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Research Article

Analysis of Blasting Effect to The Environment Around Blasting Areas of Pt. Semen Baturaja Persero, Tbk.

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ABSTRACT

PT. Semen Baturaja Persero, Tbk is one of the companies engaged in the production of cement that takes raw materials through limestone mining process located in Baturaja City, OKU Regency, South Sumatera Province. Limestone mining activities use blasting activity that produces blasting effects and flyrock. Measurements of vibration and flyrock frequencies obtained a maximum value for vibration of 4.66 mm/s and predicted farthest distance of flyrock above 170 m when powder factor exceeds 0.1 kg/m^3. The results of the data show that the level of emission has exceeded the standard limits for second class buildings (3 mm/s) based on (SNI) 7571: 2010. Blasting just 175-300 m from the nearest settlement and already exceed the save distance for equipment 300 m and 500 m for human activity based on USBM (United States Bureau of Mines). To reduce the vibration level, the maximum number of mass per delay is 43 kg/delay with PPV parameter 3 mm/s at 170 m distance. Actual factor powder should not exceed 0.1 kg/m^3 to minimize flyovers in safe zones not exceeding 150 m.

Keywords: Blasting, flyrock, Vibration, powder factor

1. INTRODUCTION

Blasting is one of the rock excavation methods used to destroy hard materials of large size into smaller materials that can be easily transferred by heavy equipment [1]. Mining activities have been recorded using millions of kilograms of explosives annually and most blasting activities are carried out in open pit operations [2].

The blasting activity will have some direct effects such as flying rock, vibration, air blast and noise. This explosive effect will cause various impacts to the environment around the blasting area, including slope instability and damage to building structures. This can occur when the high blasting frequency is accompanied by high vibration and air blast [3]. Several studies have been done in analyzing and attempting to reduce the explosive effects as T.S Bajpayee has conducted studies on the prevention of flyrock accident in open pit mining [4]. H.S Venkatesh has analyzed the reduction of the blasting vibration level by making a trench on the open pit [5].

In this research will be analyzed the impact of explosive effect especially on vibration and flyrock which resulted from blasting activity in quarry mining of limestone PT. Semen Baturaja Persero, Tbk. This analysis needs to be done due to blasting activities that are very close to the settlement (170-300 m) which causes the level of detonation effect to be felt by the society. It is expected that through this research, can be a consideration of the company in carrying out blasting activities that pay more attention to environmental and community conditions.

2. EXPERIMENTAL SECTION

2.1. Research Sites

The location of the research was conducted in quarry of limestone PT. Semen Baturaja Persero, Tbk. Vibration data retrieval is done in SMP 7 Pusar area, the location selection is based on the consideration of the distance of the nearest building (the building of the residents) with the location of the blasting [6]. The distance of the blasting location to the nearest settlement is 180 meters while the furthest is 297 meters as seen in Figure 1.

2.2. Tools and Materials

Flyrock data is taken daily by visual recording using video camera as seen in Figure 2. Vibration and airblast data was taken with daily frequency using vibration and noise gauge called Blastmate III [7].

2.3. Flow Chart of Research

Figure 3 described the research stages.

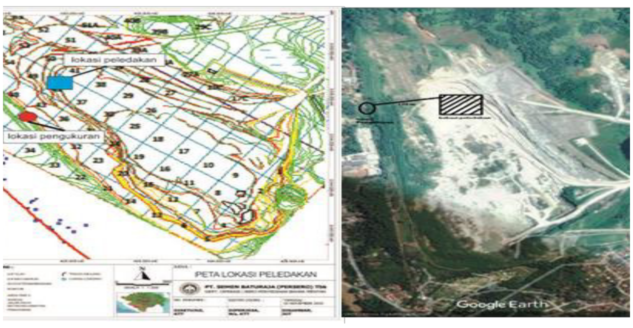

Figure 1. Research Location Quarry limestone at Baturaja East OKU

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Figure 2. Vibration and noise gauge (Blastmate III)

Table 1. Flyrock data from actual blasting

Date	Hole Quantity	Explo-sive	Powder Factor	PF Plan	flyrok plan	real
4.9.17	151	1200	0.09	0.1	151	136
5.9.17	130	1750	0.11	0.1	151	164
6.9.17	102	1000	0.11	0.1	151	157
7.9.17	105	1300	0.14	0.1	151	188
11.9.17	104	725	0.08	0.1	151	127
12.9.17	96	1225	0.11	0.1	151	164
13.9.17	92	800	0.09	0.1	151	145
14.9.17	90	925	0.08	0.1	151	135
16.9.17	102	900	0.1	0.1	151	149
23-Sep	78	975	0.07	0.1	151	121
27-Sep	150	2000	0.11	0.1	151	156
28-Sep	83	925	0.08	0.1	151	127
2-Oct	75	1026	0.12	0.1	151	171
4-Oct	70	875	0.1	0.1	151	147

3. RESULTS AND DISCUSSION

3.1.Vibration

Blastmate III will record vibrations and noise on a regular basis with a minimum limit of 0 mm/s, with a recording range of 260 m [8]. The results of recording data of April to October are summarized in the maximum limit of 2 mm/s - 5 mm/s. The result of maximum vibration and limitation is showed in Figure 4.

