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The air pollution control at PT. Semesta Indonesia Alam Raya

Cite as: AIP Conference Proceedings **2363**, 050002 (2021); https://doi.org/10.1063/5.0061095
Published Online: 23 November 2021

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The Air Pollution Control at PT. Semesta Indonesia Alam Raya

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Abstract. The study aims to make efforts to control air pollution that occurs due to the operation of PT. Semesta Indonesia Alam Raya. This company is an andesite mining industry located in Pucang Gading Hamlet, Hargomulyo Village, Kokap District, Kulon Progo Regency, Yogyakarta Special Region and then processing the andesite into the split. Split is one of the construction materials used in the casting process. At the operational stage of PT. Semesta Indonesia Alam Raya, namely the processing of andesite into split stone crusher tools, will have a negative impact, namely an increase in the amount of dust flying around the factory site. Having a wind blowing will help spread the dust in the direction the wind is blowing. If this condition is left unchecked, it will result in the direct impact of decreasing air quality around the factory site, and this will have a secondary impact. It's namely a decrease in the level of public health, one of the indicators is the increasing number of people suffering from ARI, a disease related to breathing. Therefore, it is necessary to control dust pollution by capturing dust that comes out of the stone crusher along with the exhaust gas flow. This research uses a simulation of fogging method dust capture equipment, which is carried out in the laboratory. The independent variable is the nozzle diameter in the sprayer, while the other quantities are the dependent variable. In this independent variable, a study was conducted on five quantities, and each quantity was carried out three times repetitions, then the results were averaged. After conducting the research, the data obtained from the research results show that the optimum condition for the dust mass of dust that is caught by the fog is a nozzle diameter in the sprayer with the average mass of dust that can be caught by the fog is 13,877.33 μg and the average efficiency value is 74.38%. The line equation that states the relationship between the variable nozzle diameter and the mass of dust caught by the fog is $Y = -27.779X^3 -452.7X^2 +3,600.7X +7758.8$ with a percent error of 0.58%, while the line equation states the relationship between variables the nozzle diameter in the sprayer with an efficiency value, namely $Y = -0.1458X^3 - 2.5075X^2 + 19.708X + 41.19$ with an average percent error of 0.31%. It is hoped that the use of this dust catcher can control the spread of dust to the environment.

Keywords: Control, Dispersion, Dust, Fog

INTRODUCTION

The development of physical infrastructure and non physical infrastructure is a top priority in the development being carried out by the government's development. To support this program, various construction materials are needed. In the construction process during casting activities, several construction materials are needed, such as cement, sand, water, split, and iron. To meet the availability of a split, the government opens opportunities for the private sector to build a split processing plant for andesite. PT. Semesta Indonesia Alam Raya as a private company located in Hargomulyo Village, Kokap District, Kulon Progo Regency, Yogyakarta Special Region, which is engaged in andesite mining processing of andesite into split stones.

The existence of this company has several impacts that bring benefits to the surrounding community, namely an increase in job opportunities and opening up business opportunities for the community so that it will increase public opinion. It will also have an impact that will lead to losses, significantly a decrease in air quality and increased noise. This is by what Fityatur said [1].

3rd International Conference on Earth Science, Mineral, and Energy
AIP Conf. Proc. 2363, 050002-1–050002-6; https://doi.org/10.1063/5.0061095
Published by AIP Publishing. 978-0-7354-4154-5/$30.00

