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Analysis of Differences in Overburden Volume Calculation Results Based on Survey and Truck Count Method at PT Bina Sarana Sukses Job Site Manambang Muara Enim

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ABSTRACT

PT Bina Sarana is a coal mining contractor located in Darmo village and Pulau Panggung village. Lawang Kidul district, Muara Enim regency, South Sumatera province. The calculation of overburden volume using survey and truck count method on May is a 16,394.177 BCM, percentage 11.57. The aim of this study is to determine the volume of overburden transported based on survey and truck count method, analyze the casual factor and reparation. This study use quantitative method, overburden production on June and July is 910,304.25 BCM and truck count is 975.984,86 BCM. The identification of problem conducted sampling test to know the casual capacity of vessel, CMT 96 is 23.26 BCM, CMT 106 is 25.30 BCM on June and CMT 96 is 23.21 BCM, CMT 106 is 24.87 BCM on July. The identification of problem used improving the calculation formula truck count, percentage routinely conducted sampling test to determine the actual capacity of vessel. The factor that influence of overburden volume known with survey and truck count method along June-July of 2024 are the discrepancy between actual load, the lack of bucket fill factor, the inaccurate of field survey data (inaccurate setting, tool centering, inaccuracy of detailed progress point). After the improvement, the result of overburden volume of truck count on June-July is 924,735.17 BCM, has a decrease in company's calculation differences of 6.72 % to 1.5 % with the company determination 2.75 %.

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INTRODUCTION

Overburden is a material that located in surface that loose and has no economic value (Tenriajeng, 2003). Overburden removal is one of activity that very influence the mining activity, the higher the productivity and working hour in overburden removal activities, the higher of the production will be and previous study (Rahmy & Mayudi, 2022 ; Adiwarman 2023 ; Hadi & Rizani, 2022 ; Rasyidi & Ansosry, 2020).

Overburden removal is carried out after the top soil has been collected (Anwar et al., 2021; Aswadi et al., 2022). The transport to disposal is using dump truck. After arrived at disposal site, the overburden is spread using dozer that is done with the aim of evenly distributing the overburden in the disposal area (Manik, 2022). The activity of survey at mining businesses is very important supporting activity, both on exploration stage and exploitation stage of mining material (Kurnia, et al. 2015).

Joint survey is a process of measuring and calculating mining axcavation carried out jointly between the contractor and the mining owner (Rohmatulloh, et al. 2020). Basically measuring angles using a total station is same as measuring angles on Theodolite. In a total station, there are two axes, both of which have a scale that can be used to state the size of angle (Purwohardjo, 1986). The distance between, detail points has a significant influence on volume calculation on surveys. Distances that are too far can cause errors in volume calculation because they cannot describe the shape and structure on the land accurately (Kavanagh,2000). On the other hand, if too close a distance can cause data redundancy and increase measurement costs (Wolf & Ghilani, 2006). National Geodetic Survey (NGS) also emphasize that the important of detail distance which is accurate on geodetic survey to confirm

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the accuracy and consistency of data that has been collected (NGS, 2019). The result of the survey can be accepted in form of mistake tolerance based on ASTM document on 2002, the differences falls to tolerance is ± 2.78% (Rizky, et al. 2018).

Truck count is an approximate total volume of the mined both coal and overburden (in this case we talk about overburden) based on the multiplication between the steady number of transport and volume standards (BCM) of vessel that has been agreed. The vessel standard usually get from volume of bucket that used, then it multiply with many of overburden bucket that must to load until the loading bin full, as mathematically formulated (Dicky, 2010).

RESEARCH METHOD

In an administrative capacity, the located of PT Bina Sarana Sukses *Job Site* PT Manambang Muara Enim is in Darmo, Lawang Kidul, Muara Enim regency, South Sumatera with ± 210 km to the southwest from Palembang city, geographically is on 103°34´53.7´´ to 103°44´37.8´´ east longitude and 03°47´49.8´´ to 03°48´21.7´´ south latitude.

The main data of this study is coordinates for how the mines progressing, sampling test data and cycle time data. The secondary data that is used is initial topographic coordinate, IUP coordinate, target of production, tools specification and truck count data. Processing data started with taking the progress coordinates using total station equipment, then counting the overburden volume using truck count data, and using the difference of calculation result and difference of percentage between survey method and truck count method.

