ISSN No:-2456-2165

The Evaluation of Base Coarse as a Requirement for Improving the Slippery Time on Overburden Hauling and Coal Hauling Roads

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Abstract:- One of the factors influencing the achievement of production targets in mining companies, especially in open pit mining, is weather. When using the open-open method, the weather or rain is one of the factors that will serve as a hindrance to the work, which causes a slippery recovery process. However, some measures are usually carried out to avoid slippery conditions after rainfall when the conveyance re-enters the mine road, as well as to avoid accidents and keep production running according to plan. Based on data from late August 2022, it was found that the slippery ratio in Pit 9 was above the company's set plan, which should have been 40% of the rainy hour budget. According to data on rainfall in August 2022, the total number raining hours per day was approximately 23 hours with rainfall reaching 260 mm/day. The slippery ratio, which was more than expected, even reached 86%, affecting production with an overall loss of 47,220 Bcm in August 2022. Therefore, improvements were made to reduce the slippery ratio by layering the hauling road with a layer of base coarse material (gravel). Furthermore, from the results of the analysis and calculations, it was discovered that one segment of the hauling road OB (Fast Track) with a length of 919 m, required a base course of 6,891 m3, while the coal hauling road in the 3.5 km segment, which had a length of 865 m needed a base coarse of 5,188 m3. It was also confirmed that the coal hauling road in the mars road segment, with a length of 970 m, required a base coarse of 5,819 m3. To meet these layering needs, base coarse material was taken from 2 different sources. The materials used as the base coarse were ultramafic igneous rocks, namely Serpentine and Peridotite. In addition, it was observed that after coating each predetermined segment with the igneous rocks, the slippery ratio improved to 38% or an average of 1.13 hours in September after spreading the base coarse. This is in accordance with the standard parameters specified by the company, which is 40%.

Keywords:- *Slippery, Base Coarse, Ultramafic Rock.*

1. INTRODUCTION

Open pit mining is a mining method in which all mining activities are carried out above the earth's surface, and whose workplace is exposed to the outdoors. Therefore, one of the most influential factors that affect this mining method is weather or rainy conditions [1]. The presence of rain usually halts mining activities for safety reasons. One of the obstacles associated with working in open pit mining is the presence of work barriers from slippery activities or post-rain recovery, where each mining area has a different speed level from slippery or recovery activities depending on the lithological characteristics found in the area. When the mining area is dominated by silt and loose sand lithology, the progress of slippery or post-rain recovery will likely be longer because it is influenced by the rocks' porosity and permeability. Therefore, the conveyance must be stopped until the precautions put in place to deal with the haul road's slippery condition have been implemented.. These activities were carried out to avoid slippery conditions when the conveyance passes through the road. It was also performed to help avoid potential accidents and keep production running according to plan by reducing delays due to this slippery process and, thus, always maximizing the effective working hours (EWH) for mining [2,3]. Based on the data at late August 2022, the slippery ratio in Pit 9 was still found above the company's plan, which was 40% or 1.17 hours of the planned rainy hour budget. From the rain hour trend data in August 2022, the total number of rainy hours in a day was approximately 20 hours, and the highest was 23 hours with rainfall reaching 260 mm. This slippery ratio, which is more than expected (>40%), had significant impacts on production achievement, with a total loss of up to 47,220 Bcm in August 2022. Based on all the data above, it is necessary to create a strategic plan to overcome the problems related to the slippery ratio, which is still above the plan (>40%). Therefore, it is necessary to make some improvements towards reducing the slippery ratio by layering the overburden hauling road and coal hauling road with base coarse (gravel) material

II. MATERIAL AND METHODS

This qualitative research was conducted at Pit 9 PT XYZ, Indonesia. According to V. Wiratna Sujarweni [4]. quantitative research is a type of research that produces discoveries that can be obtained with the aid of statistical procedures or other means of quantification (measurement). The data used in this research is in the form of numbers and descriptions. The first stage in this research is the data collection phase. The data collected comprises the slippery ratio, rainfall, rain hours, and slippery condition trend of August 2022, as well as the data on area increase, and the type of base rough material used. The weather conditions in the study area are one factor affecting the tool's work efficiency. The factors that cause decreased work efficiency, among others: Are rain, Slippery, Standby No Job, Downtime, Rest Time, Change Shifts, Waiting for Operator, Operator No, and Waiting for Other Units [5,6,7]. The data obtained was then evaluated and processed in order to determine the required amount of base rough material which will be laid on the

