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Optimizing Digging Equipment Productivity Using Overall Equipment Effectiveness (OEE) Method in Coal Overburden Mining Activities

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Abstract

Coal companies have an overburden stripping production target of 95,000 bcm in January 2022, while the realization of production with the Sumitomo SH 350 LHD excavator and Hitachi Zaxis 350 H excavator is only 77,000 bcm or 82% of the production target. The purpose of this study was to obtain an analysis of the productivity of the Sumitomo SH 350 LHD Excavator (40) and Hitachi Zaxis 350 H Excavator (31) in the overburden stripping activity in January 2022, analyze the obstacle factors that caused the available working hours to be reduced by using the Fishbone diagram method, get an analysis of the Overall Equipment Effectiveness (OEE) value of the Sumitomo SH 350 LHD Excavator (40) and Hitachi Zaxis 350 H (31) Excavator before being optimized, and get the analysis and productivity of the Sumitomo SH 350 LHD Excavator (40) and the Hitachi Zaxis 350 H Excavator (31) which has been optimized with the implementation of Overall Equipment Effectiveness (OEE) to achieve the overburden stripping production target. After analysis and improvement efforts, the total overburden stripping production was 149,000 bcm, which means that it has reached the target and even exceeded the production target of 95,000 bcm/month with the OEE value of the digging equipment of 41% and 43%, respectively. However, the OEE value is still very low compared to the world-class standard OEE value, which is 85% and there is still room for improvement.

Keywords: Excavator, Fishbone, Mining, OEE, Overburden.

1. Introduction

PT. Jaga Usaha Sandai is a bauxite contractor company working in the Mining Business License Area (WIUP) of PT Cita Mineral Investindo, Tbk - Sandai Site. PT Jaga Usaha Sandai has an Overburden stripping production target of 95,000 bcm in January 2022, while the realization of production with Sumitomo SH 350 LHD Excavator and Hitachi Zaxis 350 H Excavator is only 77,000 bcm or 82% of the production target. From the observation data, it can be concluded that overburden stripping production in January 2022 did not reach the target planned by the company[1], [2].

The non-achievement of the overburden stripping production target is caused by the very low effective working time of the excavating equipment, which is 229.1 hours/month for the Sumitomo SH 350 LHD Excavator (40) and 270.3 hours/month for the Hitachi Zaxis 350 H Excavator (31) from 535 hours/month of available working time. For the overburden stripping production target to run optimally and to maximize the effective working time of the working excavating equipment, it is necessary to further analyze the productivity of the working hours of the equipment, find the causes and actions taken to achieve the target, and evaluate to optimize the performance of the excavating equipment[3]–[5]. One of the appropriate methods used in overcoming these problems is the Overall Equipment Effectiveness (OEE) method which is a production process performance measurement tool that can measure various losses that occur and identify potential improvements[6].

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1.1 Mechanical Earthmoving

According to[7] earthmoving work is the same, namely moving material (soil) from one place to another, but the process of work in its implementation can vary.

1.2 Digging and Loading Equipment

One of the digging tools used in mining activities is an excavator. Excavators are generally operated by utilizing hydraulic power so they are also called hydraulic excavators. The advantage of an excavator is that it can distribute the load to all parts of the vessel evenly[5], [8]. This means that it is easier to manage the load so that the course of the dump truck can be balanced. Usually, the backhoe on Komatsu has a small bucket (PC 300 type and below), while for loading shovels, the bucket is larger such as PC 400 and above[9].

1.3 Factors Affecting Production

The factors that affect production are material loading position, material factor, material development factor (swell factor), bucket fill factor, tool cycle time, availability of mechanical equipment, and haul road conditions[10].

1.4 Productivity of Loading and Unloading Equipment

Backhoe production in this case is influenced by bucket capacity, fill factor, circulation time, and tool work efficiency[11]. To find out the backhoe's production capability, you can use the following equation:

$$Q = \frac{q \times SF \times k \times 3600 \frac{second}{hour} \times eff}{CT} \tag{1}$$

Description:

Q = Productivity of the digging and loading equipment (bcm/hour)
q = Bucket capacity (m^3)
sf = Swell Factor
k = Fill factor
Eff = Work efficiency

1.5 Overall Equipment Effectiveness (OEE) Method

According to Nakajima (1988), OEE is a method for measuring the performance of machinery or equipment used in the industry by considering various production losses. This measurement is very important to find out which areas need to be improved productivity or efficiency of the machine/ equipment[12], [13]. OEE can be obtained by multiplying Availability, Performance, and Quality Rate. In line with Nakajima's concept, OEE for load and haul equipment has been configured and defined as the product of the Availability Factor, Utilization Factor, Speed Factor, and Bucket Factor[3].

