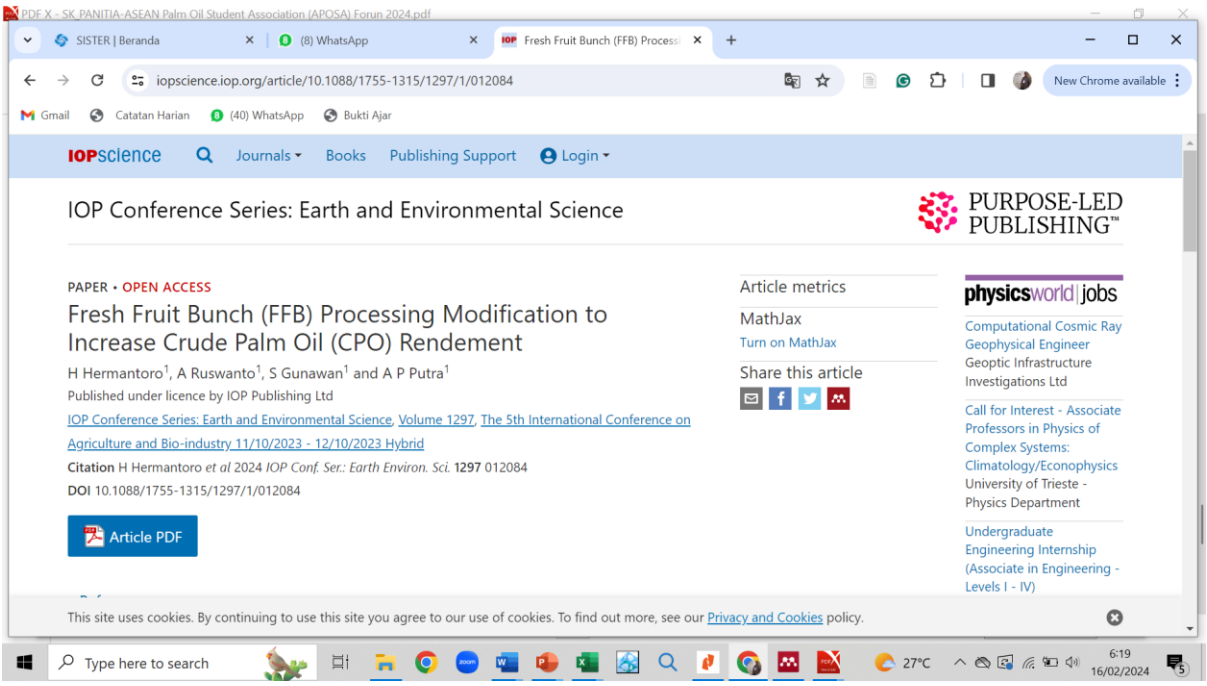
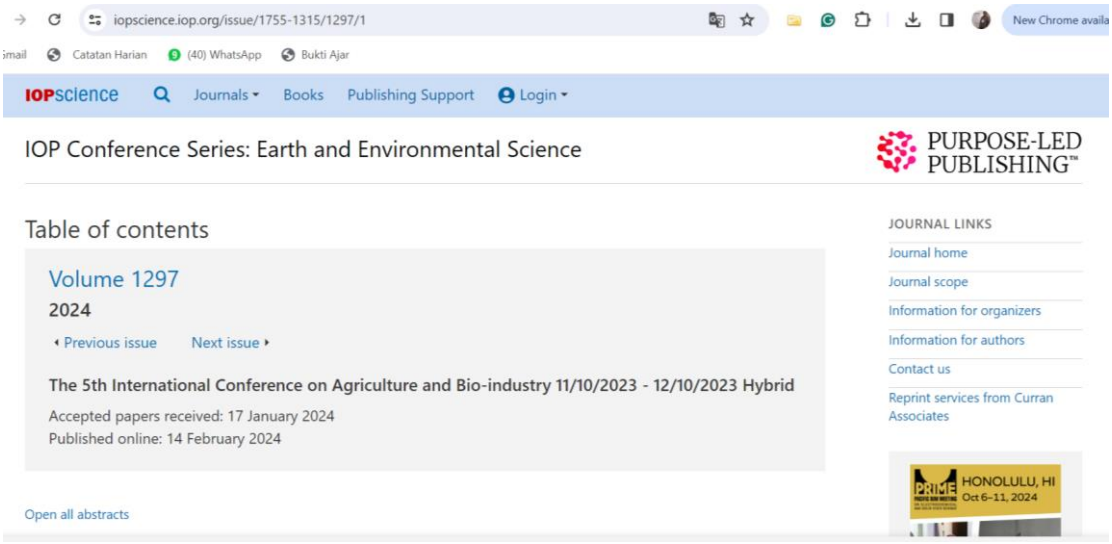
PAPER • THE FOLLOWING ARTICLE ISOPEN ACCESS