ISSN No:-2456-2165

overburden hauling and coal hauling roads. Furthermore, calculations were made using Minescape 5.7 software. After discovering the required amount of base rough material to be used, the material was then distributed on both the coal haul road and overburden haul road of PT XYZ's pit 9. After overlaying each predetermined segment with the igneous rocks, the slippery ratio, and slippery values for each predetermined part were then discovered.

III. RESULT AND DISCUSSION

1. *Base coarse Material Needs*

a. *Overview of OB and Coal Hauling Road*

Pit 9 has a 70 Ha surface area, with an overburden hauling road having a length of 1,407 m. Figure 1 shows an overview of the location and the overburden hauling road at Pit 9 PT XYZ. Point 1 in the Figure is the overburdened hauling road, point 2 is the disposal area, point 3 is pit 9, and point 4 is the settling pond.

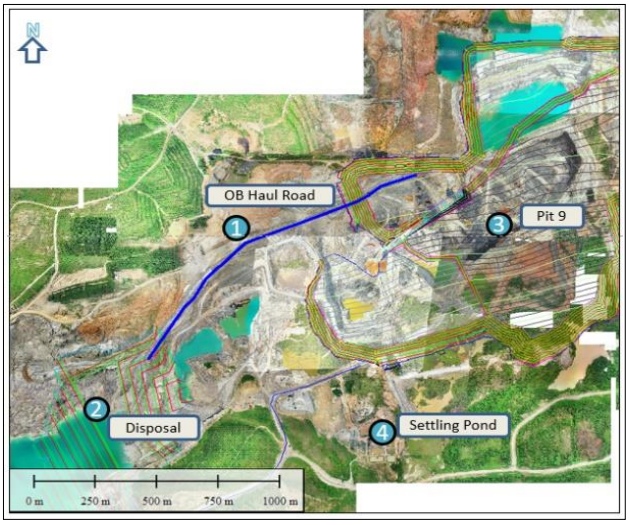

Fig. 1:- Overview Overburden Hauling Road

Fig. 2:- Overview Coal Hauling Road

An illustration of the location of the coal hauling road at Pit 9 of PT XYZ is shown in Fig. 2, where points a, b, c, and d in the Figure represent the coal hauling road, the settling pond, office location, and the Weighbridge respectively.

b. *Current Pit Condition 9*

Based on the data from late August 2022, it was found that the slippery ratio was greater than 40% in Pit 9, which is above the predefined company's plan or budget for rainy hours. The slippery ratio is shown in the table 1 below:

Date	Rain Hours (Hrs)			Freq. Rain	Slippery (Hrs)			Freq. Slippery	Rainfall (mm)			Slippery Ratio (%)
	Plan	Actual	Var	Actual	Plan	Actual	Var	Actual	Plan	Actual	Var	%
04-Aug-22	2.94	2.7	-0.24	1	1.17	1.48	0.31	1	7.28	5	-2.28	55%
12-Aug-22	2.94	3.68	0.75	1	1.17	1.98	0.81	1	7.28	7.5	0.22	54%
13-Aug-22	2.94	4.88	1.95	1	1.17	2.93	1.76	1	7.28	18.5	11.22	60%
15-Aug-22	2.94	4.55	1.61	2	1.17	2.35	1.18	2	7.28	7	-0.28	52%
19-Aug-22	2.94	5.67	2.73	2	1.17	3.38	2.21	2	7.28	26	18.72	60%
22-Aug-22	2.94	1.47	-1.47	2	1.17	0.9	-0.27	2	7.28	1.5	-5.78	61%
27-Aug-22	2.94	13.75	10.81	2	1.17	7.53	6.36	3	7.28	58	50.72	55%
28-Aug-22	2.94	6.83	3.9	3	1.17	5.87	4.69	3	7.28	31	23.72	86%
30-Aug-22	2.94	14.17	11.23	3	1.17	9.28	8.11	3	7.28	12	4.72	66%
31-Aug-22	2.94	1.5	-1.44	1	1.17	1.67	0.49	1	7.28	1	-6.28	111%

Table 1:- Slippery Ratio Pit 9 PT XYZ

According to the table above, the slippery ratio was above 40% on 10 days, and due to heavy rains in August 2022, it even reached a value of 111%. The trends for each weather delay parameter are shown below.

