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Evaluation Of Load Balancing On The Hammer Shredder At PT Sukses Mantap Sejahtera

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Abstract – Heavy duty hammer shredder is a tool used to crush sugarcane cells in sugar factory. In addition, this machine also aims to help milling work so that the work is not too heavy. This machine's hammer tip and seat can withstand up to 100,000 milling times. If it exceeds 100,000 times of grinding, it is necessary to carry out the maintenance process immediately to prevent unwanted damage. The maintenance process carried out is load balancing. This treatment is carried out so that the weight of the hammer shredder remains the same, namely 21.3 kg. Balancing process is done by means of electric welding. The electrode used to carry out the balancing process is the Sugar-827 electrode which is a special electrode for surface repair. After all balancing processes are completed, the heavy duty hammer shredder can be reassembled on the machine.

Keywords – heavy duty hammer shredder; sugarcane; load balancing; electrode

I. INTRODUCTION

PT Sukses Mantap Sejahtera (SMS) is one of the crystal cane sugar production companies in Indonesia located in the Dompu district, Nusa Tenggara Bara Province. This sugar factory is capable of producing 3,000 tons of sugar cane in a day (3,000 TCD/ton cane day). In producing sugar with this capacity, the company uses a series of chopping and milling equipment. The goal of this equipment is to extract and produce as much sap as possible while minimizing sugar loss in the cane. To achieve this, some of the equipment used includes a mill, cane cutter, cane kicker, cane leveler, head on cutter, and heavy duty hammer shredder. The cane cutter functions to prepare sugar cane at the beginning, namely chopping sugar cane until it reaches a size of 8-10 cm. In addition, the mill functions as a sugar cane grinding tool, and the heavy duty hammer shredder functions to open the cells in chopped sugar cane so that the sap obtained from the milling results can be maximized and sugar loss can be minimized.

Heavy duty hammer shredder (HDHS) is one of the most important equipment before sugar cane enters the mill. The output product of this machine determines whether cane can be squeezed optimally or not in milling process. This is indicated by the preparation index (PI) value taken from the output sample from HDHS. The preparation index value at PT SMS is set at ≥95%. To achieve the targeted PI value, optimal and periodic engine maintenance is required. In addition to maximizing the PI value, maintenance also aims to keep the machine working optimally and not easily damaged. Maintenance is an activity to maintain factory facilities by repairing or adjusting the machine so that it can operate as expected (1).

Based on research conducted by Sucahyo (1) on HDHS maintenance at the Kebon Agung sugar factory, HDHS hammer tip maintenance is classified as scheduled discard task maintenance with an interval of 31 days. This maintenance is the act of replacing spare parts when the age limit has been exceeded or before the age limit set regardless of the condition of the parts being updated. This maintenance is important to maintain optimal performance of HDHS.

In the study by Lukadono (2), the combination task between the scheduled discard task and the scheduled on condition task was carried out by examining the hammer holder and replacing it at the optimal time interval, namely 2,638.76 hours. This is

done so that production machines can run optimally and efficiently. Maulani (3) conducted research on the maintenance facility inventory system at PT PLN Tangerang. In the research it was concluded that the system that was done manually was not efficient. Based on research by Hairiyah (4), it was concluded that the long maintenance process, old machines, and low kernel quality were the factors causing the low OEE (Overall Equipment Effectiveness) value of the machine. In research conducted by Pramesti (5) states that unscheduled maintenance can be a cause of downtime. Suryadi (6) explains that in general the machine will have characteristics or symptoms when it needs to be treated when it is in bad condition. In research performed by Lukadono (2), at a sugar factory when damage is detected and has occurred, the maintenance activities carried out will be under the applicable standard operating procedures.

Types of maintenance are generally divided into two, namely unplanned maintenance and planned maintenance. The two types of treatment have differences in their implementation (7). At PT SMS the maintenance system used is planned maintenance. PT SMS repairs the tip hammer shredder once a year, namely during the factory shutdown period. Each side of the hammer shredder tip at PT SMS can last for 100,000 sugarcane mills. However, after 100,000 grinds, the surface of the hammer shredder tip is badly worn out, so a replacement or renewal is required. Therefore, in the first 100,000 mills, the hammer shredder tips are reversed and in the next 100,000 sugarcane mills the hammer shredder tips are replaced. Not only the hammer shredder tip is worn out but the hammer shredder holder is also worn out due to friction with the sugarcane. Wear and tear on the hammer shredder can cause vibrations in the hammer shredder. This is indicated by an abnormal sound from HDHS. The abnormal sound is caused by the wear and tear and causes a difference in the weight of each hammer. For this reason, it is necessary to do a balancing process by equalizing the weight of each hammer. The balancing process is carried out by means of welding (SMAW/shielded metal arc welding) where in the welding process, the electric arc at the tip of the electrode and the workpiece will generate heat generated by the welding machine which results in melting of the filler metal and forming weld metal and slag (8). According to Prayitno (9) it was stated that the magnitude of the electric welding current depends on the diameter of the filler metal used.

