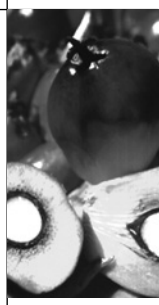
Feature Article



Technology Improvement in Sterilisation

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INTRODUCTION

Mill processing concepts to improve the oil yield as well as its quality have always been the prime objective of the millers as most of the changes focused on an increase in profit. The present focus seems to be shifting away from the profit oriented culture to one of environment protection.

The processing activities in a palm oil mill revolves around maximum oil recovery by reducing oil losses without sacrificing oil quality. There are limitations in the mechanical extraction systems as compared to soya bean which uses solver extraction methods which can give very efficient oil recovery. The newly harvested fresh fruit bunches (FFB) after weighing- in at the weighing bridge undergoes a series of operations in the mill by mechanical extraction process.

FFB after weighing is delivered into the FFB hoppers from where it is fed into a number of FFB cages that can either be loaded into individual cages or loaded at a single diacharge point that will reduce spillage of loose fruits in the marshalling yard where the raiway lines are installed for marshalling the FFB cages. The filled cages are transferred to the sterilisers using capstans or towed by skid steer loaders. The mill processing operations comprises sterilisation, stripping, digestion, pressing, clarification, purification, drying and storage of production oil. The system described until now is the conventional method of filling steriliser cages. The sterilisation process have undergone more improvements than any other processing stations in the palm oil mills. This article intends to examine an effective sterilisation system that appears to perform well.

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PURPOSE OF STERILISATION

Sterilisation Process is the first step in the processing operation. The word sterilisation does not convey its major role in the palm oil mills. Apart from the role of sterilisation that can inactivate lipases at relatively low temperatures to prevent the rapid rise of FFA in the fruit, it has another useful purpose of pressure cooking the bunches at an elevated temperature of 130°C. This pressure cooking contributes towards the following:

- Softens the wax that binds the fruit to its socket so that the fruits can easily detach from the bunches.
- Softens and conditions the mesocarp so that the fruits can be easily digested and pressed.
- Partially dries the kernel residing within the shell imparting uniform heating to it.
- Improved ability of oil to settle.
- Improved oil extraction efficiency from digested mash.
- Reduce nut breakage.
- Improve nut cracking efficiency.
- Improve oil bleachability.

TECHNOLOGY DEVELOPMENT

The FFB sterilisation systems currently practices in palm oil mills are far from perfect not only in terms of effectiveness in its performance but also from the point of view of applied thermodynamics on heat transfer and efficient utilisation of steam. Some of the new sterilisation systems flooding the market seem to be alienated from well-established fundamental thermodynamic principles. Most of the existing systems fail to extract even 50% of the energy contained in the steam. Most of the steam is discharged in vapour form carrying with it the entire enthalpy of evaporation. This is the basis of designing our system that faithfully follows the efficient utilisation of steam.

The palm oil industry started off with small vertical sterilisers with low capacities between 1 to 2 t hr^{-1} that was quite sufficient to process the crop available from the African small holders. When the volume of crop delivered to the mill started to increase from 20 t to a few hundred tonnes per day the small capacity verical steriliser could no longer be used for handling the sterilisation of the crop. This gave rise to the development of horizontal units which are still the most popular sterilisers in palm oil mills. The different types that made their appearance is listed below:

- small capacity vertical sterilisers
- small and inclined sterilisers
- large horizontal sterilisers
- continuous sterilisers
- huge vertical water filled sterilisers
- huge vertical dry type sterilisers
- hydraulically operated tilting sterilisers
- spherical pivoted sterilisers

Tilting Steriliser (TS) was invented after going through years of research and development to alienate all the negative features on the existing systems.

Tilting Steriliser was invented by taking into consideration the benefits of all the earlier sterilisation method and disposing the areas of sterilisation which gives negative effect.

Maintained and Improved Best Method of Sterilisation

Tilting Sterilisers have maintained the 'Horizontal Sterilisation' method whereby sterilisation is done when it is brought to horizontal position which ensures an even distribution of steam and good timing together with easier condensate discharge.

Minimising Empty Space (dead space)

Tilting advance the area of sterilisation by shortening the time of sterilisation due

to more compact and 'No Dead Space' in the vessel. The tilting feature of the steriliser gives great advantage in preventing the bunches from getting compacted by the sliding motion of the bunches within the steriliser during feeding.