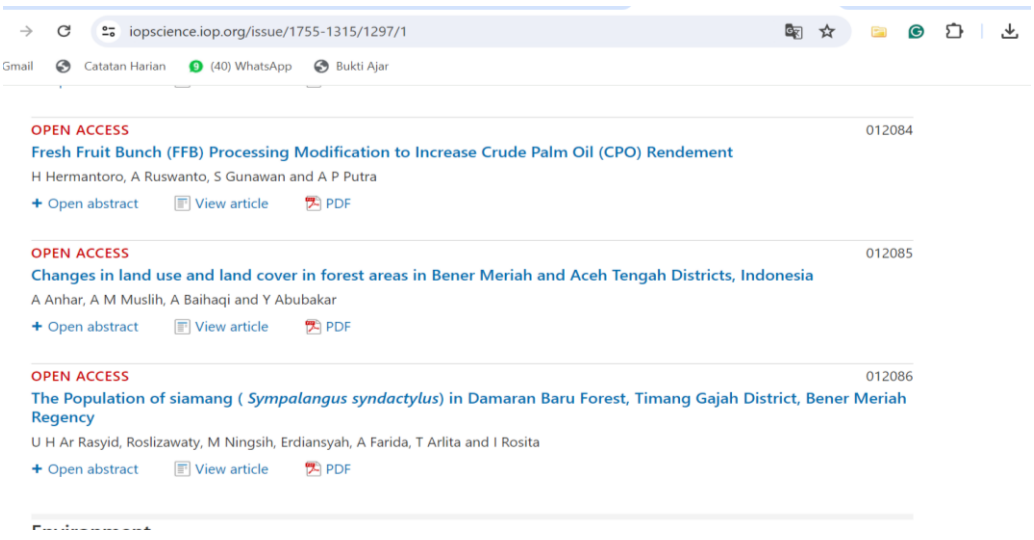
Fresh Fruit Bunch (FFB) Processing Modification to Increase Crude Palm Oil (CPO) Rendement

H Hermantoro[1], A Ruswanto[1], S Gunawan[1] and A P Putra[1]

Published under licence by IOP Publishing Ltd
IOP Conference Series: Earth and Environmental Science, Volume 1297, The 5th International Conference on Agriculture and Bio-industry 11/10/2023 - 12/10/2023 Hybrid**Citation** H Hermantoro *et al* 2024 *IOP Conf. Ser.: Earth Environ. Sci.* **1297** 012084**DOI** 10.1088/1755-1315/1297/1/01208




iopscience.iop.org/issue/1755-1315/1297/1
Catatan Harian
(40) WhatsApp
Bukti Ajar
IOPscience
Journals
Books
Publishing Support
Login
IOP Conference Series: Earth and Environmental Science
PURPOSE-LED PUBLISHING
Table of contents
Volume 1297
2024
Previous issue
Next issue
The 5th International Conference on Agriculture and Bio-industry 11/10/2023 - 12/10/2023 Hybrid
Accepted papers received: 17 January 2024
Published online: 14 February 2024
Open all abstracts
JOURNAL LINKS
Journal home
Journal scope
Information for organizers
Information for authors
Contact us
Reprint services from Curran Associates
HONOLULU, HI
Oct 6–11, 2024


