Study on the alternative mitigation of cement dust spread by capturing the dust with fogging method

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Abstract. The existence of a cement plant impact the lives of people around the factory site. For example the air quality, which is polluted by dust. Cement plant has made various efforts to mitigate the generated dust, but there are still alot of dust fly inground either from the cement factory chimneys or transportation. The purpose of this study was to conduct a review of alternative mitigation of the spread of dust around the cement plant. This study uses research methods such as collecting secondary data which includes data of rain density, the average rains duration, wind speed and direction as well as data of dust intensity quality around PT. Semen Gresik (Persero) Tbk.Tuban plant. A soft Wind rose file is used To determine the wind direction propensity models. The impact on the spread of dust into the environment is determined using secondary data monitoring air quality. Results of the study is that the mitigation of dust around the cement plant is influenced by natural factors, such as the tendency of wind direction, rain fall and rainy days, and the rate of dust emission from the chimney. The alternative means proposed is an environmental friendly fogging dust catcher.

Keywords: dust cement, mitigation, fogging method

1. Introduction

According Fityatur (2015) where the cement plant impact on the live soft people around the factory site as public revenue and public health. Similarly, the existence of the activities of PT. Semen Gresik (Persero) Tbk. Tuban plant also caused some impact, both positive and negative. Some positive effects that create jobs; increase opportunities in the community such as the establishment of food stalls, grocery stores, boarding houses/rented, and others, to support the fulfillment of the daily needs of employees; as well as rising incomes as a result of subsequent/follow-up of work opportunities and increasing the business opportunity. On the other hand, the activities of PT. Semen Gresik (Persero) Tbk. The Tuban plant had a negative impact in the form of air pollution, especially dust. The emergence of dust from the production process can be dispersed into the environment around the plant site. In effect, then the environment will be exposed to dust. Exposure to dust is inhaled dust particles public both out doors and indoors. Exposure to this dust can interfere with the respiratory community outside the home.(Thaib et al, 2014). The purpose of this study was to determine the effect of the wind against the spread of dust and find alternative means of environmentally friendly dust catcher. One is a cement manufacturing technology with Dry Process. Lower operating cost sand greater production capacity required a major consideration using Dry Process Cement factory, but the negative impact is the emergence of dust which if not managed the nitwould be harmful to the environment. (Duda,1983).

According Dimitriou and Christidou (2011), air pollution is one of the important environmental issues that contribute to the effects of high temperatures that affect public health,

animal life, natural ecosystems and ma-made environment. Air pollution is also responsible for climate change, green house effect, acid rain, and others.

According Nurbiyantara (2010), exposure via inhalation of dust particles in the respiratory tract will cause a variety of lung function impairment. The dust particles will accumulate in the respiratory tract. According to the nature of chemistry, physics, and biology of the dust. According Naqpure (2014) termed TSP dust are defined as PM (Particulate Material) with aerodynamic diameter not more than 30 μm. Dust is one type of solid aerosols formed by a material separation process mechanically like the crushing, grinding and blasting. This process occurs because of the friction material with strong winds or shift to other materials. For example, cement dust (cement dust) and dust from the metal elements (metallurgical). Dust particles of solid material is regarded as finely divided with sizes ranging from 0.1 μm to 100 μm.

Dust particulate characteristics including size, size distribution, shape density, adhesiveness, corrosive properties, reactivity and toxicity. One of the most important charakteristic of dust particle suspensions is particle-sizedistribution of aerosols. Generally, particles with a diameter of less than 2.5 μm is considered fine and larger particles 2.5 μm is considered rude (Suhariyono etal, 2003).

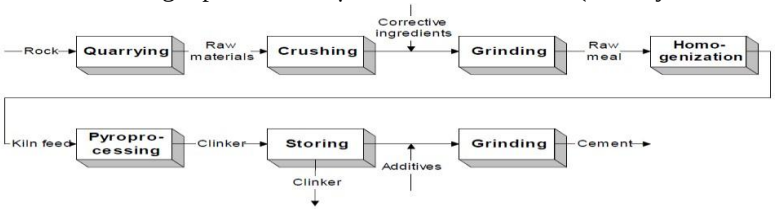


Figure1. The process of making cement
(Source: Ibrahim et al, 2012)

Control of dust emissions in the cement industry generally use mechanical collectors/collectors mechanical / dust collector, electrostatic precipitators, fabric filters, or a combination of such equipment (Kinsey, 1987). According Zimwara et al (2012), air pollution control technology that is Flexible Pulse Jet Filters, Electrostatic Pricipitators, and Wet scrubbers. In wet scrubbers, the gas stream is polluted taken and contact with the liquid that is sprayed with a liquid,and the liquid will catch dust.