Effective Process Steam Integration

The 1-3 Peak process is an integrated process requirement of steam based on providing pre-heating, de-aeration and condensation. The de-aeration process allows evacuation of the air from the sterilisers. The Tilting Sterilisers share some of its features with the proven horizontal sterilisers with added features like:

- The abity to fill it up to the brim of the sterilisers with the FFB causing significant reduction in air space that can make vast difference in the effective steam pressure which can be maintained at a much higher level
- Better sterilisation due higher partial pressure of steam
- Better strippability resuting from higher partial pressure of steam
- Easier loading of the sterilisers
- Shorter sterilisation time
- Lower steam consumption in Tilting Sterilisation Method due to minimal dead space the requirement is only maximum two peaks as this allowed shorter process time and steam requirement (Horizontal about 300-320 kg t^{-1} FFB while tilting about 200-220 kg t^{-1} FFB).

Minimise Mechanical Activity

Tilting has adopted the tipper method of feeding and discharging of FFB. The process is engineered to use the force of gravity to feed the FFB in to the vessels avoiding cages, rail tracks, winches, crane and shovels. Further on discharging, the gravity pull would easily discharge the sterilised fruits from the vessel into a hopper for transportation by conveyors to the thresher for stripping effect.

Lower Maintenance Cost

Contrary to expectations the maintenance cost of tilting sterilisers is low despite the heavy duty tilting mechanism used for tilting the sterilisers. The maintenance involves only on the door seal of steriliser, hydraulics seal, hydraulics oil and chains for the conveyors. On general average the maintenance cost per ton of horizontal steriliser system of 60 t hr^{-1} mill from an average of RM 4.00 t^{-1} FFB can be reduced to lower than RM 1.00 t^{-1} FFB on yearly basis.

A simple effective manner is to reduce cost and increase revenue.

FOOTPRINT - CONTINUATION MILL PROCESS

Tilting station is able to adapt to the space of existing mill processing space with steriliser station assembly and inter connectied conveyors with minimal disruption in mill processing. This allows mill production expansion with minimal downtime yet with a better and effective system.

Automation and Safety

This Tilting Steriliser permits easier operation through automation controls with adequate safety features as no human intervention is called for opening or closing the door of the sterilisers.

CONCLUSION

The Tilting Steriliser design and operation are based on the proven horizontal sterilisers. It has all the good features of the horizontal sterilisers combined with the elimination of its weakness in the form of trapped air that could not be satisfactorily evacuated because of the large empty space the horizontal sterilisers had to live with. The almost complete elimination of the air is the greatest feature of this steriliser.

The biggest weakness of the horizontal sterilisers is the large volume of air space inside after the steam has been injected into the steriliser which is estimated to occupy one-third space of the steriliser the remainder being air. This results in a drop of the temperature of the mixture of steam and air by 13°C (in practice 8°C) based on Dalton Law of partial pressures. This problem has been present and still continues in the palm oil mills. The tilting feature of the Steriliser has effectively solved this problem that had been plaguing the industry for a long time.

The negative points raised by users are appended below.

- higher maintenance cost;
- environment hazard;
- inefficient use of steam;
- high concern over safety; and
- not-user friendly.

Tilting have addressed the issues above by lesser working parts hence reduction of cost of maintenance, clean environment by eliminating cages, rail tracks and simplify the feeding of FFB and discharging sterilised fruit bunches (SFB).

Optimal design of 58 m^3 of vessel capacity and the inclined feeding allows minimal air space and hence reduction of steam requirement. With the integrated automation of the system combined with safety features and reduction of manual operation the issue of safety is minimised.

Improvement and advancement of the era of automation and technology has given birth to Tilting Sterilisation.

REFERENCE

LOH, T T (2010). Tilting Steriliser. *Palm Oil Engineering Bulletin, No. 94*: 29-42.

CALL FOR ARTICLES

The millers are invited to send in articles of relevance to the palm oil industry in Malaysia for publication in Palm Oil Engineering Bulletin. By sharing your expertise you will be helping the industry and the nation as a whole. The topics of interest are:

1. Plant modifications done in your mill that resulted in improvements in milling operation or maintenance.

2. Innovations done in your mill that produced improvements in the operation of the mill and that you are willing to share them with others.

3. Any special work done in your mill that directly resulted in improvements in OER and product quality.

Please submit your article to us and we shall be pleased to publish them in Palm Oil Engineering Bulletin. Feel proud to have your articles published in this bulletin that is circulated throughout the industry and MPOB offices worldwide.