Due to the conditions experienced by PT SMS, it is necessary to conduct research to obtain the best solution for the problems experienced in the hammer shredder section. The research was carried out with the aim of equalizing the weight of the hammer shredder so that when the HDHS machine is operating, the tool can work optimally and optimally and does not make abnormal noises that accelerate machine breakdown.

II. EXPERIMENTAL PROCEDURE

The research was conducted when the machine was not operating after the machine had milled sugarcane 118,000 times. The hammer shredder that will be examined is taken and then undergoes repairs with the aim of optimizing its performance again so that it can carry out its functions properly and efficiently. The shape of the hammer shredder to be examined is shown in Figure 1.

The specifications for the tips and holders of the heavy duty hammer shredder used at PT Sukses Mantap Sejahtera can be seen in Table 1.

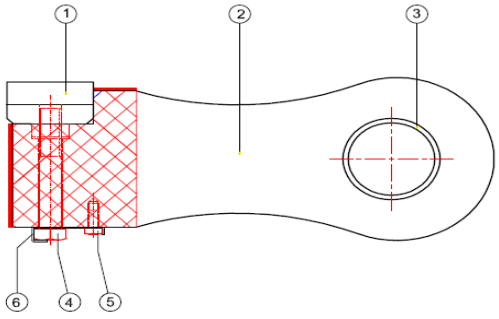

Fig. 1. Hammer shredder tip and holder components. 1. Domite tip, 2. Hammer holder, 3. Bushing, 4. Hex bolt M20, 5. Hex bolt 3/8”, 6. Locking plate

The process stages starting from hammer removal to reinstallation are shown in Figure 2. To carry out this research several

stages are required. The dismantling stage of the heavy duty hammer shredder is carried out after the machine is completely out of operation. The removal stage begins by releasing the shaft which is where the HDHS hammer is placed. A total of 152 hammers were removed from the machine and neatly arranged according to the number of axles to facilitate the balancing process. The hammer that has been removed is then placed in the balancing process workplace, which is right next to the HDHS machine. After all the hammers have been removed from the HDHS body, the next step is the process of weighing each hammer. This is done to find out how much electrode or filler metal will be added for each hammer. Based on the HDHS machine specifications, the normal weight of the hammer is 21.5 kg. However, in this treatment, the targeted weight for the HDHS hammer is 21.3 kg. The difference of 0.2 kg from the normal weight is the excess tolerance value during the balancing process. This is because the weight of the HDHS hammer cannot exceed 21.5 kg. If the weight of the hammer exceeds that specified, the load received by HDHS is also greater and it is possible for damage to the machine to occur. The tip replacement stage is the stage where all the tips on the hammer are replaced. The tips on the hammer were replaced due to wear and tear and having completed more than 100,000 grinds. This is so that at the time of the next milling, the HDHS machine is ready and able to work optimally. The tip is replaced with a new tip or with a tip that has been fabricated in the previous treatment. The hammer balancing stage is carried out to equalize the weight of all the hammers. This is done, so that when the HDHS machine rotates there is no difference in the weight of each hammer. The difference in weight between the hammers will cause abnormal vibrations in the HDHS. This balancing stage is carried out by welding. The welding used is electric welding which uses an electrode covered by flux. The part that is welded is the hammer holder. If the hammer is underweight, then the weight of the hammer is added to the desired weight, which is 21.3 kg. However, if the hammer is overweight, exceeding 21.3 kg, it is necessary to carry out a balancing process by means of grinding. The hammer balancing process uses Sugar-827 electrodes. The use of this electrode is due to the Sugar-827 electrode being produced for surface repairs such as milling rollers and hammers.