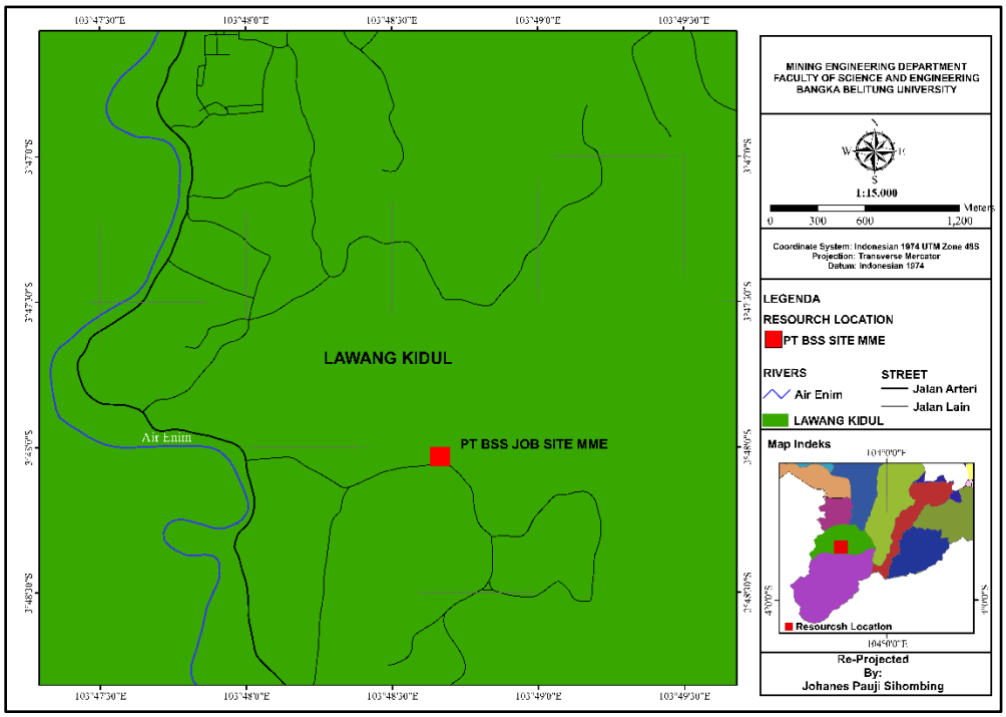

Figure 1. Research location

RESULTS AND DISCUSSION

The Calculation Of Overburden Volume Based On Survey Method

The calculation of overburden volume based on survey method is a method that use to count the overburden volume with the result of field survey data. Survey method involves field measurement and topographic mapping, then using those data to count the overburden volume. Topography data and geology is used to making topographic and geology map, identified the overburden limits, and counting the area and high of overburden.

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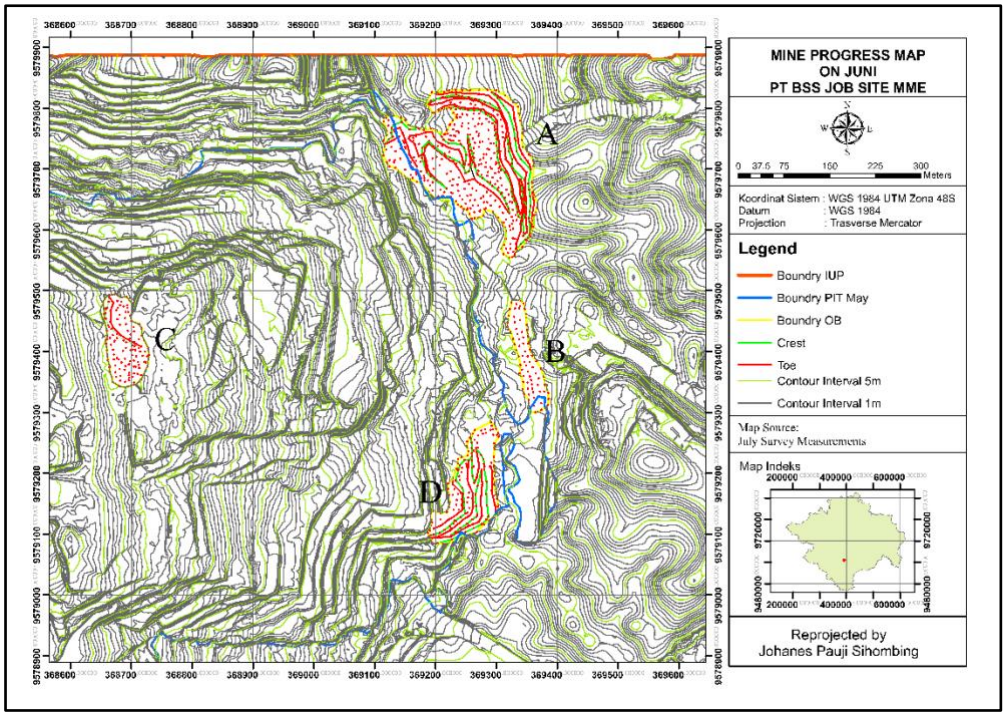

