eISBN 978-967-16145-1-8

Konvensyen Kebangsaan Kejuruteraan Pertanian Dan Makanan 2019 ***MSAE2019-ARWM11***
21 Mac 2019, Wisma Tani, Kementerian Pertanian & Industri Asas Tani, Putrajaya

A review of palm mesocarp maceration and separator machine

W. Hafizz[1,*], S. Rosnah[1,2] and Y. Robiah[2,3]
[1]Department of Process and Food Engineering, Faculty of Engineering, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[2]Institute of Advanced Technology, Faculty of Engineering, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia
[3]Department of Chemical and Environmental Engineering, Faculty of Engineering, University Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.
*Corresponding author. Tel.: +6019-8214173, Email:hafizzwondi@gmail.com

Abstract
The most usual method of extraction crude palm oil is by pressing mescarp fiber and nut together using screw press. Due to this reason, nut and kernel are tend to break by exerted pressing pressure from screw press thus resulting in high kernel loss. Over the years there are many tools and machine have been developed for fiber and nut separation. There are seeral technique hve been introduced to separate mesocarp from its nut including manual or power operated machine. Manual tools are depend on the skill of the worker itself thus, operated machine are developed to eliminate the limitation of manual tools. Most recent separation machine design and technology being discuss in this work has been conferred for various objectives and not only limited for fiber and nut separation before oil extraction. This review paper aims to bring a further understanding on the design, capabilities and limitation from differerent thechnique of fiber and nut separation have been used specifically for palm oil industries.

Keywords: separator, dehusker, fruitlet, fiber, nut

Introduction

Palm oil product contributes 31% of the world oil and fat production. Malaysia is the second largest palm oil exporter with 16.05 million tonnes of oil were recorded export in 2016 (Din, 2017). Palm oil is extracted from oil palm fruit mesocarp while palm kernel oil is similarly extracted from its kernel. Oil palm extraction processing involved five basic operations; fruit sterilization, fruit loosening/stripping, fruit digestion, oil extraction and oil clarification (Osei-Amponsah et al., 2012; Oseni K Owolarafe, Faborode, & Ajibola, 2002). After the palm fruitlets have been stripped from the bunches, the sterilized fruit together with accompanying calyx leaves will reheat and recondition inside digester to loosen the mesocarp from the nut before entering screw press for oil and kernel extraction.

The most usual method extracting process of oil palm mesocarp and kernel is by digestion and pressing in the mill. Several studies have shown that about 4% to 5% residual oil still remain in palm pressed fiber (PPF) after screw pressing(Choo, Yap, Ooi, & Ma, 1996). That remaining residual oil also contribute for the mill oil loss. This problem causes the mill to increase its hydraulic pressure limit for screw press to 70-80 bar compared to 50-60 bar commonly to ensure high oil extraction efficiency. However, the study also showed that this higher pressure exerted by the screw press will results in higher nut breakage as 40% (O K Owolarafe, Osunleke, Odejobi, Ajadi, & Faborode, 2008). The palm fruit mesocarp mash subjected to pressing is a heterogeneous mixture of nut, fibre and fluid. There is a limit to the amount of expression pressure that can be applied before the nut is not cracked. Many attemp have been introduced to overcome this problem either by research institute or by the industry itself. The findings from these attemps have their own advantage and disadvantages.

Dehusking using knife

Knife were used to dehusked the palm fruitlets mesocarp from its seed manually. The knife was design straight and sharp equipped with handle. Force is applied by hand so that the sharp area can peel off the mesocarp without breaking the nut or seed. By using this tool, all of the mesocarp can be fully utilized which can prevent oil loss. For example Federal Land Development Authority (FELDA) Sg. Tekam Mill and Research Centre (Vincent, Shamsudin, Baharuddin, & Yunus, 2016) used this method to dehusk 8000 fruitlets sample daily to analyse the quality and oil yield every fruitlets. This method is not only required longer time to complete this work, but also tiring.

Drupe dehusker

(Vincent et al., 2016) have developed a small scale drupe dehusker **PI 2014700853** with a capacity of 300 g load which is used to separate oil palm mesocarp and kernel. This machine have been developed in order to remove mesocarp from nut prior oil extraction. It consist of peeling basket with perforated sharp edges and rotatable operating disc powered by motor. Palm fruitlets is placed on the operating disc at the bottom section. The motor which is interconected with operating disc will revolve based at its designated speed. The revolution of operating speed makes the palm fruitlets throw outside and hit the sharp edges on the peeling basket wall through centrifugal force. The mesocarp then dehusked from nut by frictional contact between fruitlets and peeling basket wall. The revolution

speed can be set up to 25,000 rpm. After dehusking operation complete, dehusked nut then were collected manually on the operating disc while operating disc need to remove to collect mesocarp at the bottom side.