1.6 Fishbone Diagram

Based on research by[7], Fishbone diagrams or commonly called cause and effect diagrams are tools that help identify, sort, and display the various causes of a problem.

1.7 Simple Linear Regression Analysis

Simple Linear Regression is a statistical method that serves to test the extent of the causal relationship between the Causal Factor Variable (X) and the Resulting Variable. Causal Factors are generally denoted by X or also called Predictor while the Resulting Variable is denoted by Y or also called Response[14], [15]. The Simple Linear Regression Equation Model is as follows:

$$Y = aa + bx \tag{2}$$

Where:

Y = Response variable or dependent variable
x = Predictor variable or causal factor variable (independent)
a = Constant
b = Regression coefficient (slope), the amount of response caused by the predictor

2. Research Methodology

This research uses a type of quantitative research which refers to experimental research. This is because the research will use data in the form of numbers which are then processed and presented in the form of tables or graphs to present the results of the data processing and then analyzed using statistical and percentage data analysis methods. Based on the type of use, this research is included in applied research methods[16], [17]. Applied research is research that aims to increase scientific knowledge with practical goals.

The object of the research is mining equipment, especially the main equipment used in overburden stripping activities, namely the Sumitomo SH 350 LHD Excavator and the Hitachi Zaksis 350 H Excavator[2]. This research uses two types of data, namely qualitative data and quantitative data. Qualitative data is used to obtain information regarding the causes of a decrease in machine effectiveness. Meanwhile, quantitative data is used in calculating machine effectiveness. The data used in this research are data on available hours, cycle time of the Sumitomo SH 350 LHD excavator and Hitachi Zaksis 350 H excavator, hours of constraints on overburden stripping digging tools, overburden stripping production plan data[18]. This research begins with measuring the level of machine effectiveness using the OEE method. So we get the productivity value of the Sumitomo SH 350 LHD excavator and the Hitachi Zaxis 350 H excavator[19]. Analyze the factors that influence the productivity of loading digging tools by calculating the Availability Factor (A), Utilization Factor (U), Speed Factor (S) and Bucket Fill Factor (B)[20]. The most dominant type of loss is then selected to be identified using a cause-and-effect diagram to determine the causes of the decline in machine effectiveness by considering four aspects, namely humans, materials, machines and methods and continuing by providing suggestions for these problems[21]. So the productivity of the Sumitomo SH 350 LHD excavator and the Hitachi Zaksis 350 H excavator were optimized until the company's required production target was achieved.

3. Result and Discussion

3.1 *Working Time of Digging and Loading Equipment*

The following is data on the working hours of the Sumitomo SH 350 LHD Excavator (40) and Hitachi Zaxis 350 H. Excavator (31) in January 2022 which can be seen in Table 1 as follows:

Table 1. Working Hours of Loading and Unloading Equipment

No	Unit	Time available	Work (hour)	Repair (hour)	Standby (hour)
1	Sumitomo SH 350 LHD Excavator (40)	535	229.1	46.0	260.0
2	Hitachi Zaxis 350 H Excavator (31)	535	270.3	2.5	262.2

From the working hour data of the digging and loading equipment in Table 2, the MA, PA, UA, and EU values of the digging and loading equipment can be obtained as follows.

Table 2. Working Hours of Digging and Loading Equipment

No	Unit	MA (%)	PA (%)	UA (%)	EU (%)
1	Sumitomo SH 350 LHD Excavator (40)	83	91	47	43
2	Hitachi Zaxis 350 H Excavator (31)	99	100	51	51

3.2 *Cycle Time of Digging and Loading Equipment*

Based on field observations, the average circulation time data for Sumitomo SH 350 LHD Excavators and Hitachi Zaxis 350 H Excavators in January 2022 can be seen in Table 3 below:

Table 3. Average Circulation Time of Digging and Loading Equipment

No	Unit	Digging (second)	Swing content (second)	Spill (second)	Empty swing (second)	Total
1	Sumitomo SH 350 LHD Excavator (40)	5.80	6.27	4.41	5.29	21.77