2. Methods

This research are : determining the trends in wind direction by collecting secondary data rainfall intensity, long average rainfall, and wind speed and direction in Tuban last few years. The data was then entered in to the file soft Wind Rose to know the trend of the wind direction and designing a dust catcher equipment fogging method.

3. Discussion

3.1. Determining the trends in wind direction

Table 1. Monthly rainfall during the year 2011-2015

Month	Rainfall (mm/month) at Year.....					Average
	2011	2012	2013	2014	2015	
January	185.13	264	344	152	17	192.4260
February	107.79	219	161	187	45	143.9580
March	214.50	267	147	312	15	191.1000
April	205.25	0	232	170	36	128.6500
May	213.13	123	148	45	83	122.4260
June	20.54	61	52	86	-	54.8850
July	21.88	0	93	117	-	57.9700
August	0.67	0	-	26	-	8.8900
September	9.29	0	-	-	-	4.6450
October	47.04	77	16	-	-	46.6800
November	273.17	27	150	57	49	111.2340

Month	Rainfall (mm/month) at Year.....					Average
December	274.54	435	257	527	6	299.908
Amount	1,572.93	1,473.00	1,600.00	1,679.00	251.00	1,315.1860

Source : DPU Kabupaten Tuban (Bidang Pengairan) dalam Kabupaten Tuban dalam angka 2012-2016

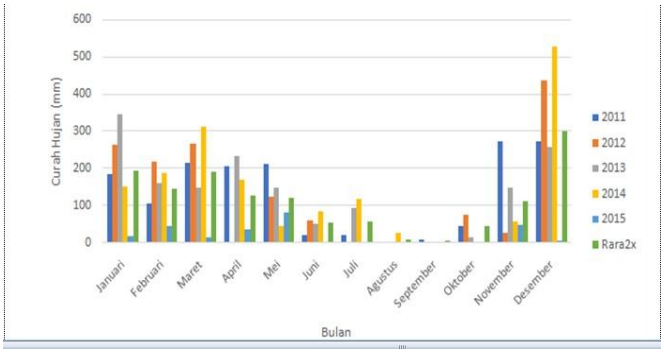


Figure 2. Graph rainfall monthly average in Tuban for 5 years (Years 2011-2015)
(Source: data processing constituent, 2017)

Based on the chart above can be observed that for the highest rainfall in December 2014, because it is the peak of the rainy season, while the lowest rainfall in September in the year 2012-2015, when drought.

Table 2. The number of rainy days during the Year 2011-2015

Month	Number of rainy days /month in Year...					Average
	2011	2012	2013	2014	2015	
January	15.79	15	11	8	5	10.9580
February	8.54	12	7	6	12	9.1080
March	12.83	14	5	8	4	8.7660
April	11.58	0	11	5	9	7.3160
May	9.88	4	12	3	2	6.1760
June	1.50	2	9	4	0	3.3000
July	1.75	0	7	3	0	2.3500
August	0.08	0	0	1	0	0.2160
September	0.08	0	0	0	0	0.0160
October	0.92	3	1	0	0	0.9840
November	13.42	2	11	2	2	6.0840
December	14.50	9	18	13	7	12.3000
Amount	90.87	61	92	53	41	67.5740

Source : DPU Kabupaten Tuban (Bidang Pengairan) dalam Kabupaten Tuban dalam angka 2012-2016