iopscience.iop.org/issue/1755-1315/1297/1
Gmail
Catatan Harian
(40) WhatsApp
Bukti Ajar
OPEN ACCESS
012084
Fresh Fruit Bunch (FFB) Processing Modification to Increase Crude Palm Oil (CPO) Rendement
H Hermantoro, A Ruswanto, S Gunawan and A P Putra
+ Open abstract
View article
PDF
OPEN ACCESS
012085
Changes in land use and land cover in forest areas in Bener Meriah and Aceh Tengah Districts, Indonesia
A Anhar, A M Muslih, A Baihaqi and Y Abubakar
+ Open abstract
View article
PDF
OPEN ACCESS
012086
The Population of siamang (Sympalangus syndactylus) in Damaran Baru Forest, Timang Gajah District, Bener Meriah Regency
U H Ar Rasyid, Roslizawaty, M Ningsih, Erdiansyah, A Farida, T Arlita and I Rosita
+ Open abstract
View article
PDF

IOP Conference Series: Earth and Environmental Science

PAPER • OPEN ACCESS

Fresh Fruit Bunch (FFB) Processing Modification to Increase Crude Palm Oil (CPO) Rendement

To cite this article: H Hermantoro *et al* 2024 *IOP Conf. Ser.: Earth Environ. Sci.* **1297** 012084

Fresh Fruit Bunch (FFB) Processing Modification to Increase Crude Palm Oil (CPO) Rendement

H Hermantoro*, A Ruswanto, S Gunawan and A P Putra

Agricultural Engineering Department, Stiper Agricuture University

*Email: hermantoro@instiperjogja.ac.id

Abstract. Oil palm has grown from an area of 300 thousand ha in 1980 to now 16.1 million ha (according to GAPKI) with CPO production of 40 million tons. People's plantations continue to increase and currently account for 52 percent of the total area of oil palm plantations. In this research, pressing pressure experiments were carried out at 60 bar, 70 bar, and 80 bar, respectively, oil losses in fiber were obtained at 13.22%,9.34%, and 7.63%. Through regression analysis, it was found that oil loss in the mesocarp was 1.1% at a pess pressure of 106 Bar. So from this experiment it can be concluded that separating the mesocarp and kernel before pressing provides an increase in oil yield, minimizing oil loss in fiber. The standard oil loss in fiber is 5% in the current palm oil processing process. After modifying the process, very small oil loss in the fiber can be achieved.

1. Introduction

Indonesia is a country that has extensive palm oil plantations and is also the number one producer of Crude Palm Oil (CPO) in the world with CPO production reaching 24 million tons [1] Indonesian CPO production is also a source of foreign exchange income for the country while fulfilling 47% of the world's vegetable oil needs [2]. According to the Indonesian Palm Oil Entrepreneurs Association [3], in 2020 Indonesia's palm oil (CPO) production was 47.40 million tons with a land area of 16,381,959 ha (16.38 million ha) from 26 provinces and in 2021 it is projected to be 52.30 million tons. [4] The highest increase in ALB was in the field or before processing started at the PKS. During processing at the PKS the increase in ALB was only 0.1% - 0.5%. The length of the processing delay can increase the ALB of CPO by 0.94% for every 1 day of processing fruit [5]

Palm oil (CPO) is a vegetable oil obtained from the flesh and fiber of the fruit (mesocarp) which contains a lot of oil, mostly from the Elaesis guineensis species. Palm oil is an oil that has high levels of saturated fat, including fatty acids esterified with glycerol. During processing, some palm oil undergoes oxidation. In the palm oil processing process, the company always strives to optimize the amount of CPO yield. One of the company's management systems that has been established to achieve optimal results is to reduce oil loss in CPO during the production process. Oil loss that occurs at each palm oil processing station is caused by various factors. The high level of oil loss affects the efficiency of the production process, causing losses, this is du e to equipment that does not have optimal design capabilities and capacity