2	Hitachi Zaxis 350 H Excavator (31)	6.43	6.32	5.01	5.07	22.93

3.3 *Calculation of Actual Productivity of Digging and Loading Equipment*

The calculation of actual productivity of digging and loading equipment is as follows:

- Excavator Sumitomo SH 350 LHD (40)

Known:

Bucket capacity (q) = 2.1 m^3
Swell factor (SF) = 0.82
Bucket fill factor (k) = 1.0
Work Efficiency (Eff) = 0.43
Cycle time (CT) = 21.77s

Completion:

$$Q = \frac{q \times SF \times k \times 3600 \frac{second}{hour} xEff}{CT}$$

$$Q = \frac{2.1\ x\ 0.82x1.0x\ 3600\ x\ 0.43}{21.77\ s}$$

$$Q = 122.45\ bcm/hour$$

- Excavator Hitachi Zaxis 350 H (31)

Known:

Bucket capacity (q) = 2.1 m^3
Swell factor (SF) = 0.82
Bucket Fill factor (k) = 1.0
Work Efficiency (Eff) = 0.51
Cycle time (CT) = 22.93 s

Completion:

$$Q = \frac{q \times SF \times k \times 3600 \frac{second}{hour} xEff}{CT}$$

$$Q = \frac{2.1\ x\ 0.82x1.0x\ 3600\ x\ 0.51}{22.93\ s}$$

$$Q = 137.88\ bcm/hour$$

The productivity of loading and unloading equipment is shown in Table 4 as follows:

Table 4. Productivity of Loading and Unloading Equipment

No	Unit	Available time (hours/month)	Effective Working Time (hours/month)	Work Efficiency (%)	Hourly production (bcm)	Production per month (bcm)
1	Sumitomo SH 350 LHD Excavator (40)	535	229.10	43	122.45	28.053
2	Hitachi Zaxis 350H Excavator (31)	535	270.30	51	137.88	37.104
Total production in January 2022						63,934
Monthly production target						90,000
Achievement of production targets (%)						70

Based on the results of calculations for the production of loading digging equipment, it shows that production in December 2022 was 63,934 bcm/month or 70% of the production target of 91,000 bcm/month. So, it can be concluded that the overburden stripping production target in December 2022 in block 55 was not achieved.

3.4 *Calculation of Actual Productivity of Digging and Loading Equipment with Overall Equipment Effectiveness (OEE) Method*

The results of the calculation of OEE components, OEE values, and production based on OEE on Sumitomo SH 350 LHD Excavators (40), and Hitachi Zaxis 350 H Excavators (31) can be seen in the following Table 5 as follows:

Table 5. Calculation Results of OEE Value of Sumitomo SH 350 LHD Excavator (40) and Hitachi Zaxis 350 H Excavator (31)

No	Unit	A	U	S	B	OEE	O (m³)	O (m³)Actual
1	Sumitomo SH350 LHD Excavator (40)	0.74	0.43	0.88	1.00	0.28	76,090.99	32,579.27
2	Hitachi Zaxis 350H Excavator (31)	0.74	0.51	0.87	1.00	0.33	88,724.13	44,823.65

Total	77,402.92

Based on the results of the calculation of the Overall Equipment Effectiveness (OEE) value of the Sumitomo SH 350 LHD Excavator (40), and Hitachi Zaxis 350 H Excavator (31) in January 2022, the OEE valueis 0.28 and 0.33 respectively, this means that the effectiveness of the use of equipment as a whole is only 28% and 33% respectively, which means less than the world-class OEE standard of 85%. From the results of calculations using the OEE method, it was also obtained that the total production yield of Sumitomo SH 350 LHD Excavator (40) and Hitachi Zaxis 350 H Excavator (31) in January 2022 was 77,402.92 bcm, which means that overburden production did not reach the production target of 90,000 bcm / month.