Figure 2. Progress area of overburden on June

The figure 2(a) map of mining progress on June 2024 show the enlargement of operational topography compared on May 2024. Boundary area on May 2024 involve the 82.06 ha, meanwhile on June 2024 has changed enlargement area to 85.89 ha. The mining condition showed on mine progress map on June 2924 (yellow line boundary overburden) from boundry Pit on Mei 2024 (blue line).

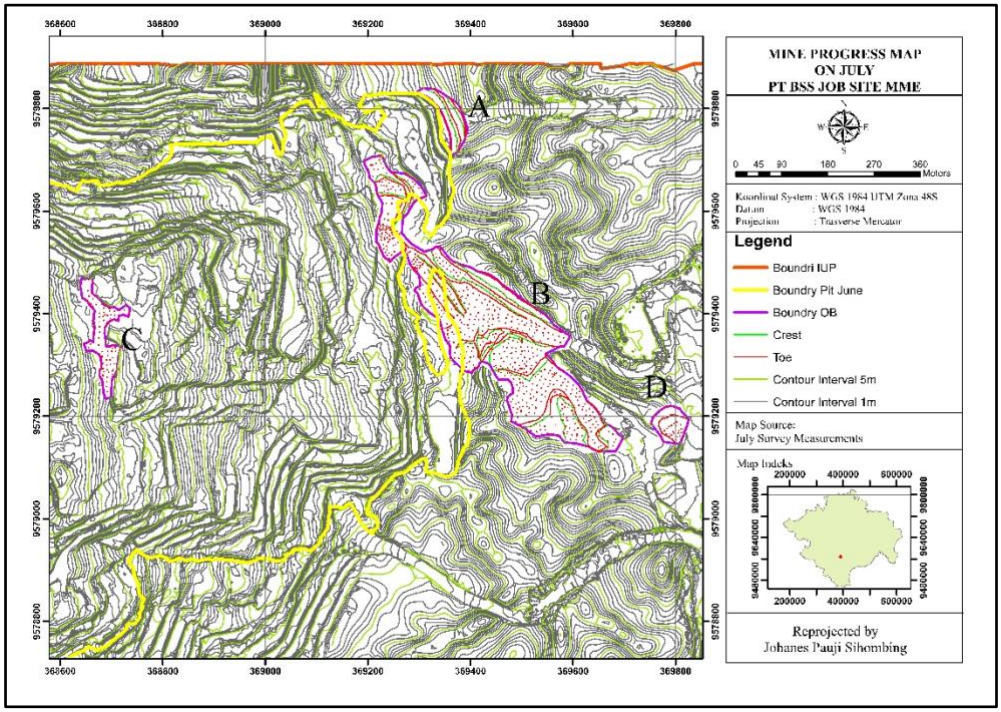

Figure 3. Overburden progress area on July 2024

Figure 2(b) progress mining map on July 2024 has been enlargement to 93.56 ha. The mining condition showed on mine progress map that there is elevation changing and wide Pit area on July 2024 (yellow line boundary overburden from boundry Pit on July 2024 (blue line).

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The Calculation Volume of Overburden *Survey* Method

On June 2024, the amount of overburden excavated is 313,868.60 BCM. This total is result of overburden stripping activities in some Pit area, including enlargement to make mine bench and land clearing activities in northeast Pit and also to ensure work safety and optimize mine production. On July, the amount of overburden that excavated has an increase to 596,435.65 BCM. This improvement shows the significant progress on mining activity process.