Sterilization, fruit stripping, digestion, screw pressing and refining are wet processes in the CPO factory. FFB is sterilized with hot steam. Next, the fruit is crushed using a rotary thresher and continues

to the digester. Fruit that has gone through the digestion process will be pressed with a twinscrew press to extract oil from th e FFB. Large particles contained in the oil from the screw press are separated using a vibrating screen. The addition of water to the digester, screw press, and filtering process functions to increase the efficiency of CPO extraction from palm fruit [6]. So far, the stages of the CPO processing process are reception station (weighing and greading), sterilization station (using steam), fruit peeling, digesting and press station and clarification station (clarification). In the actual boiling (sterilization) process in the field there is a continuous syst em sterilizer with a temperature of around 95ºC-100ºC (pressure around 1-1.5 bar) and a batch system sterilizer with a triple peak temperature of around 135ºC-145ºC using a pressure of 1.5 - 3.0 bar, time around 80 - 90 minutes, as shown in figure 1.

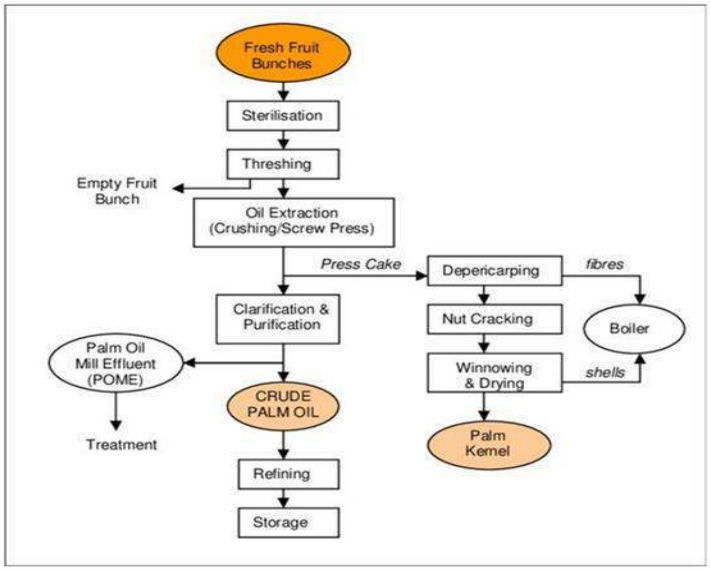


Figure 1. Flow diagram of the palm oil processing process.

One of the things that can reduce the productivity of palm oil processing is that there is still a large amount of oil or oil content that is still included in the fiber or dregs left over from production. This is caused by the hydraulic cone being less than optimal in applying pressure to the screw, so that the fiber compression process is not optimal. The function of the screw press is to extract the oil (crude oil) in the fruit flesh (mesocarp) as much as possible and break the nuts to a minimum. This tool consists of a cylinder (press cylinder) which has holes and inside it there are two screws (screws) in opposite directions that function as pushing the loose hair towards the cone. The press pressure is regulated by two cones at the end of the press, which can move back and forth hydraulically, so that the screw and cone produce very high pressure in the extraction process. This extraction process must also meet the standard press quality parameters, along with these quality parameters.

Table 1. Standard press units.

No	Parameter	Standard
1	Oil Losses	< 5%
2	Broken Nut	<10%

Based on this background, process modifications need to be carried out, by separating the fiber/mesocarp from the kernel before pressing is carried out on the mesocarp. In this way the cpo can be completely pressed, oil loss through the fiber is close to zero. The aim of the research is:

1. change the mesocarp and kernel separation unit before pressing
2. Increase CPO yield by increasing mesocarp press pressure so that oil loss is small

2. Materials and methods

This research stage was carried out during the press machine operation process, but only changed the Ampere on the control panel with 3 treatments, namely 42-45 Ampere (60 Bar), 43-46 Ampere (70 Bar), and 44-47 Ampere (80 Bar. So by changing the Ampere, the pressure of the hydraulic cone automatically changes according to the rotation of the electric motor. The following is the process or stages of the oil processing process at the palm oil factory and the sampling location, as shown in figure 2.