3.5 Calculation of Optimal Time to Meet Overburden Stripping Production Using Simple Linear Regression Analysis

Optimal time to meet overburden stripping production Sumitomo SH 350 LHD (40) Excavator optimal time calculation. The calculation of the optimal time of the Sumitomo SH 350 LHD (40) Excavator can be seen in Table 6 below:

Table 6. Simple Linear Regression of Sumitomo SH 350 LHD (40) Excavator

Excavator Sumitomo SH 350 LHD (40)						
No	X (hour/month)	Y (bcm)	X^2	Y^2	XY	Q (bcm)
1	10.57	870.64	111.65	758,009.28	9,199.73	117.13
2	18.00	0.00	324.00	0.00	0.00	
3	9.03	933.10	81.60	870,684.07	8,429.04	
4	6.92	1,298.15	47.84	1,685,186.99	8,978.85	
5	9.05	1,048.28	81.90	1,098,887.87	9,486.92	
6	11.33	780.84	128.44	609,712.07	8,849.53	
7	9.00	1,054.13	81.00	1,111,200.24	9,487.21	
8	11.17	800.36	124.69	640,578.74	8,937.37	
9	9.00	1.054.13	81.00	1,111,200.24	9,487.21	
10	9.00	937.01	81.00	877,985.37	8,433.08	
11	9.00	1,054.13	81.00	1,111,200.24	9,487.21	
12	9.17	1,034.61	84.03	1,070,425.74	9,483.96	
13	9.17	1,034.61	84.03	1,070,425.74	9,483.96	
14	9.00	1,054.13	81.00	1,111,200.24	9,487.21	
15	9.13	1,038.52	83.42	1,078,519.67	9,485.13	
16	9.17	1,034.61	84.03	1,070,425.74	9,483.96	
17	9.30	901.87	86.49	813,371.14	8,387.40	
18	9.33	1,015.09	87.11	1,030,413.39	9,474.20	
19	9.08	1,044.37	82.51	1,090,717.72	9,486.40	
20	12.38	657.86	15.35	432,777.43	8,146.48	
21	9.13	1,038.52	83.42	1,078,519.67	9,485.13	
22	9.08	1,044.37	82.51	1,090,717.72	9,486.40	
23	9.13	1,038.52	83.42	1,078,519.67	9,485.13	
24	9.08	927.25	82.51	859,789.28	8,422.50	
26	10.00	937.01	100.00	877,985.37	9,370.09	
27	9.97	940.91	99.33	885,317.16	9,377.77	
28	10.03	933.10	100.67	870,684.07	9,362.15	
29	12.00	650.05	155.00	422,564.76	8,093.12	
30	12.25	673.48	150.06	453,568.62	8,250.07	

31	17.00	0.00	289.00	0.00	0.00	
Total	306	26,830	3,276	26,260,588	255,027	117.13

Based on the regression analysis parameter values, it can be determined, to calculate the coefficients a and b can be calculated using the following equation:

$$a = \frac{(\Sigma Y)(\Sigma X^2) - (\Sigma \mathrm{X})(\Sigma \mathrm{XY})}{n(\Sigma X^2) - (\Sigma X)^2}$$
$$= \frac{(26{,}830)(3{,}276) - (306)(255{,}027)}{30(3{,}276) - (306)^2}$$
$$= \frac{9{,}872{,}981.01}{4{,}644.30}$$
$$= 2{,}125.83$$

$$b = \frac{(\Sigma Y)(\Sigma X^2) - (\Sigma \mathrm{X})(\Sigma \mathrm{XY})}{n(\Sigma X^2) - (\Sigma X)^2}$$
$$= \frac{(30)(255{,}027) - (306)(26{,}830)}{4{,}644.30}$$
$$= \frac{-557{,}277.62}{4{,}644.30}$$
$$= -119.99$$

3.5.1 Simple Regression Relationship

From the previous calculations, the correlation coefficient and the coefficient of determination can bedetermined as follows:

$$r = \frac{\Sigma XY}{\sqrt{\Sigma X^2 X\ \Sigma \mathrm{Y}^2}}$$
$$= \frac{255{,}027}{\sqrt{3{,}276\ X\ 26{,}260{,}588}}$$
$$= 0.87$$

Based on the above calculations, it can be seen that the regression results show a correlation coefficient of 0.87. This means that the effect of loss time on production results is 87%. Thus, using a simple linear regression equation, the optimal time of loss time to meet the daily overburden stripping production target of 1,517 bcm is obtained:

$$Y = 2{,}125.83 - 119.99\mathrm{X}$$
$$1{,}517 = 2{,}125.83 - 119.99\mathrm{X}$$
$$1{,}517 - 2{,}125.83 = -119.99\mathrm{X}$$
$$-608.83 = -119.99\mathrm{X}$$
$$X = \frac{-608.83}{-119.99}$$
$$X = 5.1$$

Based on the above calculations, the standby time value (X) = 5.1 is obtained. So the maximum standby time (X) limit of loss time in meeting overburden stripping production is 5.1 hours/day. The improvement of effective working time aims to get the maximum standby time in achieving daily overburden stripping production of 1,517 bcm. The maximum standby time in January 2022 to achieve overburden stripping production is 5.1 hours x 30 days = 152 hours/month.

