



FAILURE ANALYSIS OF THE FLOUR PRESS MACHINE AND ALTERNATIVE SOLUTIONS AT PT ANEKA USAHA LABA JAYA UTAMA PESAWARAN

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ABSTRACT: Processing chocolate from dried cocoa beans to become a ready-to-eat chocolate paste involves a long process, including separating the cocoa oil from the flour. The separation process is mechanized using a press machine with high pressure at a certain temperature level. However, a press machine deals with obstacles prone to failure and damage. This study aims to analyze the causes of the chocolate pressing machine's failure using hydraulic pressure and find alternative repair solutions. The cylinder of the machine press is made of stainless steel material and has a cylindrical geometry with a diameter of 23 mm and a tube length of 30 cm. Failure analysis is carried out by observing the machine's operating conditions, the procedure for its use, and the load imposed on the machine, including, in this case, the service life to date. Observations were also made on the form of failure, the type of damage, and each component's function. Thus, based on the data obtained and relates to the theoretical theory, the conditions that should occur are obtained. The study results showed that the damages occurred, such as press tube damage, deformed fins, clogged gaps between fins, worn support rods, corroded threads, worn and stiff seals, and bearing damage to rupture. More damage was caused by the tilted position of the machine so that it didn't move the flashlight anymore. The part of the machine must be repaired flat based on standard procedures operation and carry out periodic checks on machine components.

KEYWORDS: *Press Machine, Failure Analysis, Alternative Solutions*

1. INTRODUCTION

Press machines in the chocolate industry are used to press cocoa powder to remove oil because the oil from roasted cocoa beans is highly valued and produces the best quality chocolate [1]. Using a press machine to produce cocoa oil mechanically is easier than using chemicals to extract it because mechanical pressing shortens the process chain [1-2]. However, the mechanical process has its main disadvantage, in that the machine used requires a large investment cost and must be made from materials that are free from contamination. The use of stainless-based materials and the need for large hydraulic pressure causes investment costs to increase sharply [3]. Raw materials processed in the form of chocolate fruit as food ingredients must be free from metal materials that can damage food ingredients and consumers. Thus, stainless steel is the main alternative for processing foodstuffs such as cocoa oil [4]. In addition to being resistant to rust, stainless steel has high strength and toughness against repeated loads.

The processing of cocoa beans into powder and separating cocoa oil involves a long chain of processes: drying, roasting, powdering, refining, and separating cocoa powder and oil [5].



Drying uses a drying machine or sun drying. Meanwhile, roasting uses a roaster machine with an electric or artificial heat source. The powdering process uses a grinding and meshing machine to obtain a fine and uniform powder.

Processing of cocoa beans to obtain cocoa oil at PT Aneka Usaha Laba Jaya Utama Pesawaran is carried out using a mechanical system with a pressing method or press until the pressure reaches 60 bar. The cylinder of the press machine used in this industry is made of stainless-steel material with a certain wall thickness, has a tube diameter of 23 cm, and a heating temperature of up to 80 degrees Celsius. Due to the long service life, this machine is not operated due to damage during operation. The temperature pressure parameter is the main factor that plays an important role in the tool's durability because it operates at a certain pressure and temperature [6]. When pressure is applied, the cocoa powder becomes denser, and at the same time, the cocoa oil will come out. The amount of oil obtained depends on the pressure level applied. More oil is produced if the pressure applied is high (up to 60 bar).

When the machine operates at high pressure, the drum wall will experience high pressure. Therefore, accuracy is needed in determining pressure, locating the machine on the rigid floor, operating with the correct procedure, and controlling the hydraulic oil [7]. The tube wall thickness is important because it continuously receives loads from hydraulic pressure for about 2 hours. Long-term use impacts the tool's service life, and it will be worse if the operating process goes wrong or does not follow proper procedures.

The problem in this research is that the cocoa flour press machine is damaged, so it cannot produce cocoa oil. The working mechanism of the press machine occurs at high pressure and a specific temperature. The material used is made from stainless steel with high corrosion resistance. Although stainless steel is a high-strength material, it should be able to withstand the intended load. However, the chocolate pressing machine was damaged, and the cylinder blades were deformed to change the drum's inner diameter. As the inner diameter of the drum increases in the middle, this causes the pressure to be unable to make the cocoa powder release the oil. It is not known why the press tube was damaged so that it could not be used to produce cocoa oil.

2. METODOLOGI

This research referred to the research flow chart, which begins with the provided materials and equipment for the analysis data. Furthermore, analyze the damage to the machine and provide alternative solutions, as shown in Fig. 1.