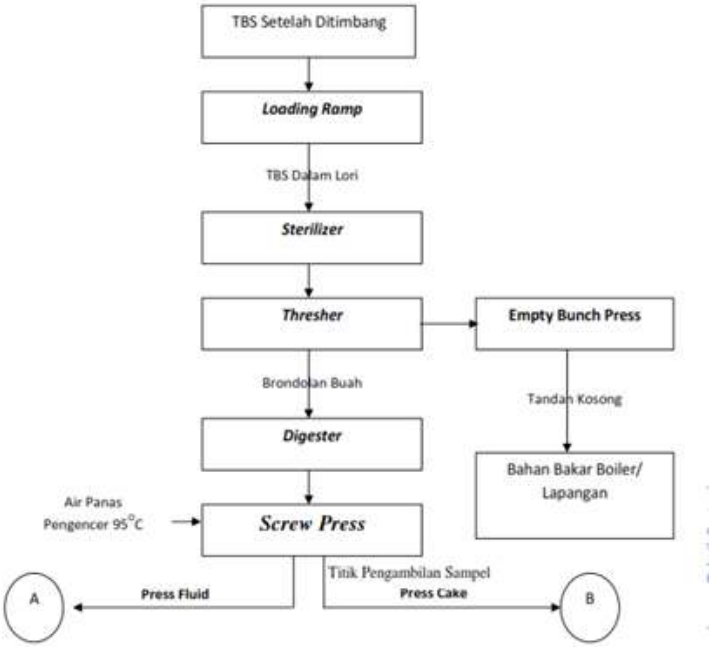


Figure 2. Palm oil processing flow diagram.

3. Results and discussion

In this research, oil is preferred in the flesh part of the fruit (mesocarp). Meanwhile, the physical condition of nuts or fruit seeds must be considered during the "pressing" process, because after this extraction process the nuts will be reprocessed at the nut and kernel station to extract the kernel, which will later be sold to the kernel oil processing factory or PKO (Palm Kernel Oil). Data on oil losses resulting from the extraction carried out are as follows.

Table 2. Experiment results oil loss in fiber (%).

Treatment	60 Bar	70 Bar	80 Bar
I	9.27	7.98	9.67
II	12.92	9.42	8.37
III	18.69	12.27	7.63
IV	12.01	7.68	8.44
Amount	52.89	37.36	34.13
Average	13.22	9.34	7.63

The regression equation between pressure (bar) and oil loss in fiber is as follows Y = 33655x

1.919, with a coefficient of determination R2 = 0.99. with a coefficient of determination R2 = 0.99. Next, an extrapolation analysis of the equation is carried out so that the smallest oil loss of 1% can be obtained at pressure 220 Bar.

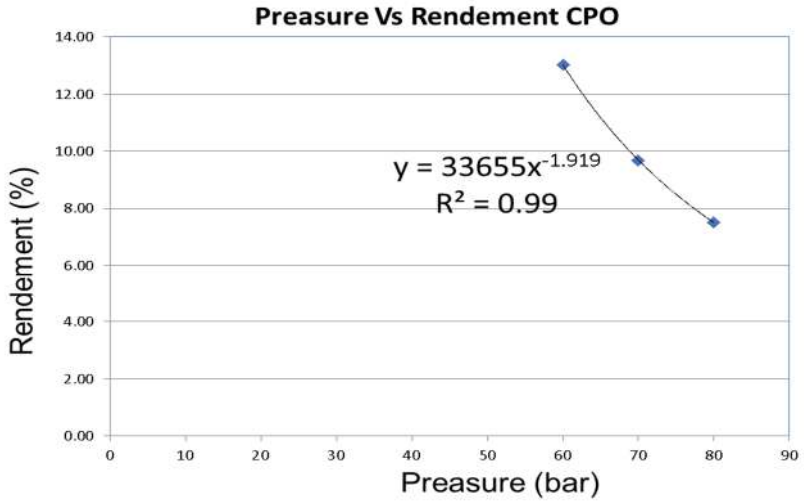


Figure 3. Relationship between pressure and oil loss.