The dust is generated in the activity of reducing andesite to split will be spread to the environment around the factory by the direction of the blowing wind, and the wind functions as a medium for carrying dust. The spread of dust will cause a decrease in air quality. This dust distribution is cumulative so that the longer the dust content that is spread into the environment will increase so that at a specific time, the amount of dust has exceeded the dust quality standard, namely 230 µg / m^3. Dust that is exposed to this can cause respiratory problems [2]. The air pollution is also responsible for the greenhouse effect, the change of climate, the rain of acid, and others resulting from air pollution. Emissions from cement dust or other dust particles which are very small in size are one of the main contributors to global warming, which is approximately 6% in the world[3]. The same thing was also conveyed by Grudnig and Wang[4], emissions from the process of making cement or other particles are one of the main contributors to climate change and global warming, and based on the physical properties that are almost the same between the dust generated from the production of cement and the dust generated from the production of the split, in controlling the distribution of dust generated in the production of this split, the equipment is similar to controlling the spread of dust in cement production. To control cement dust, according to Otaru et al.[5], cement factories usually use cement dust control equipment in the form of Bag Filters (BF) and Electrostatic Precipitator (ESP), while according to Khattak, et al.[6]. There are 5 types of particulate control engineering designs, namely particulate wet scrubbers, gravity settling chamber, mechanical collectors, electrostatic precipitators, and fabric filters. Therefore, these tools can also be used to control the spread of dust in the production of the split. Controlling the spread of dust in the production of the split uses a dust catcher with fogging methods as dust catching medium. According to Siolie[7], dust and gas emissions will be reduced by various strategies, technologies, and the provision of dust control devices so that environmental issues can be controlled.

METHOD

Study Sites

This research is located in Hargomulyo Village, Kokap District, Kulon Progo Regency, Yogyakarta Special Region. Namely the andesite mining and andesite stone processing industries of PT. Semesta Indonesia Alam Raya.

Material and Equipment

The research uses tools and materials in the form of a nozzle, tube, fog generator, water, andesite rock dust, and a dust gauge.

Optimizing Equipment Operating Conditions on the Variable Sprayer Hole Diameter (Dn)

In this research, I want to find the optimizing equipment operating conditions on the variable sprayer hole diameter (Dn). Fogging method dust capture equipment. Humidity, temperature, and changes in air quality are factors that influence the fog formation process. The fogging method dust capture equipment can be seen in Figure 1.

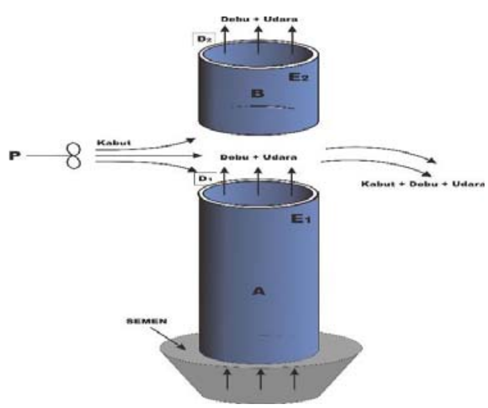

FIGURE 1. The picture of operational the fogging method
(Source: the author, 2020)

Information:
A: Pipes AE: exhauster,
B: Pipe BP: Toolkit,
D: Dust Collector

Dust Catcher Laboratory-scale Test

The fogging method dust catcher and the material will be tested on a laboratory scale. The nozzle diameter on the sprayer (Dn) is an independent variable, while the dependent variable is the amount of dust caught by the fog. As a fixed variable, namely the distance between the sprayer and the tool (L = 2.00 m), the velocity of the water going into the sprayer (Va = 110 ml/minute), airspeed in column (Vu = 430 m per min), and the distances between the top end of the chimney with the gauge (Z = 100 cm).

Analysis of Data

Andesite rock dust, which is very fine, will be caught by the tiny grains of fog. ANOVA analysis with a percent error rate below 5% can be used to calculate the speed of dust capture. Efficiency shows the level of performance of the tool which is calculated based on the amount of dust trapped by the fog, namely the following:

$$\% \text{ Reduction (efficiency)} = 100\% - 100 \times \frac{\text{avg. dust caught fog}}{\text{avg. dust before fogging}} \quad (1)$$

Efficiency indicates the level of performance of these tools is calculated based on the amount of particle of dust arrested by the mist.

RESULTS AND DISCUSSION

A working efficiency of the dust catcher with the fogging method can be calculated and is shown in Tables 1 and 2.