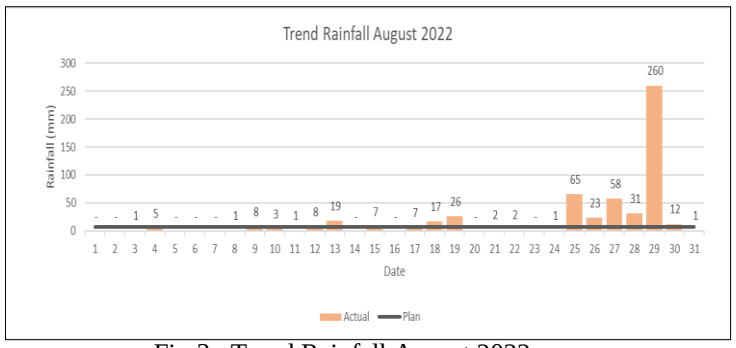

Fig.3 : Trend Rainfall August 2022

From the graph in Fig. 2, it can be seen that the daily amount of rainfall was above the plan (> 7.28 mm) for August 2022. This rainfall plan was obtained from the rainfall trend compiled in the plan for the last 5 years. The highest rainfall was experienced on August 29, 2022, at 260 mm.

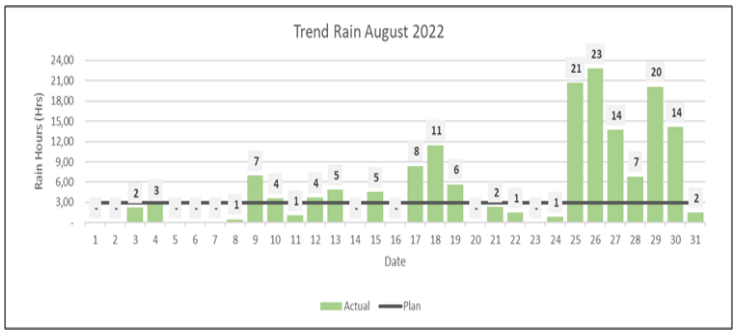

Fig. 4 : Trend Rain Hours August 2022

From the graph in Fig. 4, we can see that there are still a number of hours of rain per day that are above the plan (> 2.94 hours) for August 2022, this plan of rainy hours is obtained from the rain trend for the past 5 years which has been compiled in the plan. mining on an annual basis (Annual Mine Plan). The highest rainy hour is 23 hours and occurs on August 26, 2022.

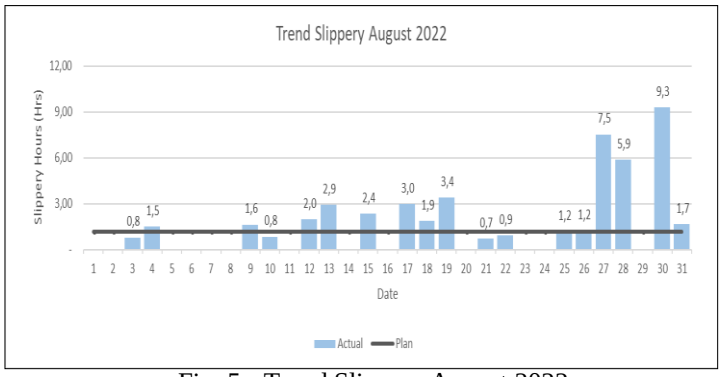

Fig. 5:- Trend Slippery August 2022

The chart in Fig. 5 shows that the number of slippery or recovery hours per day was above the plan with > 1.17 hours for August 2022. The slippery period plan resulted in the calculation of the number of rainy hours that have been set and compiled in the mining plan on an annual basis (Annual Mine Plan) as well. Meanwhile, 12 days out of the 31 days of the month had a slippery ratio above 40%, and the highest slippery period was 9.3 hours which occurred on August 30, 2022.