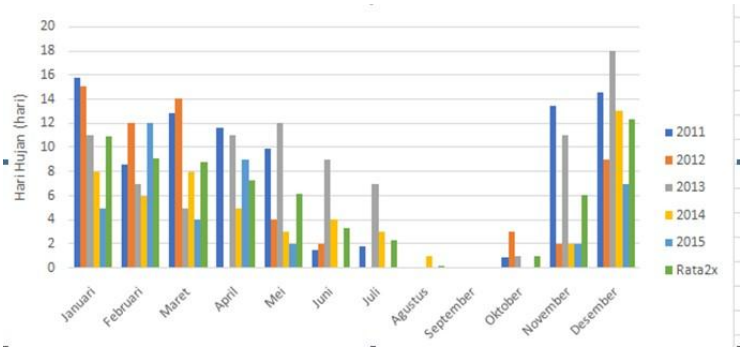


Figure 3. Graphic number of rainy days during the years 2011-2015
(Source: data processing constituent, 2017)

Based on the picture above it can be seen that the highest number of rainy days in the month of December 2013 which is 18 days, so in about the month, the dust can not be spread with maximum because rain water is affected. While the number of rainy days was lowest in the few months in 2012-2015 with the number of rainy days 0 days of rain. In the months with the minimal number of rainy days it will contribute to increasing the deployment area of cement dust.

Table 3. Data monitoring wind speed and direction were done by. Semen Gresik (Persero) Tbk. Tuban at Some village in the district of Kerek, Tuban, East Java Province (2016)

No	Measurement Locations (Village)	Measurement Time (km/jam)	Wind Speed	Wind Direction	No	Measurement Locations (Village)	Measurement Time (km/jam)	Wind Speed	Wind Direction
1	**Temandang**	07-08March	0.90	East	13	Temandang	01-02 August	0.60	North
2	**Tlogowaru**	08-09March	0.70	East	14	Tlogowaru	01-02 August	1.20	West
3	**Kasiman**	11-12March	0.70	West	15	Kasiman	02-03 August	1.00	West
4	**Margomulyo**	14-15March	1.40	East	16	Margomulyo	02-03 August	1.40	North
5	**Sumberarum**	15-16March	1.30	East	17	Sumberarum	03-04 August	1.10	West
6	**Karanglo**	16-17March	1.30	East	18	Karanglo	03-04 August	1.20	West
7	**Temandang**	09-10May	0.90	West	19	Kasiman	20-21 Nov	1.30	East
8	**Tlogowaru**	09-10May	0.50	South	20	Sumberarum	24-25 0ctober	1.30	West
9	**Kasiman**	11-12May	1.10	North	21	Karanglo	25-26 October	1.40	North
10	**Margomulyo**	11-12May	0.90	North	22	Margomulyo	26-27 October	1.30	East
11	**Sumberarum**	12-13May	2.00	South	23	Temandang	17-18 October	1.50	East
12	**Karanglo**	12-13May	1.00	South	24	Tlogowaru	18-19 October	1.30	East

Source:Laporan Pelaksanaan RKL-RPL PT. Semen Indonesia Semester I&II 2016, 2016

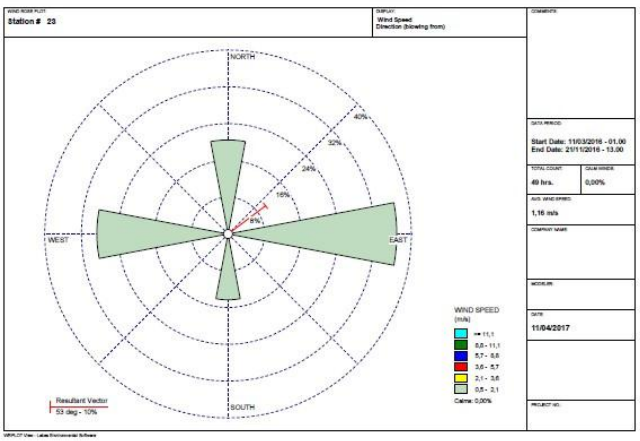


Figure4. Wind rose on March-November 2016
(Source:data processing constituent, 2017)

In the picture above it can be seen that the dominant wind speed in the area of 0.5 to 2.1 m/s and the average wind speed is 1.16 m/s. The tendency of the wind direction is east. This means that the spread of dust tends to the east so that the area on the east side impact sources will be potentially affected by the spread of dust more than the territory in the other direction.