TABLE 1. Dust Trapped by the Mist in the Fogging Method with a Variable Sprayer Diameter of Nozzle (Dn)

after	The diameter of nozle (mm)	The measurement sequence to	Dust mass (g)	
			before misting	after misting
1	2.50	1	18,760.00	7,690.00
		2	18,675.00	7,875.00
		3	18,615.00	7,785.00
2	2.00	1	18,650.00	5,625.00
		2	18,480.00	5,850.00
		3	18,620.00	5,790.00
3	1.40	1	18,890.00	4,978.00
		2	18,615.00	4,790.00
		3	18,475.00	4,580.00
4	1,00	1	18,580.00	5,370.00
		2	18,600.00	5,685.00
		3	18,560.00	5,560.00
5	0,40	1	18,720.00	7,560.00
		2	18,675.00	7,735.00
		3	18,590.00	7,710.00

Source: Sports Data, 2020

TABLE 2. The dust mass average Caught by fog and working efficiency Dust Catcher Equipment fogging method average with Variable Diameter of the nozzle (Dn)

No.	Distance sprayer to the tool (m)	The measurement sequence to	The dust mass is caught fog (g)	The average mass of dust caught in the fog (g)	Efficiency (%)	Average efficiency (%)
1	2.50	1	11,070.00		59.01	
		2	10,800.00	10,900.00	57.83	58.34
		3	10,830.00		58.18	
2	2.00	1	13,025.00		69.84	
		2	12,630.00	12,828.33	68.34	69.03
		3	12,830.00		68.90	
3	1.40	1	13,912.00		73.65	
		2	13,825.00	13,877.33	74.27	74.38
		3	13,895.00		75.21	
4	1,00	1	13,210.00		71.10	
		2	12,915.00	13,041.67	69.44	70.19
		3	13,000.00		70.04	
5	0,60	1	11,160.00		59.62	
		2	10,940.00		58.58	58.91
		3	10,880.00	10,993.33	58.53	

Source: Sports Data, 2020

Based on experimental data from the variable nozzle diameter, a graph can be made to see the relationship between the effectiveness of dust capture by fog.

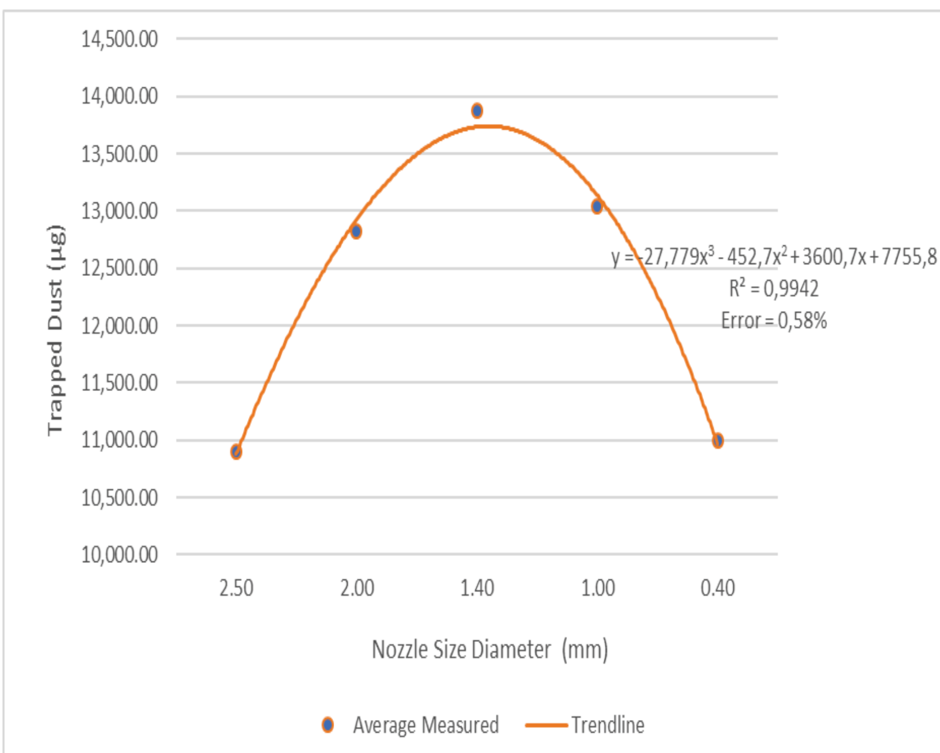

FIGURE 2. The relationship between the nozzle diameter on the sprayer and the dust material caught in the fog