In the design of the flow process palm oil mill the researcher limited the research to the design of the CPO processing process using FFB raw materials with process stages starting from rotary feeder, screw conveyor c/w heater, demesocarper, single screw press, crude oil tank, filter press and storage tank.

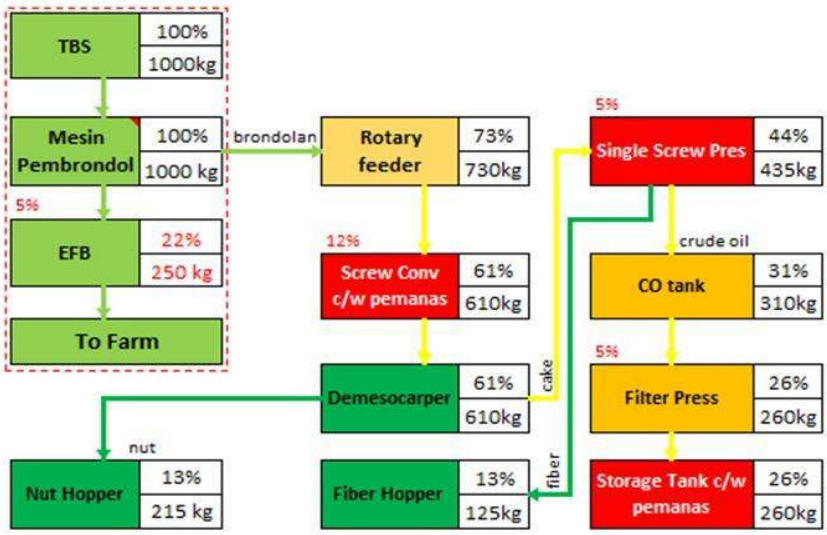


Figure 4. Design of the flow process palm oil mill.

4. Conclusions

Through processing modifications, can be designed mill with minimum oil loss in the fibre 1% at pressure of 220 Bar, in other words it can increase oil yield. This research is a preliminary study, to obtain the basis for the mill design, further experiments are still needed.

References

[1] N. Hairiyah, R. Rizki, and R. A. Wijaya, "Analisis Total Productive Maintenance (Tpm) Pada Stasiun Kernel Crushing Plant (Kcp) Di Pt. X," *J. Teknol. Pertan. Andalas*, vol. 23, no. 1, p. 103, 2019, doi: 10.25077/jtpa.23.1.103-110.2019.
[2] Wiyono, "Hasrat menguasai pasar minyak sawit. Info Sawit," 2013, pp. 7(1):12-15.
[3] GAPKI, "Peran Strategis Sawit Rakyat Indonesia," *https://gapki.id/news/3875/peran-strategis-sawit-rakyat-indonesia*, p. 13 Februari 2023, 2020.
[4] "BADAN PUSAT STATISTIK BPS-STATISTICS INDONESIA."
[5] S. Mangoensoekarjo and H. Semangun, "Manajemen Agrobisnis Kelapa Sawit.," *Gajah Mada Univ. Pr*, 2003.
[6] A. B. Rantawi, "Korelasi Kadar Air pada Kernel terhadap Mutu Kadar Asam Lemak Bebas Produk Palm Kernel Oil yang Dihasilkan," *J. Citra Widya Edukasi*, vol. 13, no. 1, pp. 27–32, 2021.