Table 1. Overburden volume of survey method on June-July

Mounth	Polid OB	Surface Area (Ha)	Volume (BCM)
Juni	A	3.870	201,822.34
	B	1.269	76,782.69
	C	0.807	27,177.08
	D	0.563	8,086.49
Sum			313,868.60
Juli	A	0.438	13,065.17
	B	7.640	546,947.55
	C	0.739	22,846.62
	D	0.372	13,576.31
Sum			596,435.65

The Complete Volume of Overburden Truck Count Method

Hauling equipment of CMT 106 has 28 BCM capacity and hauling equipment of CMT 96 has 24 BCM capacity, with loading equipment XCMG-PC 900, in a single cycle hauling equipment CMT 106 can haul 6-7 of buckets and hauling equipment CMT 96 can haul 5-6 of buckets, actaual bucket filling from company is 9 times for hauling equipment of CMT 106 and 8 times for hauling equipment of CMT 96.

The total of overburden productivity hauling equipment of CMT 106 and hauling equipment of CMT 96 based on truck count method on June-July 2024 is 975,984.86 BCM with differences productivity on June and July is 289,076.38 BCM. This is caused of increased production of overburden on July that has enlargement mine to Pit east.

Table 2. Result of Overburden volume truck count data by company calculation.

Mounth	Loader	Ritase	V. TC (BCM)	Sum (BCM)	Difference (OB Juli – OB Juni) BCM
Juni	CMT 106	7,470	293,434.08	343,454.24	289,076.38
	CMT 96	6,131	141,020.16		
Juli	CMT 106	13,425	381,927.00	632,530.62	
	CMT 96	11,682	272,773.11		
Sum		-		975,984.86	-

The Volume Difference of Overburden based on Survey and truck count method

The calculation volume difference of overburden between survey method and truck count method use to know how big the difference between those method in counting overburden volume.

The result of survey method and truck count method on June has a volume loading discrepancy of overburden is 29,585.64 BCM and on July is 36,094.97 BCM. The calculated volume of overburden with survey method is 313,868.60 BCM on June and 596,435.65 BCM on July.

Table 3. The difference volume of survey and truck count company calculation

Volume of survey and truck count on June – July 2024				
Mounth	V. *Survey* (BCM)	V. *Truck Count* (BCM)	V.*Truck Count* - V. *Survey* (BCM)	% difference
Juni	313,868.60	343,454.24	29,585.64	
Juli	596,435.65	632,530.62	36,094.97	
Sum	910,304.25	975,984.86	65,680.61	6.72

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Volume calculation discrepancy overburden of survey and truck count data on June and July with percentage difference 6.72% is too far with different of tolerance from company that is 2.75%, meanwhile graphic of difference survey volume and truck count volume on June and July 2024.

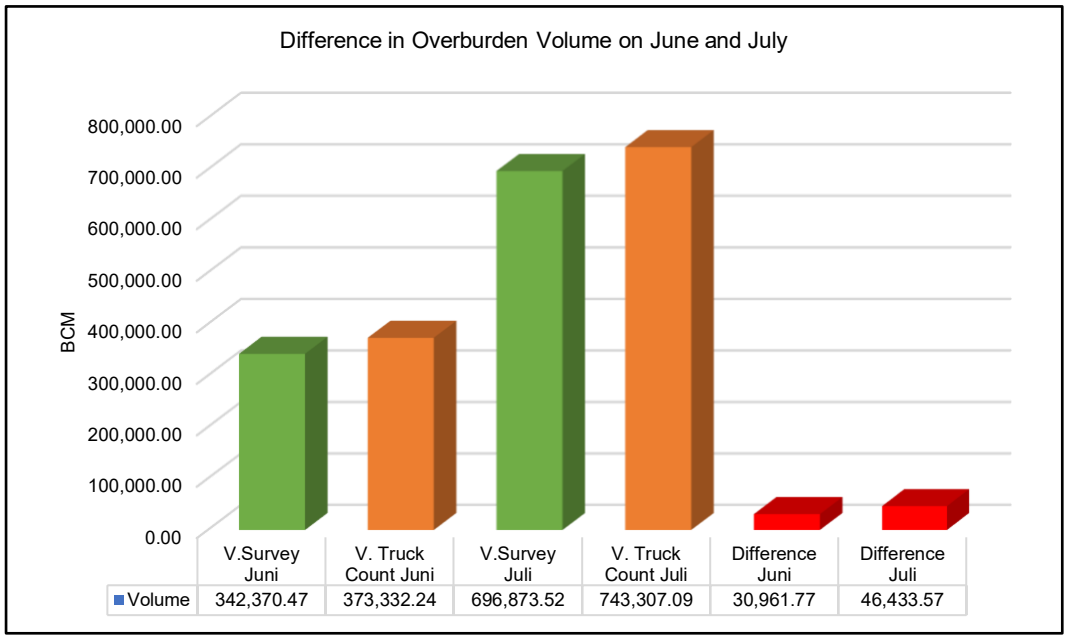

Figure 4. Difference of survey volume with truck count volume on June and July.