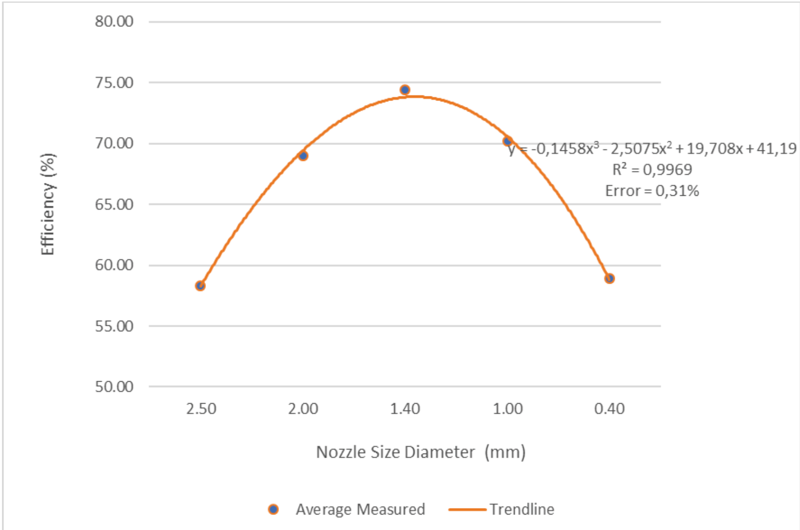

FIGURE 3. The relationship between the nozzle diameter and the efficiency of the fogging method dust catcher

Based on the graph of figure 3, it can be seen that the larger the nozzle diameter used in the sprayer, the greater the amount of dust caught by the fog. However, at the diameter of the nozzle more than 1.40 mm, the average mass of dust that can be caught by fog is less. This is because, at the nozzle diameters of 2.00 mm and 2.50 mm, the fog cannot be strongly sprayed from the chimney so that the amount of fog that reaches and can catch dust is not maximized so that the mass of dust picked up by the fog becomes less. The optimal condition occurs at a nozzle diameter of 1.40 mm with an average mass of dust that can be caught by the fog, namely 13,877.33 µg.

This condition will affect the efficiency of the fogging method dust catcher. The larger the nozzle diameter, the greater the efficiency of the fogging method dust catcher, and after the nozzle diameter is more significant greater than 1.40 mm, the efficiency of the tool will decrease. The optimal condition occurs at 1.40 mm nozzle diameter with an efficiency value of 74.38%.

While the analysis of the recommended mist quality related to the nozzle diameter variable is as follows:

1. 2.50 mm : The amount of mist that is conveyed to the dust that will be captured by the fog, is less than the amount of mist offered on a nozzle whose diameter is 2.00 mm due to the larger diameter of the nozzle.
2. 2.00 mm : The amount of mist that is conveyed to the dust that will be captured by the fog is less than the amount of mist offered on a nozzle, which is 1.40 mm in diameter due to the larger diameter of the nozzle.
3. 1.40 mm : A perfectly formed mist that is presented to the dust that will be caught by the fog, the maximum amount, and can catch dust properly so that the amount of dust caught by the fog can be optimal.
4. 1.00 mm : Which is assumed to be in the form of a mist whose shape is less than perfect so that it cannot wholly bind the dust so that the difference in weight obtained is relatively small.
5. 0.40 mm : What is suggested is not fog, because the fog has not yet been realized, the dust catching power is very little.

Based on this analysis, the best conditions for the variable diameter of the nozzle of these five kinds occur at 1.40 mm with a mass of dust of 13,877.33 µg and average efficiency value of 74.38%.

CONCLUSIONS

The optimum operating condition for the fogging method dust catcher occurs at a diameter of nozzle of 1.40 mm with an average mass of dust that can be caught by the fog is 13,877.33 µg and average efficiency value of 74.38%. In these operating conditions, the fogging method can capture fine dust optimally. This reduces the spread of dust to the environment and thus improves air quality.

ACKNOWLEDGMENTS

The fogging method used in this dust catcher is a new method, environmentally friendly innovation tool that can be developed from both operating variables and equipment to obtain better efficiency products in the future research.

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