Feature Article

# Mongana Basic: 3 – Sterilization

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Sterilizers are classified into two types – vertical and horizontal ones. Whilst most of the millers are familiar with the horizontal sterilizers, they will have to be contented with the pictures of the vertical ones as there are no vertical operating units in Malaysia. The vertical sterilizers with capacities ranging from a few hundred kilogrammes to 5 t are filled up directly or sometimes receive a basket loaded with bunches. Most of the young palm oil mill engineers in Malaysia probably never had a chance to actually see a vertical sterilizer. The same applies to the hydraulic presses that have virtually vanished from Malaysia.

It will be worthwhile to establish a palm oil processing machinery museum to benefit the future generation of millers as the old designs can certainly come back with modern features. Now the vertical sterilizers are coming back and some Malaysian entrepreneurs have already built and installed them overseas as there are demands for small mills in the range of 5 to 10 t FFB $hr^{-1}$ capacities in Africa and Latin American nations. The vertical sterilizers maintain the same steam pressure as the horizontal units and use the conventional processing methods for both oil and kernel. It is still a batch process well suited for processing fruits from a 1000 to 1500 ha estate having a yield of 15 t $ha^{-1}$ $yr^{-1}$, that is normal in many countries.

## Vertical Sterilizers

In the old version of the vertical sterilizers, the loading takes place through the top mostly by means of a bucket elevator. In the case of sterilizers with large capacities, as bunches fall from a height of several metres bruising cannot be avoided even if a damping cushion is provided. Unloading is labour intensive and may take about an hour as it is difficult due to the compaction of bunches during sterilization. The thickness of the FFB layer is high, oil losses in the EFB is particularly high. In this 1 t of bunches occupy approximately 2 $m^3$ of space as there is not much unused space in a vertical sterilizer. The vertical sterilizers have high thermal efficiency and the weight of metal to be heated up in relation to that of the bunches is also very low.

The basket-type vertical sterilizer makes it possible to empty the baskets by tilting them around fulcrum points placed near the centre of gravity or through the bottom. A system to extract the basket from the sterilizer like monorail, gantry *etc.* will be necessary. The basket capacity ranges from 1 t to 3 t of bunches. The unused space in this sterilizer is slightly more than the previous type.

## Horizontal Sterilizer

In horizontal sterilizers, the unused space is large and the corresponding ratio of the weight of the metal to that of the bunches leading to a higher consumption of steam. Oil loss in EFB is lower than in a vertical sterilizer as the bunch layers are not very thick. The loading of FFB in and out of the sterilizer is fast and easy especially now with the double door type. The de-aeration however, is better in the vertical sterilizer but with continuous air bleeding, the air purging efficiency can be improved.

## Recommended Design Criteria for Sterilizers

- The ratio of the weight of the metal to the weight of bunches should be as low as possible.

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- It must be possible to open the doors in a minimum of time.

- The closing device must be simple and sturdy. It must be designed so as to ensure that the steam tightness is maintained as long as possible and the gasket replacement is easy. The material used for the gaskets must be lasting. In the horizontal units, the gaskets should be preferably sunk in the door rather than in the body of the sterilizer because in the latter case, the gasket is frequently damaged as a result of the movement of overfilled or carelessly filled cages. If the gasket is sunk in the sterilizer, it must be protected against the impact of bunches which may cause the damage.

- The height from which bunches drop into the cages during the loading should be kept to the minimum.

- The injection of the steam into the sterilizer can be made at a single point located at the top in the case of vertical sterilizers. For the horizontal ones, multiple inlets preferably connected to a steam manifold extending over the whole length of the sterilizer are essential.

- The steam inlet pipe must be so sized as to get 3 bar-g pressure inside the sterilizer within 10 min. The steam requirement at the beginning of the sterilization cycle is high and the pipe sizing should be based on a steam flow rate of 1 t of steam per tonne of the bunch during the initial steam flow.

- The pressure reducing valve must not close gradually as the pressure rises in the sterilizer. It must cut off steam supply when the steam pressure nearly reaches the required level.

- The steam exhaust valve must be located at the bottom of the sterilizer. The diameter of the pipe must be large enough to complete the steam blow down in 4 min when all the bunches have reached the temperature of the steam (about 140°C).

- During the sterilization, all the condensate, must be evacuated through a steam trap fitted with a filter that can be easily cleaned or through a valve, the setting of which must be ascertained by trial and error.

- In addition to discharging the condensate, a continuous bleed off of steam from the bottom of the sterilizer must be provided. The bleed off valve may be fitted to the bottom dished end in vertical sterilizers or a manifold extending over the whole length of the vessel in the case of horizontal ones.

- The sterilizer control equipment consists of a dial pressure gauge, a pressure recorder and a clock. A temperature recorder indicating the temperature at the bottom of the sterilizer is also useful. During commissioning a sterilizer, it is useful to make use of an apparatus to determine the air content in steam with a view for selecting the appropriate sterilization cycle.

- A horizontal sterilizer may have a slight slope in order to facilitate the introduction of cages, the discharge of the condenser and the de-aeration through sweeping.

- The exhaust steam may be used for the sweeping of air. In that case, the sweeping must be prolonged to compensate for the less heat content in the steam than the fresh steam.

- The sterilizer must be lagged.

- The sterilizer must be fitted with the usual safety devices used on boilers and also with door locking device operating as long as the vessel is under pressure. They also must be fitted with a standard flange for connection to a calibrated pressure gauge.

- The condensate must be drained adequately.

- A silencer may be installed on the exhaust line.

- The valves operating wheels must be grouped in a control post so that automation to achieve any type of cycle can be easily arranged.

- The sterilizer bay must be located away from the main process building so as to avoid steam blowing into process plants and machinery.

- The steam consumption is not steady throughout the sterilization process. At the beginning of the pressure build up, allowance must be made for large steam requirements like 1 t steam $hr^{-1}$ $t^{-1}$ of bunches. After a few minutes, they fall off considerably and do not exceed 50 kg $hr^{-1}$ $t^{-1}$ of bunches towards the end of the cycle. The total steam consumption is approximately 250 kg $t^{-1}$ of bunches. These indications permit to ascertain if the average hourly capacity of the boilers is sufficient and moreover, to establish if the boilers can cope with the sharp steam demand at the beginning of the sterilization. *A steam accumulator may be the answer to the problem of achieving steady steam draw off from the boilers.* ■