The influence factors of different *survey* volume and *truck count* volume

1. The discrepancy actual loading of hauling equipment with theoretical loading.

Based on field research and analysis of survey value with truck count, which is main cause of discrepancy volume survey with truck count is load of hauling equipment, that is hauling equipment of CMT 106 with vessel capacity 28 BCM with plan swing bucket loading of excavator PC 900 is 9 times loading, while actual at field, the hauling equipment of CMT 106 only needs6-7 times to fill the loading, it is same with hauling equipment of CMT 96 that has 24 BCM capacity with plan swing 8 times to fill Excavator 900, actually it only need 5-6 times to fill the loading.

The main data that need are material, flat and far area from mining activity, and coordinate of x, y, z which collected from measuring equipment of Total Station, with calculation in software it needs base and progress data (overburden pile), average of vessel volume from hauling equipment of CMT 106 is 25.30 BCM and CMT 96 is 23.26 BCM ON June and July is 24.87 BM for hauling equipment of CMT 106 and 23.21 BCM for CMT 96. The total of sampling test is 52 vessel hauling equipment on June and 30 vessel hauling equipment sampling test on July.

The result of sampling test from hauling equipment of CMT 106 under 2.70 BCM in each of trips, and hauling equipment of CMT 96 under 0.74 BCM in each of trips on June and July, loading from vessel hauling equipment of CMT 106 under 3.13 BCM and hauling equipment of CMT 96 under 0.79 BCM. Those are become the main factor of discrepancy survey volume and truck count volume. Based on sampling test, it known that the influence of less material loading of vessel very influence towards overburden volume that haul.

Table 4. Discrepancy load of hauling equipment after sampling test

Mounth	Hauler	Teory (BCM)	Actual (BCM)	Difference (BCM)
Juni	CMT 106	28	25.30	2.70
	CMT 96	24	21.32	2.68
Juli	CMT 106	28	24.87	3.13
	CMT 96	24	23.21	0.79

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2. *Bucket Fill Factor*

Bucket Fill Factor influence towards discrepancy survey and truck count volume, which is on filled the material to hauling equipment vessel, fill bucket less than 100%, as productivity fill bucket is not qualified that caused the less of volume. The rate between 0 and 1 of bucket fill factor showing the efficiency of material storage in a bucket. The higher of rate bucket fill factor means the full of the bucket, can influence the material volume that excavated.

The discrepancy of bucket fill capacity XCMG 900D X9368 and XCMG 900D X9266 with bucket capacity as theoretically is 0.86 % and 0.89 % for hauling equipment of CMT 106 capacity vessel is 28 BCM while discrepancy of bucket fill capacity XCMG 900D X9368 and XC MG 900D X9266 with bucket capacity as theoretically is 0.92 % and 0.87 % for hauling equipment of CMT 96 with vessel capacity is 24 BCM and average of capacity is 0.88%.

Tabel 5. Capacity calculation *bucket actual*.

Unit	KVA	KVT	Jlh. *Bucket*	KBA	KBT	*Fill Factor*
XCMG 900D X9268	26.54	28	6	4.42	5.1	0.86
XCMG 900D X9266	27.37	28	6	4.56	5.1	0.89
XCMG 900D X9378	23.53	24	5	4.70	5.1	0.92
XCMG 900D X9324	22.33	24	5	4.46	5.1	0.87
		Average				0.88

3. Taking of progress data at field

a. Inaccurate of setting and centering equipment.

The quality of reference point is very important to shoot survey detail point because inaccurate reference point can make inaccurate shoot of detail point, then produce unreliable data. It can effect to the whole of survey project, because the inaccurate data can influence calculation and analysis.

b. Inaccurate of taking detail point progress at field

Inaccurate of taking detail point progress at field has significant effect towards overburden management in mining. Mistake of taking data can make the inaccurate calculation of overburden volume that can influence planning of excavation and hauling of overburden.

The Calculation of Difference Overburden Volume Based On *Survey* Method and *Truck Count* Method after Reparation.

The repair that is used is count the overburden volume based on calculation theory (similarities 2.2) and doing sampling test to know the actual capacity of hauling equipment vessel. Sampling test is used to compare the overburden loading volume that count theoretically with actual volume that haul. Based on investigation the discrepancy between theoretical volume and actual can conclude that information of mistaken in on calculation.