c. Areas of Improvement and Calculation of Basecoarse Needs

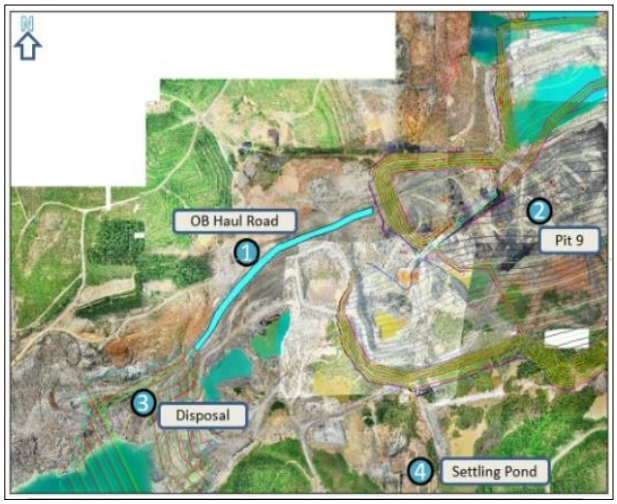

Fig. 6:- Area Improvement Overburden Hauling Road

Fig. 7:- Area Improvement Coal Hauling Road

Two large areas needed to be covered with the base coarse, namely the overburden hauling road and the Coal Hauling Road Road, which has a road width between 20 and 25 m. From the calculation results, the total volume of base coarse required for layering the two areas is 17,898 m3. The details are as follows.

Segmen Area	Length (m)	Width (m)	Thickness (m)	Volume (m^3)
Overburden Hauling Road (Fast Track)	919	25	0.3	6,891
Coal Hauling Road (CHR km 3,5)	865	20	0.3	5,188
Coal Hauling Road (Mars Road)	970	20	0.3	5,819
Total				17,898

Table 2.- Base Coarse Hauling Road Needs

From the table above, it can be seen that the Fast Track segment on the overburden hauling Road with a length of 919 m requires a total base coarse of 6,891 m3. While the coal hauling roads with a length of 865 m (CHR km 3.5) and 970 m (Mars Road) needs 5,188 m3 and 5,188 m3 of base coarse respectively.

2. Base coarse Material

The selected base coarse material for layering both the coal hauling road and the ob hauling road is igneous rock. This rock was selected because it is a compact, solid, hard, and readily available around the mining area, sufficient enough to meet the need for a base coarse material [8]. Additionally, there was no hard material in the mine site that is competent enough to be used as material for road layering. Therefore, to meet the material needs of 17,898 m3 of base coarse, which was to be used in the overburden hauling road and coal hauling road areas, the material was obtained from 2 different areas.

ISSN No:-2456-2165

The details base coarse materials used are Ultramafic igneous rocks, namely serpentine and peridotite [9]. The serpentinite rock was used for layering on the coal-hauling road. The serpentine rock used has the following characteristics, a dark greenish grey fresh color, dark grey weathered color, Hypocristalline crystallization, Faneritic granularity, an intrusive structure, equigranular contact, Olivine with lesser pyroxene mineral content, and an estimation compressive strength of 374-452kg/cm2 .

Fig. 8:- Serpentin Rock

Following this, the Peridotite Rock was used for layering on the overburden-hauling road. The Peridotite Rock possessed the following features, a Dark greenish-gray fresh color, dark grey weathered color, Hypocristalline crystalization), Faneritic granularity, an Intrusive structure, Equigranular contact, serpentinite & olivine chemical contents, and an estimated compressive strength of 2446.898 kg/cm2

Fig. 9:- Peridotite Rock

3. Analysis after Improvement with Base Coarse

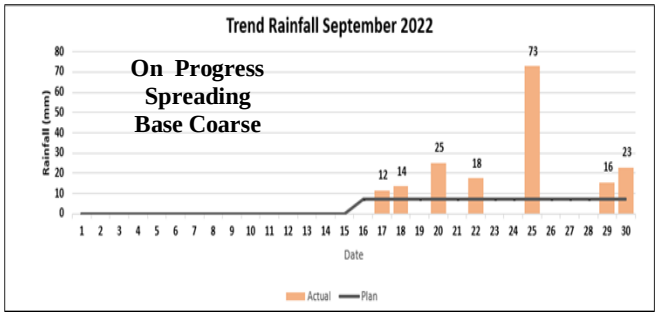

Fig. 10 : September 2022 Rainfall Trends

Fig. 10 shows that the base coarse distribution was carried out within the period from September 1, 2022, to September 15, 2022. As visualized on the graph, the amount of rainfall per day was still above the plan with > 7.28 mm. From September 15, 2022 to the end of September 2022, the highest rainfall was 73 mm, and occurred on September 25, 2022.