This research was carried out consisting of the preparation stage, implementation stage, and reporting stage. The preparation stage is the provision of research tools, materials, and tools used in research. In contrast, the implementation stage involves observing tools in the field, data collection and analysis, and discussion. Identify the damage that occurs as data to determine the cause and solutions so that the machine can function properly. In detail, it can be explained as follows.

1. The research preparation stage consists of preparing the research equipment used, observing the equipment in the field, how to operate it, and observing the damage. The study process is carried out to determine the damage type and estimated cause. All materials and equipment used have been confirmed to be ready for using the implementation of the research.
2. The implementation stage of the research begins with determining the type and form of damage in the press machine, the amount of damage, and changes in the press tube,

measuring the deformation in the tube, taking the pressure data given when operating and operating procedures are carried out according to the standard or not. The temperature used for heating and the maximum pressure given during the process becomes an important factor. The amount of chocolate that is put in the tube.

3. The next stage is analysis, discussion, and conclusion. Discussion and analysis were carried out quantitatively and qualitatively. It was quantitatively used to calculate the load given during the cocoa flour pressing process. Meanwhile, the qualitative analysis was carried out by taking pictures of the damage to the blades of the press machine tube.

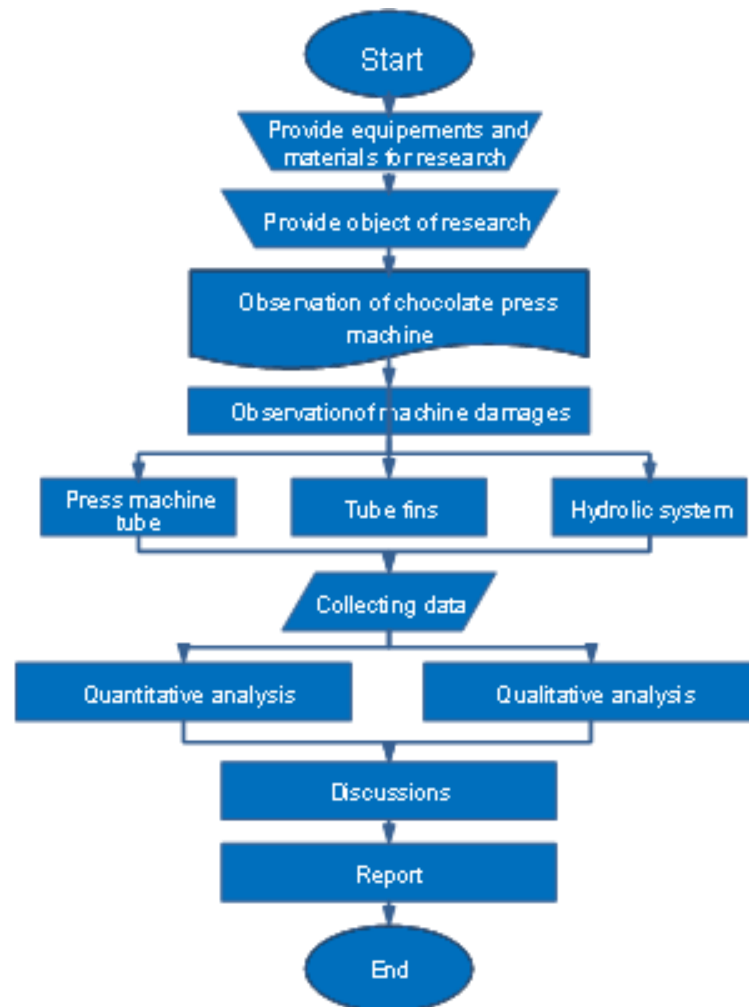


Fig. 1. Flow chart of researched activities

3. RESULT AND DISCUSSION

3.1. Chocolate Press Machine

Fig. 2 shows a chocolate pressing machine used to produce cocoa oil from cocoa flour generated by the hydraulic pump. This machine has a breakdown, but the cause of the breakdown is unknown. After the observations, some damages were obtained in the field. This press machine has several parts, including the retaining rod, controller, press tube, cocoa oil channel, and so on, as shown in Fig. 2. The main part of this machine is the press tube and fins

where the cocoa's oil is released after pressing. The press tube is used to press the cocoa powder inserted into the tube.

One part of the pressing machine that plays an important role, but its nature is the main support, namely the engine holder. The engine holder used to support the engine load consists of wood, so there is a possibility that it is not as sturdy as the load base that can accept heavy loads. Most engine seats are made of rigid materials, so they are not easily deformed, causing the engine to be in an uneven or tilted position. Concrete or iron castings are the best choices because this material is rigid and does not change its position easily [8]. When the engine is running, the vibration caused by the engine affects the position of the engine. Therefore, the engine mount must be rigid and hard to change position. Changing the position will cause the engine flatness to be not standard anymore.

