JMI Jurnal Multidisiplin Indonesia

Volume 2 Nomor 11 November 2023
E-ISSN: 2963-2900 | P-ISSN: 2964-9048
https://jmi.rivierapublishing.id/index.php/rp

CREATING A LINEAR REGRESSION CURVE FOR LOI (LOSS OF IGNITION) TESTING PT SEMEN TONASA HOTMEAL USING X-RAY

Grenatha Lengke[1] , Muhammad Apris Cam[2] , Rosalia Sira SarungAllo[3]
Indonesian Christian University
Email: grenathalengke27@gmail.com[1], abuh4176@gmail.com[2], rosaliasarungallo@gmail.com[3]

Abstract

As development progresses in Indonesia, the role of the industrial world is also experiencing rapid development. The company's ability to produce high quality products is one of the things that can support the company's long-term success. As the era progresses, the application of conventional technology in the industrial world begins to shift to an automatic model using computer devices. PT Semen Tonasa, especially in the Quality Control unit, there are still some sample tests that are carried out manually, so it takes a long time to carry out sample preparation to test the sample. If you calculate the average time needed to carry out the test to test the sample, it takes 60 minutes, which is wrong. one test is the LOI (Loss Of Ingnation) test. The aim of the research is to create a formula that is suitable for calculating LOI (Loss of Remembrance) specifically for hotmeal 05 and 10. The research was carried out using direct experimental methods and data processing using Microsoft Excel 2013 software. The research was carried out by directly taking raw materials in the form of clinker chunks and Kiln Feed in the factory area, then preparation and data processing were carried out. This research was conducted at PT Semen Tonasa, Quality Control Unit IV from April 1 2023 to June 30 2023. The results of this research are that a linear regression equation is obtained, namely y= 1.1824x-6.9094, then this equation is input into a computer device with the method name, namely Hotmeal_2023, to be used as a reference in working on Hotmeal samples more quickly. It is necessary to carry out research with more samples. Again, so that the value obtained on the computer is the same as the manual LOI calculation, and the cleanliness of the equipment in carrying out the analysis needs to be improved so that the sample is not contaminated by other dirt/dust.

Keywords: *Semen Tonasa, Loss Of Ignition, Hotmeal.*

Corresponding Author; Grenatha Longe
E-mail: grenathalengke27@gmail.com

Introduction

As development progresses in Indonesia, the role of the industrial world is also experiencing rapid development (Purba et al., 2021). The company's ability to produce high-quality products is one of the things that can support the company's long-term success (Lasdi, 2017; Brata & Soediantono, 2022). PT Semen Tonasa is a cement industry that has the largest installed capacity in eastern Indonesia with an initial design capacity of 5,980,00 tons of cement per year, but the company has succeeded in increasing its production capabilities so that currently the capacity has reached 6,700,000 tons of cement per year (Soamole, 2022). The manufacture of cement at PT Semen Tonasa uses raw materials, namely clinker which is made from a mixture of clay and limestone, limestone and other additional materials (Effendi, 2018) (Zahidin & Rubianto, 2020). The cement manufacturing process involves several industrial tools, including; *crusher*, warehouse, *belt conveyor, silo landing*, *kiln*, *cooler*, *mill*, etc. The economy is currently developing very rapidly, along with the development of increasingly sophisticated science and technology (IPTEK) (Radiansyah, 2018; Fitri Mulyani, 2021). Thus, increasingly fierce competition between companies encourages each company to establish control over the quality of refrigerated production (Rasul, 2017). As the era progresses, the application of conventional technology in the industrial world begins to shift to an automatic model using computer devices

(Fauzi et al., 2023). PT Semen Tonasa, especially in the *Quality Control unit*, still has some sample tests carried out manually, including the *Blaine* test, *kiln feed* and cement residue tests, *moisture*, and LOI *(Loss of Ignition)* so it takes a long time to carry out sample preparation to sample testing. The average time needed to carry out the test is calculated at 60 minutes (Fajri, 2021). One type of sample that is tested each shift is *hotmeal* which is the result of initial combustion at a temperature of 530-700 ^{o}C which occurs in cylones 5 and 10. This research aims to create a formula that is suitable for calculating LOI (*Loss Of Ignition)* specifically on *hotmeal* 05 and 10 (Darmalaksana, 2020). The expected benefit of the research is for the factory where it is hoped that it will be able to provide an overview of the formula/formula in determining LOI (*Loss of Ignition*) so that it can save time and energy in carrying out sample analysis every day at PT Semen Tonasa *Quality Control*, the second expected benefit is for the author It is hoped that it will be able to increase the author's knowledge and experience in using *software* in everyday life, especially in the world of work, as well as increase the author's thinking power in finding solutions to problems that occur.