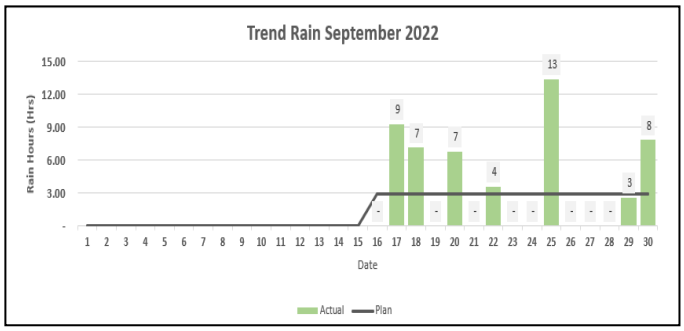

Fig. 11 :Trend Rain Hours September 2022

From the graph in Fig. 11, it can be seen that there are still a number of days whose rainy hours were still above the plan with > 2.94 mm for September 2022. The highest number of rainy hours was 13 hours which occurred on September 25, 2022.

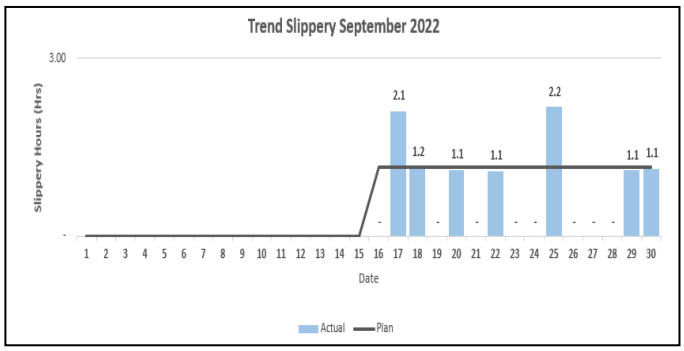

Fig. 12:- Trend Slippery September 2022

Lastly, the graph in Fig. 12 shows that there was a significant change after the improvement of the OB and Coal haul roads by coating with the base coarse layer, which only occurred 2 days out of a total of 7 days from a slippery event in September 2022. The slippery hour target was 1.17 hours, however, the average in September was only 1.13 hours after base coarse spreading was carried out as a form of improvement to reduce post-rain delays and increase effective working hours which should in turn increase productivity, even in the future.

1V. CONCLUSION

The biggest obstacle often faced by mining companies is high rainfall which makes mine roads slippery [10]. To tackle this problem, advancements were made to reduce the slippery ratio by layering the overburden hauling road and coal hauling road with a layer of base coarse material (gravels). From the analysis and calculated, it was found that in one segment of the OB (Fast Track) hauling road, which had a length of 919 m, a base coarse of 6,891 m^3 was required. Meanwhile, the coal hauling road in the km 3.5 segment with a length of 865 m, required a base coarse of 5,188 m^3, and the coal hauling road

in the mars road segment, whose length was 970 m, required a base coarse of 5,819 m^3. Furthermore, the total volume of base coarse needed for proper distribution on the area of the overburden hauling and coal hauling roads was 17,898 m^3. In order to meet this need, the base coarse material was obtained from two different sources. The materials used as the base coarse are ultramafic igneous rocks, namely perpentine and peridotite. After laying the igneous rocks on each predetermined segment as a form of improvement to reduce post-rain delays and increase effective working hours, the slippery value increased to approximately 38% or an average of 1.13 hours in the month of September. This slippery value is in accordance with the standard parameters set by the company, which was 40%. Lastly, an increase in the effective working hours is expected to in turn increase the company's production rate in the future.

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