The calculation of the optimal time of the Hitachi Zaxis 350 H Excavator (31) can be seen in Table 7 below:

Table 7. Simple Linear Regression of Hitachi Zaxis 350 H Excavator (31)

Excavator Hitachi Zaxis 350 H (31)						
No	X (Hour/Month)	Y (bcm)	X^2	Y^2	XY	Q (bcm)
1	9.42	1,178.32	88.67	1,388,433.08	11,095.83	137.28
2	9.33	1,189.76	87.11	1,415,523.82	11,104.41	
3	0.55	2,258.25	0.30	5,099,702.02	1,242.04	
4	7.42	1,452.88	55.01	2,110,852.79	10,775.51	
5	9.50	1,166.88	90.25	1,361,604.09	11,085.34	
6	0.50	2,402.40	0.25	5,771,505.23	1,201.20	
7	9.33	1,189.76	87.11	1,415,523.82	11,104.41	
8	9.42	1,178.32	88.67	1,388,433.08	11,095.83	
9	9.42	1,178.32	88.67	1,388,433.08	11,095.83	
10	10.57	883.17	111.65	779,982.94	9,332.13	
11	9.17	1,212.64	84.03	1,470,490.54	11,115.85	
12	9.17	1,212.64	84.03	1,470,490.54	11,115.85	
13	9.28	1,196.62	86.18	1,431,903.90	11,108.64	
14	9.13	1,217.21	83.42	1,481,609.52	11,117.22	
15	9.00	1,235.52	81.00	1,526,504.24	11,119.66	
16	9.00	1,235.52	81.00	1,526,504.24	11,119.66	
17	9.00	1,098.24	81.00	1,206,126.81	9,884.14	
18	9.00	1,235.52	81.00	1,526,504.24	11,119.66	
19	10.25	1,063.92	105.06	1,131,921.74	10,905.16	
20	9.00	1,235.52	81.00	1,526,504.24	11,119.66	
21	9.12	1,219.50	83.11	1,487,184.72	11,117.79	
22	9.23	1,203.49	85.25	1,448,378.21	11,112.19	
23	9.58	1,155.44	91.84	1,335,036.84	11,072.95	
24	9.42	1,041.04	88.67	1,083,760.43	9,803.11	
26	9.67	1,144.00	93.44	1,308,731.34	11,058.65	
27	10.33	1,052.48	106.78	1,107,710.21	10,875.61	
28	10.50	1,029.60	110.25	1,060,072.39	10,810.78	
29	9.33	1,189.76	87.11	1,415,523.82	11,104.41	
30	9.50	1,166.88	90.25	1,361,604.09	11,085.34	
31	10.58	880.88	112.01	775,946.81	9,322.63	
Total	265	37,104	2,494	48,802,503	306,221	137.28

Based on the regression analysis parameter values, it can be determined. To calculate the coefficients a and b can be calculated using the following equation:

$$a = \frac{(\Sigma Y)(\Sigma X^2) - (\Sigma \mathrm{X})(\Sigma \mathrm{XY})}{n(\Sigma X^2) - (\Sigma X)^2}$$

$$= \frac{(37{,}104)(2{,}494) - (265)(306{,}221)}{30(2{,}494) - (265)^2}$$

$$= \frac{11{,}481{,}918.01}{4{,}758.27}$$

$$= 2{,}413.05$$

$$b = \frac{(\Sigma Y)(\Sigma X^2) - (\Sigma X)(\Sigma XY)}{n(\Sigma X^2) - (\Sigma X)^2}$$

$$= \frac{(30)(306.221) - (265)(37.104)}{4{,}758.27}$$

$$= \frac{-635{,}517.60}{4{,}758.27}$$

$$= -133.56$$

3.5.2 Simple Regression Relationship

From the previous calculations, the correlation coefficient and the coefficient of determination can bedetermined as follows:

$$r = \frac{\Sigma XY}{\sqrt{\Sigma X^2 X\ \Sigma Y^2}}$$

$$= \frac{306{,}221}{\sqrt{2{,}494\ X\ 48{,}802{,}503}}$$

$$= 0.88$$

Based on the above calculations, it can be seen that the regression results show a correlation coefficient of 0.88. This means that the effect of losing time on production results is 88%. Thus, using a simple linearregression equation, the optimal time of loss time to meet the daily overburden stripping production target of 1517 BCM is obtained:

$$Y = 2{,}413.05 - 133.56X$$

$$1{,}517 = 2{,}413.05 - 133.56X$$

$$1{,}517 - 2{,}413.05 = -133.56X$$

$$-896.05 = -133.56X$$

$$X = \frac{-896.05}{-133.56}$$

$$X = 6.7$$

Based on the above calculations, the value of standby time (X) = 6.7 is obtained. So the maximum standby time (X) limit of loss time in meeting overburden stripping production is 6.7 hours/day. The improvement of effective working time aims to get the maximum standby time in achieving daily overburden stripping productionof 1,517 bcm. The maximum standby time in January 2022 to achieve overburden stripping production is 6.7 hours x 30 days = 201 hours/month.

3.6 Calculation of Overburden Stripping Production Using Overall Equipment Effectiveness (OEE) Method After Loss Time Improvement

The results of the calculation of the veral Equipment Effectiveness (OEE) value of the Sumitomo SH 350 LHD Excavator (40) after repairing the loss time value obtained an OEE value of 0.41 (41%) and the Hitachi Zaxis 350 H Excavator (31) of 0.43 (43%) which means that the OEE value increases from before the repair of the lost time value, but this value is still less than the world-class OEE value standard of 85%, indicating that improvements can still be made to the OEE value of the loading and excavation equipment.

Then based on the results of production calculations using the OEE method with the OEE value after making improvements to lose time, the overburden stripping production of the Sumitomo SH 350 LHD Excavator (40) and Hitachi Zaxis 350 H Excavator (31) as a whole amounted to 149,014.67 bcm which meansthat it has reached the target and even exceeded the overburden stripping production target of 90,000 bcm / month. After improving the productivity loss time value using the OEE method, it can be seen in Table 8 below:

Table 8. Calculation Results of OEE Value of Sumitomo SH 350 LHD Excavator (40) and Hitachi Zaxis 350 H Excavator (31) After Improvement

No	Unit	A	U	S	B	OEE	O (m³)	O (m³) Actual
1	Sumitomo SH 350LHD Excavator(40)	0.74	0.64	0.88	1.00	0.41	112,929.57	71,761.29
2	Hitachi Zaxis 350H Excavator (31)	0.74	0.66	0.87	1.00	0.43	116,478.80	77,253.38
				Total				149,014.67

4. Conclusion

The actual productivity of Sumitomo SH 350 LHD Excavator and Hitachi Zaxis 350 H Excavator in January 2022 was 63,934 bcm from the planned production target of 90,000 bcm. Based on the results of calculations with the Overall Equipment Effectiveness method, the OEE value of the Sumitomo SH 350 LHD Excavator and Hitachi Zaxis 350 H Excavator in January 2022is very low, namely 28% and 33% respectively with a total production of 77,402.92 bcm. From the results of the analysis using the Fishbone diagram method, it was found that the root cause of the obstacle factor that caused the high loss time on the Sumitomo SH 350 LHD Excavator and Hitachi Zaxis 350 H Excavator in January 2022 was equipment factors, environmental factors, human factors, and method factors. To optimize the performance of the working digging and loading equipment, improvements are made to the lost time value, namely the delay time value (controllable obstacle time). Improvement efforts are carried out using simple linear regression statistical analysis, which obtained the optimal loss time for Sumitomo SH 350 LHD Excavator is 152 hours/month and Hitachi Zaxis 350 H Excavator 201 hours/month. The results of production calculations with the application of the Overal Equipment Effectiveness (OEE) method after making improvement efforts by reducing the delay time value according to the optimal loss time in one month obtained a total overburden stripping production of 149,014.67 bcm which means that it has reached the target and even exceeded the production target of 90,000 bcm with the OEE value of the digging and loading equipment of 41% and 43% respectively which means an increase, but the OEE value is still relatively low when compared to the world-class OEE value standard of ≥ 85% and there is still room for improvement.

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