TABLE 1. SPECIFICATIONS FOR HEAVY DUTY HAMMER SHREDDER TIPS AND HOLDERS AT PT SUKSES MANTAP SEJAHTERA

Name	**Specification**
Weight of hammer	21.5 kg
Material of hammer holder	Material C45
Bushing	Ø80 x Ø90 x 46 mm
Hex bolt	- Hex, Bolt M20 x 1,5 Pitch, HT, GR, 10,9 - Hex, Bolt 3/8” G 16, HT, GR, 4,6
Locking plate	Material SUS 304, 1,2 x 40 x 100 mm
Material of tip	Domite chromium carbide
Mechanical properties of tips	- Tensile strength 630 MPa - Shear strength 250 MPa - Hardness 700 HBN
Number of hammers	19 pieces per shaft
Number of shafts	8 shafts

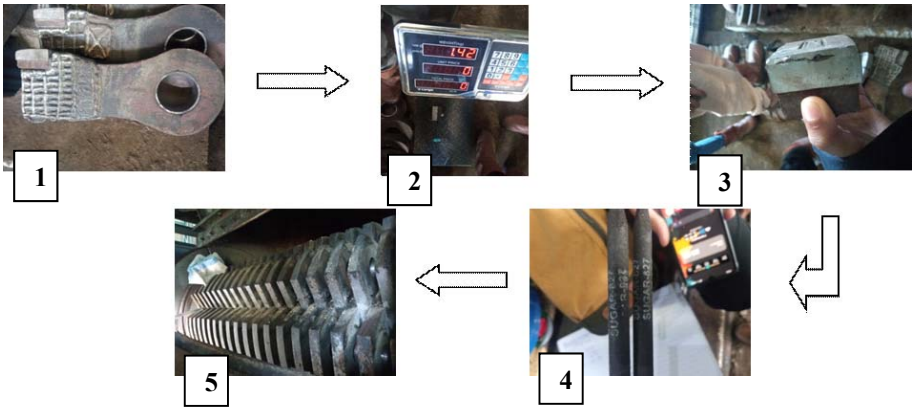

Fig. 2. Schematic of the hammer shredder maintenance process. (1) Hammer removal process, (2) Hammer weighing, (3) Installation of new tips or tips that have been fabricated, (4) Hammer load balancing by welding, (5) Hammer installation.

III. Results And Discussion

The hammer that has been taken from its position is first weighed to determine the weight of each. The results of measuring the weight of the hammer shredder are shown in Figure 3. These results provide information to the operator to find out quickly on which shaft the most wear occurs. There are 19 hammers studied on each shaft where the number of shafts is 8. Therefore, the total hammer is 152.

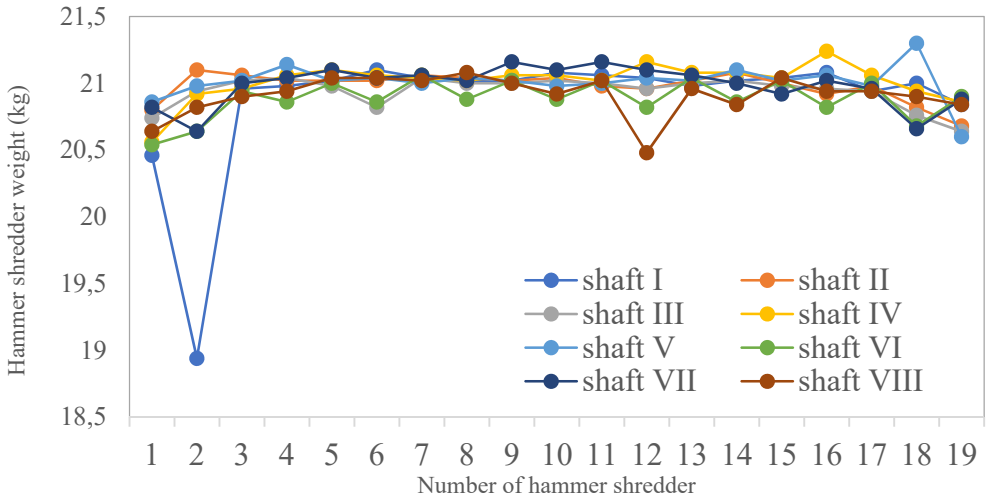

Fig. 3. The weight of the hammer shredder before the balancing process

Based on Figure 3 it can be seen that after operating for 1 year in 118,000 milling times the majority of the hammers have worn out or lost weight. On average, there is a hammer weight loss of 2.5% of its initial weight. If we examine it more closely, it appears that the biggest wear and tear occurs on hammer number 2 on shaft I where the weight of the hammer is now 18.94 kg or reduced by 11.8%. The reduced weight of the hammer will have a negative impact on the quality of sugarcane grinding where sugarcane cannot be squeezed to the fullest. This of course will be very detrimental to the company because the amount of sugar water obtained will also be less. Besides that, the presence of hammers that are not the same weight and even have a large difference with other hammers will have an impact on the hammer holder which can experience cracks because it is subjected to a greater load than other hammers. This of course will be very detrimental because it will cause additional expenses. As for the things that can cause a reduction in the weight of hammer number 2 on shaft 1 can be caused by more cane passing through the hammer so that the hammer experiences a greater workload and ultimately causes wear and tear. Another cause is the entry of foreign material such as stone, iron and other hard materials into the hammer during the grinding process. The entry of these foreign objects is possible due to the washing process of sugarcane stems and the magnetic separator's work is not optimal. This