3.2 Designing tools dust catcher with fogging method

The spread of dust can be overcome by using a dust catcher fogging method is environmentally friendly appliance because it uses the mistatomized water demand will be less than with other methods, can catch cement particles whose size is very small and Clots/floc capture results of this appliance can be recycled. To determine the concentration of dust particles, base do the data results of sampling and substituted into the following equation: $C= [(M_1-M_0) /(t.v)](\mu g/m^3)$ ..... (1)

Information:
C : The concentration of dust particles measured
($\mu g/m^3$) M_1: Weight filter after dust measurements (pg)

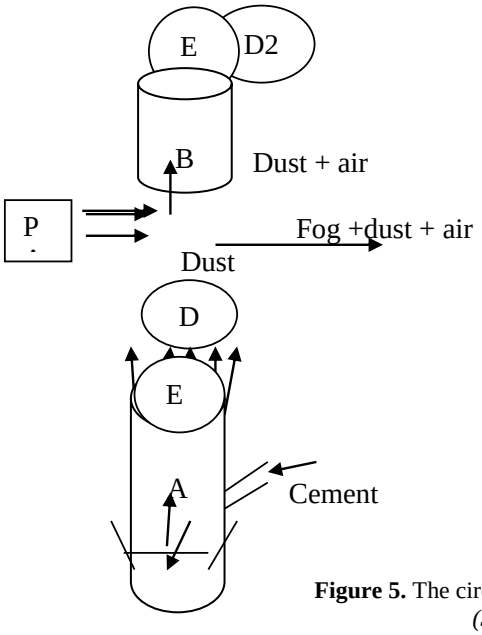
M_0: Heavy dust filter before measurement (g)
t : Duration of measurement (hours)
v : velocity of volumetric air (m^3/ h), in this study v= 1,698 m^3/ h

Cement dust concentrations obtained in equation (1) to them odel equations Canter conversion to obtain cement dust concentration at the time of sampling/sample for 24 hours so in accordance with Government Regulation No. 41 of1999. $C_1 = C_2.[(t_2/t_1)\ p]$..... ..... (2)

Information:
C_1:The concentration of cement dust with long average sampling instance t_1(µg/m^3)
C_2: an average dust concentration at the sampling time instance t_2 (µg/m^3)
t_1 : The duration of sampling sampel 1 (in this study=24 hours)
t_2 : The duration of sampling sample 2 (h)
p : conversion factor value between 0.17 to 0.2.

Thep-value in equation (2) obtained from the Government Regulation No.41 of 1999 with C_1=150 µg/m^3, t_1= 1 day, C_2= 50g/m^3 and t_2= 365 days in order to obtain the value of p = 0.186. Factors temperature, humidity, and pressure greatly affects the air concentration including the Concentration of dust. Therefore the weather conditions recorded and accounted for in this study either temperature, humidity, wind direction, wind speed, and the season. (Suhariyono, 2003). Equation (2) corrected for the effects of T, P, and RH normal to the following equation.
a. Normal wet air condition (≥50% RH): Cn,f= CB.[T /TN][PN/P] .... (3)
b. Normal dry air conditions (RH<50%): CN, tr= CN,f. [100 /(100-F)]..... ..... (4)

Information:
C N, f: The concentration of dust in normal conditions (µg/m^3)
CB: The concentration of dust in the air in the normal condition at the measurement time= C_1µg/ m^3. C N, tr =concentration of dust in the dry air conditions (µg/m^3).
T = temperature at the time of measurement (^{o}K).
TN= air temperature in normal conditions (^{o}K) = 25^{o}C = 298,15^{o}K
P N= The air pressure in normal conditions (Pa)= 760mmHg = 1Atm.
P = absolute air pressure at the time of measurement (Pa).
F = humidity at the time of measurement/TN][PN/P]



Note: A : Pipe A
B : Pipe B
D : Dust collector
E : Exhauster
F : Fogging tool

Figure 5. The circuit schematic tool in fogging method
(Source: the author, 2016)

This research will use the variabel of nozzle diameter (Dn) and distance betwen betwen sprayer toward column (L).

4. Conclusion

The trend of wind direction identical with the trend towards the spread of dust which is to the east with average wind speed is1,16 m/s. Found alternative means dust catcher with foggging method is more environmentally friendly.

5. Acknowledgments

I look forward to another opportunity to develop this research, namely by examining other variables to obtain optimal operating conditions for the dust catcher with the foggging method.

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