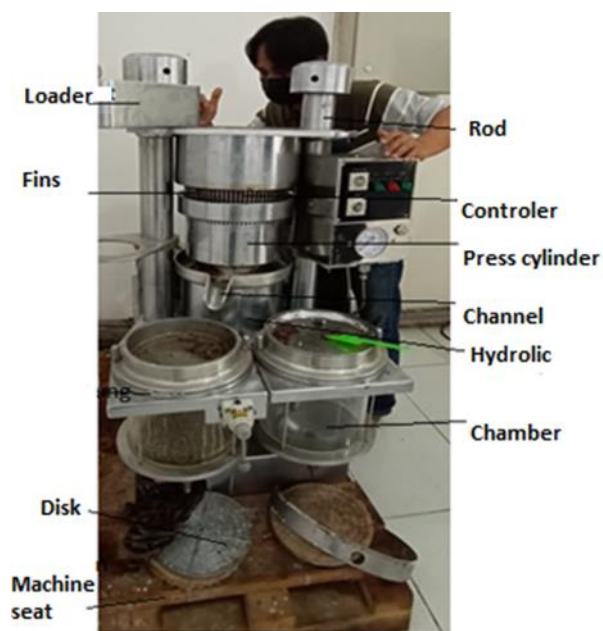


Fig. 2. Chocolate press machine used for producing high-quality cocoa oil.

3.2. Press Machine Cylinder

Fig. 3 is a hydraulic tube used for pressing cocoa powder to get oil as one of the chocolate products, which is very expensive. The brown tube consists of several fin rods tied with tie rings at the bottom, middle and top. The fins and tubes are made of stainless steel because the tool is used for food processing which must be protected from contamination. Consideration of strength is very good because it is made of stainless steel, which has a high level of strength. It's just that due to the wrong use process, or overload, it is possible to experience damage in the form of changes in shape.

The main part of tube one is the fin, where the brown oil drains into the container. The damage on the pressing machine is triggered by damage to the tube. The clogging of the gaps between the fins is caused by the accumulation of brown powder (granules) until it hardens. The hardening of cocoa powder in the gaps between the fins is triggered by not cleaning every time the machine is used. Even if the material that passes through the light is brown oil, it can harden and clog the gaps between the fins. High temperature or hot cocoa oil as a result of pressing pressure this condition accelerates the hardening of the cocoa powder that sticks to the tube. The lower fins and the gaps between the fins are clogged due to the accumulation of



hardened cocoa powder. The longer or more often used, the more cocoa powder accumulates in the gap area. The hardening of cocoa powder on the fins and the gaps between the fins can cause damage to the tube because if the pressure increases and no load comes out, it will impact the construction of the press tube [8-9].

The hole leading to the gap between the fins is located at the top of the ring. The function of the hole is to drain the brown oil from the top. The hole is clogged by powder material that has thickened and hardened. Improper usage procedures cause this condition. When the operator finishes using this press machine, the operator should clean the potentially clogged holes. Otherwise, the consequences could be worse. The blockage of several holes has prevented the brown oil from flowing into the reservoir. Oil will accumulate around the seal and cause the seal to be submerged by oil, and at that time, the working temperature is high, causing the seal to be damaged.

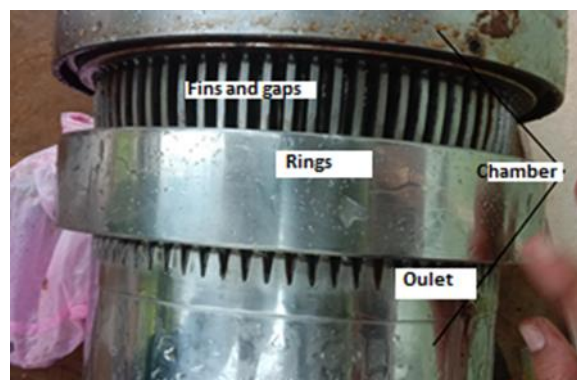


Fig. 3. The damages occurred on the press machine tube.

3.3. Press Machine Tube Damages

Fig. 4 shows some of the damage to the brown press tube operated at the Pesawaran Regency BUMD Company, including clogged oil channel holes, clogged fins, worn inner surface of the tube, not tight seals, and the gaps between the fins were compressed. In general, several types of damage that occur to the tube press machine are caused by incorrect procedures for using the tool. An example of damage caused by incorrect machine operating procedures is the swelling in the gap between the fins. Every time after using the machine should be cleaned so that the remaining raw materials do not become dirty and cause damage. The material can accumulate in one place and then clump until it hardens. If it has hardened, then it can no longer be cleaned normally. It must be scraped to remove the hardened dirt.