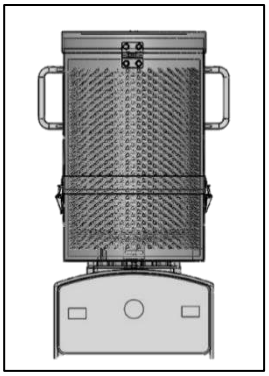

Figure 5: Drupe Dehusker

Palm Digester

Palm digester are machine reviewed by (Stork Amsterdam, 1960) to macerate or digest sterilized palm fruitlets prior pressing. This machine are improvise technology based on the primitive fruitlets processing technique. It is design vetical consist of main shaft, beater arms, cylinder vessel, steam injector and side bottom discharge.

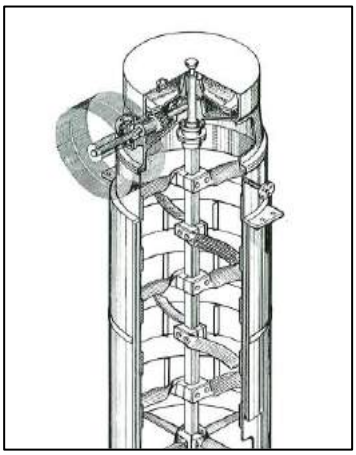

Figure 6: Internal design of palm digester

Stipped palm fruitlets are feed from the bottom of digester through hopper until ¾ of the volume. Shaft attached with 5 sets of beater arm comprised with long and short arm are rotate to stir the fruitlets inside digester. This stirring operation will create rubbing and pressing action to fruitlets in order to break up the oil cell at the mesocarp and loosen it from the nuts. Steam are supplied inside the vesses throughout this process to elavate and maintain the temperature until 90 degree celcius for maximum digestion operation. Complete digested mesh (mixture of mesocarp and nuts) are continously being remove through side bottom discharge for oil extraction. This technology currently are still being used at the existing palm oil mill in Malaysia.

Palm Nut-Fiber Separator

The palm nut-fiber separator machine developed by (Kwasi Adzimah & Seckley, 2009) purposely to separate nut and fiber from pressed cake after oil extraction. This machine are proposed to be installed after screw press machine and expected to increase the kernel recovery efficiency. This machine comprise with two horizontal shaft (top and bottom), metallic mesh, and outlet for nuts and fiber. With separation efficiency of 90%, this machine capable to process with capacity of 500kg/hr.

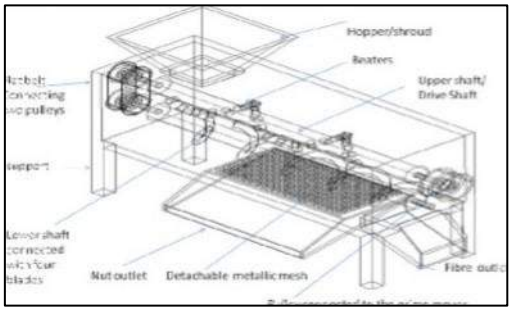

Figure 7: Palm nut-fiber separator

Pressed fiber (after screw press) are feed through top hopper then enter to top horizontal beater shaft to break and separate fiber from its nuts. The lower shaft equiped with worm blade with equal pitch are used to convey the fiber to funnel discharge at the left side. While, the nuts will fall through gravity force at the bottom of the machine.

Palm Nut-Pulp Separator

Nut and Pulp separator machine was developed by (Nduka, Okay, & Jonah, 2012) to separate digested mesh between palm nut and pulp or digested mesocarp. This machine design quite similar to the previous palm nut-fiber separator machine but this machine are proposed to be installed between the digester and screw press machine. With processing throughput of 120kg/hr, this machine consist of cake breaking unit and separating unit powered by electric motor. Digested mesh are feed through top hopper then enter to cake breaking unit section at the upper chamber. The rotaty motion of beater in this section makes the pulp that adhere to the palm nut detached.

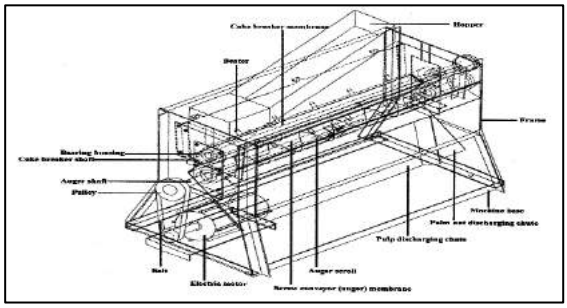

Figure 8: Palm nut-pulp separator

The entangle pulp need to detach at this section for effective separation. Then the minture of pulp and nut

are further separate at separating unit section located at the lower chamber of this machine. The separating unit consist of adjustable blade and auger are used separate and convey the loosed digested mesh from right to the left side section of this machine. During this process, pulp will discharge through an opening of slit at 2.5mm wide while nuts will discharge at the end section of machine.