Maximum vibration reached was 4.66 mm/s on September 5th. The standard ground vibration threshold value referred to SNI 7570: 2100 is maximum 3 mm/s for category 2 building [9]. The result of the measurement data below shows the potential vibration level to cause damage to building if the frequency of vibration occurrence is high [10]. Based on the percentage data accumulated from vibrations above 1 mm/s to 5 mm/s, the percentage of the vibration level of the blast measurement results can be seen in Figure 5.

3.2. Flyrock

The flyrock data was taken from actual blasting activity based on the actual and planning blasting design. Table 1 shows the database of rock throw rates from blasting that has been implemented.

Based on the number of data retrievals for 14 days, the percentage of flyrock emerged that exceeded the limitation of planning ranged from 42.86% with the farthest throw as far as 188 m. This is certainly very dangerous considering the settlement is very close to the blasting activities [11].

3.3. Level of Damage caused by the Blasting Effect

The resulting blast effect has an effect on the community activity around the mine, especially to the structure of the community building. The type of housing located around the mine site of PT. Semen Baturaja especially in Talang Jawa and Pusar area is housing with foundation, including foundation with wood, masonry couple, some building wall using pillar foundation of ordinary mortar, but also found that do not use foundation pole, and the floor is given mortar. Based on SNI 7571: 2010, the building is classified as a 2nd class building [12].

Residents around the mine claim that their homes are cracked as a result of blasting activities undertaken by PTSB. Type of damage to houses, namely the cracks in the wall which is the arrangement of bricks and walls that have been using the pillar foundation mortar cement, can be seen in the picture. The community also once commented on the existence of flying stones that hit the roof of their house. One of the damage situation of resident around blasting area is shown in Figure 6.

3.4. Efforts to minimize blasting effects

3.4.1.Minimize vibration with scaled distance limitation

Vibration measurement results are incorporated into log charts for prediction of vibration limitation based on USBM (United States of Bureau of Mines) is shown in Figure 7.

With a PPV limitation of 3 mm/s as a security consideration, the scale distance result was 25 and the maximum explosive per delay that can be used is 43 kg / delay at a distance of 170 m. With explosive capacity of 16 kg/holes at a depth of 6 m holes, the number of explosive burst per holes shall be 3 holes/delay only. In the 9 m depth explosion hole with a capacity of 20 kg/hole, then the blasting per delay can only be done as much as 2 holes/delay. It is expected that with this limitation the explosive effect of vibration can be reduced.

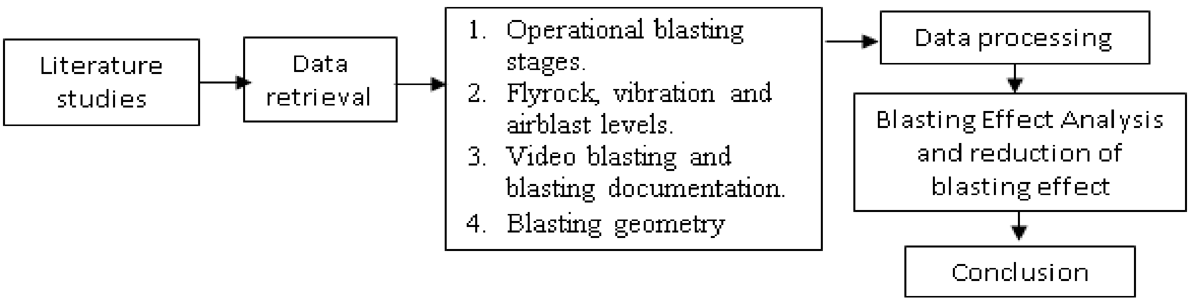

Figure 3. Flow Chart of Research

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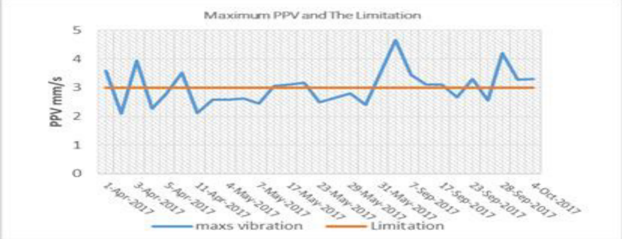