Table 6. Calculation of survey and truck count volume after sampling test and theoretical calculation.

Bln	OB *Survey* (BCM)	OB TC (BCM)	OB TC (UP) (BCM)	Selisih		Persentase	
				OBS vs TC	OBS vs TC (UP)	OBS vs TC	OBS vs TC (UP)
Juni	313,868.60	343,454.24	319,716.20	29,585.64	5,847.60	-	-
Juli	596,435.65	632,530.62	605,018.97	36,094.97	8,583.32		
Total	910,304.25	975,984.86	924,735.17	65,680.61	14,430.92	6.72%	1.5%

The result of processing survey data and truck count data, calculation with sampling test 82 sample of vessel hauling equipment (Appendix E) on June has a decrease discrepancy overburden volume with truck count data, which is on early June is 29,585.64 BCM become 5,847.60 BCM with amount of decrease around 23,738.04 BCM and on July has a decrease discrepancy overburden volume with truck count data, which is on early July is 36,094.97 BCM become 8,58.32 BCM with total decrease around 27,511.65 BCM with 6.72% total percentage after doing reparation discrepancy percentage less 1.5%. Discrepancy percentage can be tolerance by company as decision of 2.75% by

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the deal. Instead of sampling test is very important because it can help to determine vessel actual loading for haul material.

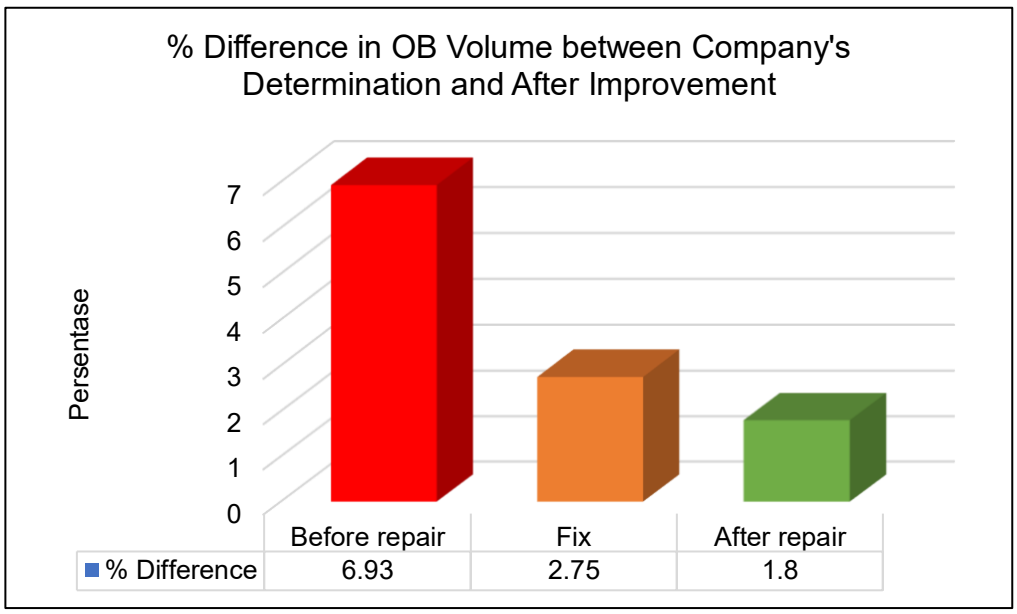

Figure 5. Discrepancy percentage after reparation of calculation survey volume with truck count volume on June-July 2024 with company rules.

CONCLUSION & SUGGESTION

Overburden volume that showed based on survey data on June and July 2024 is 910,304.25 BCM. Overburden volume that showed based on truck count data on June and July 2024 is 975,984.86 BCM. Based on company calculation, the discrepancy of overburden volume based on survey method with truck count is 65,680.61 BCM with discrepancy percentage 6.72%.

Factors that inaccurate of actual loading volume with theoretical loading on hauling equipment vessel are less of bucket fill factor on excavate, inaccurate of take survey data at field (inaccuracy setting and centering equipment, inaccuracy take of detail progress point).

The result of calculation after reparation shows overburden volume on June and July based on truck count method is 924,735.17 BCM, has a decrease discrepancy numbers from 975,984.86 BCM with discrepancy percentage 6.72% company calculation become 1.5%.

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