Kernel nut and Mesocarp Separator

Kernel nut and mesocarp separator are developed by (Foster & Yunus, 2016) for separating mesocarp surrounding a kernel nut of a fruitlets. This machine are comprised with tapered helical screw, protuding cutting cylider wall and steam nozzle.

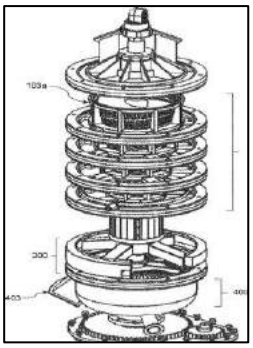

Figure 9: Kernel nut and mesocarp separator

The operation start with feeding the palm fruitlets from the top hopper. The fruitlets then are conveyed to the bottom by rotation movement of tapered helical screw. Throughout the movement of fruitlets from top section to the bottom section, the mesocarp were removed and separate from nut by protuding cutting wall along the helical path. The teared mesocarp then fall to the bottom discharge assisted with skimming arm while nut are removed to the nut discharge for nut washing process.

Conclusion

The palm mesocarp/fiber and nut separator machine specifically for oil palm industry has been reviewed. It is is obvious that the are two types of separation technique involved which are dry separation (without steam or hot water) and wet separation (using steam or hot water injection). It has been observed that there are several type of mechanism has been used; centrifugal separation, rotary beater or blade and rotary auger with conveyor. The adoptation and further improvement of these machine will improve the oil yield thus maximizing the mill revenue.

Acknowledgement

The authors would like to thank Universiti Putra Malaysia and Ministry of Education, Malaysia for the financial support through the Graduate Research Assistance (GRA) scholarship, Universiti Putra Malaysia Grant scheme (UPM/700-1/2/GPPI/2017 /9543300).

References

Choo, Y., Yap, S., Ooi, C., & Ma, A. (1996). Recovered Oil from Palm-Pressed Fiber : A Good Source of Natural Carotenoids , Vitamin E , and Sterols, 73(5), 599–602.

Din, A. K. (2017). Malaysian Oil Palm Industry Performance 2016 and Prospects for 2017. Http://Bepi.Mpob.Gov.My/Index.Php/En/Statistics/Production/186-Production-2018/851-Production-of-Oil-Palm-Products-201, Accessed M, 6. Retrieved from http://www.mpob.gov.my/images/stories/pdf/2017/2017_Dr.KushairiPALMEROS2017.pdf

Foster, G. L., & Yunus, R. (2016). Kernel Nut and Mesocarp Separator.

Kwasi Adzimah, S., & Seckley, E. (2009). Modification in the design of an already existing palm nut - fibre separator. African Journal of Environmental Science and Technology, 3 (11)(November), 387–398. http://doi.org/10.5897/AJEST09.051

Nduka, N. B., Okay, O. A., & Jonah, A. C. (2012). Design , Fabrication and Evaluation of Palm Nut-Pulp Separator. Journal Od Emerginr Trends in Engineering and Applied Sciences (JETEAS), 3(1), 144–151. http://doi.org/ISSN: 2141-7016

Osei-Amponsah, C., Visser, L., Adjei-Nsiah, S., Struik, P. C., Sakyi-Dawson, O., & Stomph, T. J. (2012). Processing practices of small-scale palm oil producers in the Kwaebibirem District, Ghana: A diagnostic study. NJAS - Wageningen Journal of Life Sciences, 60–63, 49–56. http://doi.org/10.1016/j.njas.2012.06.006

Owolarafe, O. K., Faborode, M. O., & Ajibola, O. O. (2002). Comparative evaluation of the digester – screw press and a hand-operated hydraulic press for palm fruit processing, 52, 249–255.

Owolarafe, O. K., Osunleke, A. S., Odejobi, O. A., Ajadi, S. O., & Faborode, M. O. (2008). Mathematical modelling and simulation of the hydraulic expression of oil from oil palm fruit. Biosystems Engineering, 101(3), 331–340. http://doi.org/10.1016/j.biosystemseng.2008.08.007

Stork Amsterdam. (1960). Stork Review. http://doi.org/10.1017/S0021911813002374

Vincent, C. J., Shamsudin, R., Baharuddin, A. S., & Yunus, R. (2016). Separation Performance of Oil Palm Mesocarp and Kernel using Different Blade Orientation. The International Symposium on Agriculture and Biosystem Engineering, (August), 9–11.