Figure 4. Maximum vibration and limitation

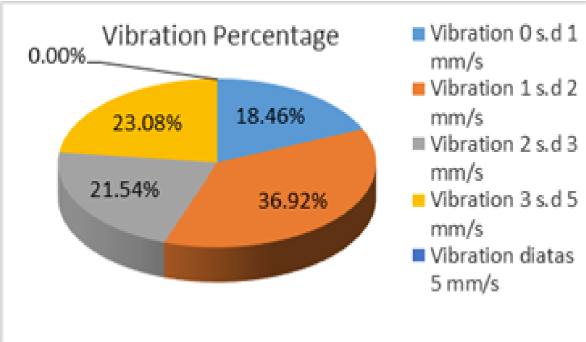

Figure 5. Vibration Percentage

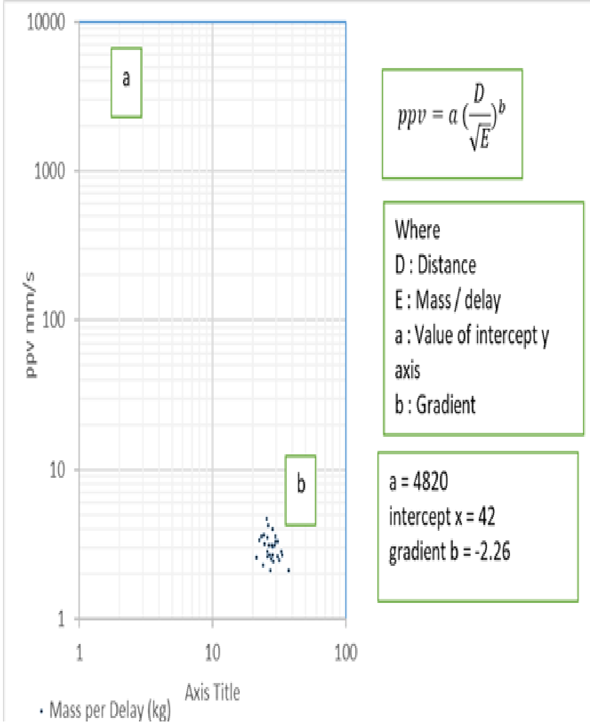

Figure 6. The visual damage of the resident building around blast area.

3.4.2. Reducing flyrock with limitation powder factor

The condition of the blasting activities, which is only 170-300 m apart with the settlement, requires the blasting to be carried out thoroughly. Using the SveDeFo equation (probability hit at 1 in 10 million) the save distance can be calculate using formula:

$$L = 35(dk)^{0.67} \quad (1)$$

Where:

L: Distance from blast (m)

d: Holes Diameter (mm)

k: Powder Factor (kg/m^3)

Considering the 150 m as throw rock save distance and holes diameter 89 mm, the maximum powder factor that can be used is 0.1 kg/m^3. Field conditions that cause variable changes in the

Table 2. Summarizing data showing rate of flyrock blasting exceed 150 m

Date	Holes Quantity	Explosive	burden		Spacing		Hole Depth		PF Actual	PF Plan	flyrok		Detail Information
			plan	real	plan	real	plan	real			plan	real	
5.9.17	130	1750	3	3	5	4.5	9	8.8	0.11	0.1	151	164	Spacing, and the burden shrink, holes depth is reduced
6.9.17	102	1000	3	2.5	5	4.5	9	8.2	0.11	0.07	151	157	Spacing, and the burden shrink, holes depth is reduced
7.9.17	105	1300	3	2.2	5	4.5	9	9	0.14	0.09	151	188	Spacing, and the burden shrink
12.9.17	96	1225	3	2.5	5	5	9	9	0.11	0.09	151	164	Spacing, and the burden shrink
27-Sep	150	2000	3	2.55	5	5.5	9	9	0.11	0.1	151	156	Spacing, and the burden shrink
2-Oct	75	1026	3	2.8	5	4.5	9	9	0.12	0.1	151	171	Spacing, and the burden shrink

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Figure 7. PPV limitation graphic log (USBM) [8]

burden, spaces, depth of the holes and stemming length caused powder factor number changes from the expected plan [5]. From field observations the deviation rate of actual geometry and plans reaches 74%. Table 2 showed summarizing data that recorded high flyrock blasting.

From 14 blasting, there were 6 blasting or 42.86% which produced a powder factor exceeding 0.1 kg/m^3. Maximum Powder Factor produced is 0.14 kg/m^3 with flyrock distance of 188 m. High Powder factor result due to the occurrence of deviation in blast geometry including spacing, burden, as well as changes in the depth of the hole between planning and actual implementation. In order to maintain powder factor at the limit of 0.1 kg/m^3 the company should perform routine checks against actual blasting geometry parameters to avoid deviation from blast plan [5].

4. CONCLUSSION

The measurement result of vibration and flyrock level of explosion activity in quarry of limestone shows tendency of negative impact to society environment especially to damage of building structure. The blasting distance close to the community settlements will further magnify the negative effects of the blasting effect.

To reduce the level of vibration, the company may consider reducing the number of bursting holes simultaneously into 3 holes/delay for 6m depth and 2 holes delay for holes depth of 9m for PPV result 3 mm/s in 170m distance. Companies may also consider the use of longer in holes delay or electronic detonators so that delay time can be made into single holes firing.

To minimize the impact of flyrock, the company must ensure the actual powder factor is 0.1 kg/m^3. The actual blasting geometry deviation can be avoided by performing monitoring and checking during blast operations.

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