The inner surface of the press tube wears out due to friction between the tube's inner wall and the hydraulic plunger's outer wall. This damage should not have occurred because between the two walls. There is already a gap, so it is impossible to rub against each other. Damage on the press wall tube is caused by friction caused by the movement of the plunger that is not centered. The machine is not located on a flat surface, so the plunger is not a flashlight-the position of the machine is not located on a flat plane. The wooden support at the base has changed the position of the machine, causing it to tilt. The damage to the inner wall of the tube occurred only on one side, so it was suspected that it was caused by friction between two surfaces.



Fig. 4. The damages on the press machine tube and fins

The gap between the compressed fins was damaged because of the wrong procedure. There is also damage to the type of deformation or deformation of the fins, as shown in Fig. 5. The shape of the fins that were originally straight now looks not straight anymore. The distance between the fins looks not the same, so the fins can shift-this is caused by too much pressure during the pressing process [10]. It is also possible that due to the slits being compressed, the brown oil does not escape but contributes to the forced pressure on the fins. Not every fin changes shape, but only in certain parts. The hydraulic thrust may be uneven in all directions of the fin surface. This pressure unevenness is most likely due to the unstable position of the machine.

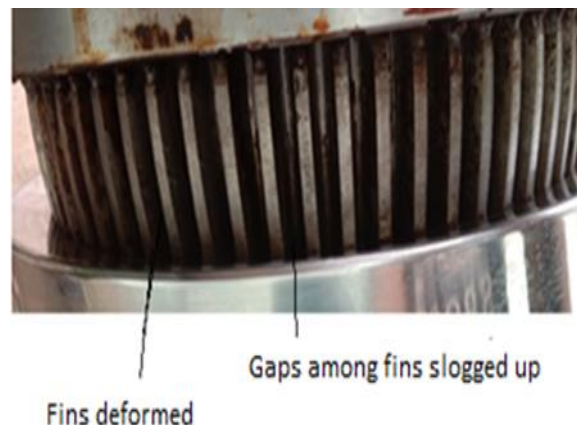


Fig. 5. A part of the fin experiences deformation and gaps among fins

3.4. Seal and the Cover of the Press Tube

Fig. 6 shows the components of the chocolate pressing machine, namely the seal and the cover of the press tube. The tube cover is used to hold the cocoa powder, which comes out of the tube and is retained, thereby expelling the cocoa oil. In contrast, the seal is to close the two surfaces of the tube so that there is no gap between them [11]. If the two tubes are not tight, the cocoa powder will come out of the gap, and the pressure cannot be maximized. If there is a gap between the two surfaces, it can be categorized as leaking because the pressure will be reduced. It is estimated that the seal has not been replaced for a long time because its shape has changed



or is not in a circular geometry position—damage to the seal, most likely due to high pressure and temperature during pressing. The high temperature causes the seal to change and harden when it cools down again, making it stiff and difficult to fit in its original position.



Fig. 6. The seal and tube cover

3.5. Damages on Thread Rod

Fig. 7 shows a load-bearing hydraulic rod attached to both sides of the press, which consists of a straight section and a threaded section. Both parts of the supporting rods were damaged, and the damage that occurred was the wear surface of the straight rods. The wear that occurs on the threaded rod is due to friction unevenly along the length of the rod. The damage or thread defects occur in many places (either at the bottom of the rod or the top). Black color is widely spread along the threaded rod, and it is all damaged in the form of a peeling surface or partially corroded material. In certain parts, the damage accumulates in one place. An uneven load may cause it during operation. It can be ascertained that when the hydraulic presses with a full load, the threaded rods also hold a large amount because the support rods work as retainers.

Black color or holes are a type of damage to the threaded surface; most likely, this is caused by corrosion because oil or water can enter this area. A large load increases the movement of the damage. There is also some black color that is cocoa powder that sticks and hardens so that it looks like something hard sticks to the surface of the thread



Fig. 7. Damages on the threaded rod

4. CONCLUSIONS

The conclusion that can be drawn from the results of this study is the type of damage that occurs in the chocolate pressing machine and alternative repairs that may be carried out:

In general, the failure of the chocolate pressing machine to operate is caused by the damage that occurs, and the main source of damage is the uneven placement of the machine, not following the standard; it causes the tilt of the position when operating.

Types of damage that occur to engine components are:

- Press tube wears out due to friction;
- The gap between the fins is clogged;
- Mining flow hole;
- Fins change shape;
- The threaded rod is worn out, and the thread is corroded;
- Types of damage that occur to engine components are:
- Hydraulic seals wear out, deform, stiffen, and don't form circles anymore.:

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