unwanted foreign material can cause the tip to experience severe wear and even break. Apart from showing the location of the worst wear on the hammer, the picture also shows that the hammer needs repair because the weight is not the same which is caused by the wear factor. This wear is caused by friction between the cane with the tip and the holder. The friction that occurs causes erosion of the hammer material. For this reason, maintenance is carried out, namely changing tips and balancing hammers. Balancing hammer process is done by welding and grinding. This process is carried out with the aim of making all hammers have the same weight, namely 21.3 kg with a tolerance of 0.05 kg. Tolerances are given less to prevent excessive vibration during the grinding process.

After the process of adding weight and equalizing the weight of each hammer, the hammer is then put back in position. After this process, it is expected that the milling process can run well again and produce sap in normal quantities.

IV. CONCLUSIONS

After one year of use, the hammer shredder experiences wear and tear with different levels of wear on each shaft. The sugarcane washing process that does not run properly affects hammer wear. This occurs because unwanted hard material can escape and come into contact with the hammer. Likewise, the magnetic separator needs to be checked periodically to ensure its function is running properly. A well-functioning magnetic separator can keep the hammer shredder in optimal condition. Repair of hammer shredder which is experiencing wear is carried out by balancing process through welding using a special electrode, namely the Sugar-827 electrode. After this series of treatments, the hammer shredder can work optimally in the next mill.

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REFERENCES

[1] H.E. Sucahyo, “Perencanaan Perawatan Mesin Heavy Duty Hammer Shredder dengan Metode Reliability Centered Maintenance II (Studi Kasus: PG Kebon Agung Malang),” Thesis undergraduate, Universitas Muhammadiyah Malang, 2017.

[2] R.P. Lukadono, Praktikno, R. Soenoko, “Analisis Penerapan Metode RCM Dan MVSM Untuk Meningkatkan Keandalan Pada Sistem Maintenance (Studi Kasus PG. X)” Jurnal Rekayasa mesin, vol. 4, No.1, pp. 43-52, 2013.

[3] G. Maulani, D. Septiani, P.N.F Sahara, “Rancang bangun sistem informasi inventory fasilitas maintenance pada PT. Pln (persero) tangerang,” ICIT (Innovative Creative and Information Technology) Journal, Vol. 4, No. 2, pp 156-167, 2018.

[4] N. Hairiyah, R. R. Rizki, R. A. Wijaya, “Analisis Total Productive Maintenance (TPM) Pada Stasiun Kernel Crushing Plant (KCP) Di Pt. X,” Jurnal Reknologi Pertanian Andalas, Vol. 23, No. 1, pp. 103-110.

[5] V.D. Pramesti, A.E. Susetyo, “Analisis Penerapan Metode Reliability Centered Maintenance (RCM) Untuk Meningkatkan Keandalan Pada Sistem Maintenance,” Industrial Engineering Journal of The University of Sarjanawiyata Tamansiswa, Vol. 2, No. 1, pp. 44-53.

[6] D. Suryadi, R. Meilinda, A.F. Suryono, Munadi, “Sistem Pakar untuk Mengidentifikasi Kerusakan Mesin Industri Menggunakan Metode Certainty Factor,” Rotasi, Vol. 20, No. 1, pp. 56-62.

[7] F. Mustaqim, W. Kosasih, Ahmad, “Pemeliharaan mesin hydraulic shear menggunakan pendekatan reliability centered maintenance dan manajemen suku cadang, Jurnal Rekayasa Sistem Industri, Vol. 9, No. 3, pp. 153-161.

[8] A.S. Ritonga, E.S. Purwaningsih, “Penerapan Metode Support Vector Machine (SVM) Dalam Klasifikasi Kualitas Pengelasan Smaw (Shield Metal Arc Welding),” Jurnal Ilmiah Edutic, Vol. 5, No. 1, pp. 17-25.

[9] D. Prayitno, H.D. Hutagalung, D.P.B. Aji, “Pengaruh Kuat Arus Listrik Pengelasan Terhadap Kekerasan Lapisan Lasan pada Baja ASTM A316,” Jurnal Dinamika Vokasional Teknik Mesin, Vol. 3, No. 1, April 2018, pp. 1-6.