure can change quickly within the container and so recordings should be taken frequently, possibly one reading every ten seconds.

Fig. 1
Tunnel pasteuriser

Convection currents in containers

The liquid inside a container cannot be regarded as a uniform fixed mass, it can and will move during pasteurisation. It is now generally accepted that a slow circulation takes place in the container, driven by the temperature difference between the hot container wall and the cooler body of liquid within the container.
At the lowest point of the container, where the liquid in the falling core turns to rise again up the side walls there is a thin layer of turbulence about 5 mm thick. This turbulence is increased in cans by the fact that the base will heat up by conduction from the walls.

Above the layer of turbulence, between about 5 mm and 15 mm from the base and on the central axis line of the container, the temperature of the falling core is at its coolest. This is known as the cold spot of the container.

When the temperature difference between the spray water and the product is high – as it is in the heating zones – the liquid completes one circuit of the container in about four minutes. As the temperature difference becomes smaller– that is in the holding zone – one circuit can take more than ten minutes. For beer and products of similar viscosity this results in only about four to six complete circuits during the time of an average pasteurisation run.

Choosing probe position

The slow circulation described above implies that the product will not be well mixed in the container during pasteurisation and so we must assume that there will be variations in the treatment received between individual contaminant cells and

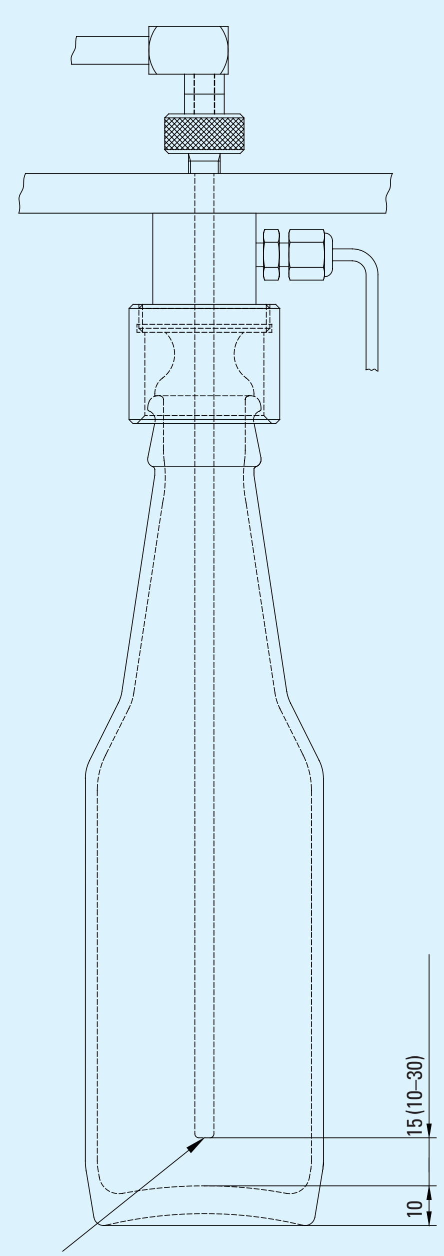

Fig. 3 Cold spot of the container

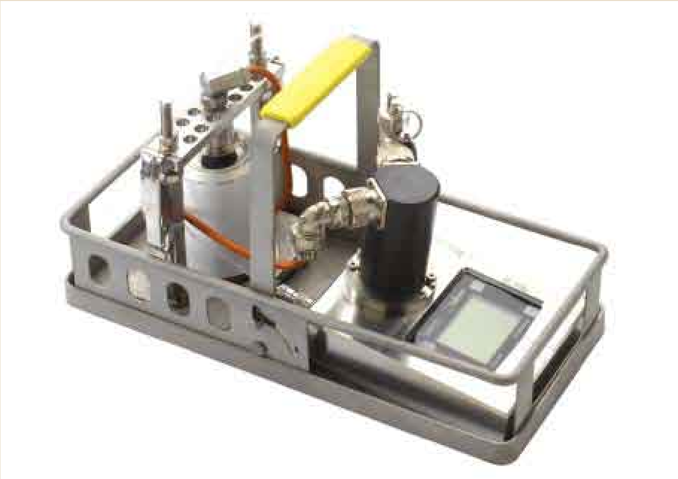

Fig. 2
Redpost
PU-monitor RPU 353

micro-organisms. It might be possible to measure the value of PU achieved for the average contaminant cell but it cannot be determined which place in the container will receive the average treatment and whether the heat treatment has been successful. It is recommended to position the tip of the temperature probe, which is its most sensitive part, at the cold spot of the container.

This is approximately 10 mm up from bottom of the container and exactly on the central axis. Choosing the cold spot gives the minimum result for PU achieved. The recorded PU total varies very little with probe height just at the cold spot and so this position also gives the best repeatability of PU measurement.

Analysis

A soon as the recordings are completed and the PU monitor is removed from the pasteurizer, the results can be viewed and analysed in several ways:

- directly from the recording instrument using a built-in display.
- connected to a PC by means of supplied software.
- connected to a dedicated piece of reading equipment with display and printer interface.