Research methods

Internship II will be held from April 1 2023 to June 30 2023 at the Tonasa factory, Pangkep Regency, South Sulawesi, Tonasa IV *Quality Control Unit*.

1. Data collection technique

The method for carrying out data collection for this special task is, among other things, through the interview method, namely a method carried out by asking the resource person (operator) directly to obtain data. Literature Study Method (literature study) is a method carried out by looking for various references from books, journals, etc. as a basis for analysis and making reports. The next method, namely the observation method, is a method carried out by making direct observations and measurements in the field. The final method, namely the discussion method, is a method that is carried out by discussing with many people in the field the possible main causal factors in the problem that occurs and the best way to solve the problem that can be applied later.

2. Working Steps

a. Creation of standard sample series

The standard sample series was made by varying *the kiln feed* and clinker to obtain an LOI range of 0.5-12%.

b. Homogenization

The first step is to weigh 5 kg of clinker and 5 kg *of kiln feed* using a container and scales, then grind the clinker to get a smaller size using *a crusher*, put the sample into *the vessel* to get a sample in very fine condition using *a windmill.* The third step, namely Put each sample into *the mixing* to get a more homogeneous sample for 2 hours. Then weigh the clinker and *kiln feed samples* according to the specified proportions then combine them in one container. After that, homogenize the mixture using a homogenizer for 30 minutes. Then put each sample into a plastic zipper that has been named after the sample in sequence.

c. Manual LOI Analysis

The first step is to weigh the empty Simplo and Duplo containers. Then weigh 1 gram of each sample simply and in duplicate. Next, put the sample in *the furnace* for 15 minutes, then put it in *the desiccator* for 10 minutes. Weigh the container + sample again using a scale. The final step is to calculate the LOI using the formula and record the results:

$$LOI = \frac{Wadah\ Kosong + Wadah\ Sampel}{Berat\ Sampel} \times 100$$

d. CaCO3 XRD analysis

The first step is to weigh 15 grams of each sample with 3 pills. Second, set the program on the HP-MP, namely program 7 for Hotmeal. Make sure the ring is on the conveyor belt and press the star mill and press. Then insert the sample into the HP-MP, wait until the sample comes out of the conveyor belt and spray with air to remove dirt on

the sample that has been ground and pressed. Insert the sample container into the XRD tool, set the program on the screen, click start on the screen and wait until the sample has finished analyzing, then record the results.

e. Xray Intensity Analysis

Weigh 15 grams of each sample with 3 pills, and set the program on the HP-MP, namely program 7 for Hotmeal. Make sure the ring is on the conveyor belt and press the star mill and press. Insert the sample into the HP-MP, wait until the sample comes out of the conveyor belt then spray with air to remove dirt on the sample that has been ground and pressed. Enter the sample in position number 22 in the X-ray tool. The next step is to set it on the computer (operational mode, click sample number 13, make sure the method "CaCO3 hot meal" make sure the sample number is correct, change the name according to the sample name, click start at the top), wait until the analysis results come out and record the results of the analysis in the form kbps.

f. Data Processing

Data processing for this special task uses Microsoft Excel, namely by collecting data from each sample analysis in a table. Then the data is created in graphical form so that it is easy to read and draw conclusions from each work step carried out. The results of data processing will be further validated through experiments.

g. Initial Validation

The initial validation stage was carried out using the LOI equation formula that had been obtained at the data processing stage, then testing was carried out to ensure the accuracy of the formula in determining LOI.

h. Evaluation result

The evaluation results were carried out when the equation was obtained, namely y= 1.1824x-6.9094, this evaluation was carried out for 1 week (5 working days) and the results were close to the LOI calculation value manually (gravi).

Results and Discussion

A. Creation of Standard Sample Series

The composition comparison between clinker and Kiln Feed is 80%: 20%, this comparison aims to obtain an LOI range of 0.5-12%. The creation of a standard sample series can be seen in the table below.

Table 1
Results of Making a Standard Sample Series

No	Proportion				LOI HM
	Clinker (%)	Sample Weight (grams)	Kiln Feed (%)	Sample Weight (grams)	Total Sample Weight (grams)	Target
1	80.00	200.00	20.00	50.00	250	7.20
2	67.01	167.52	32.99	82.48		12.00
3	69.60	173.99	30.40	76.01		11.00
4	72.36	180.9	27.64	69.1		10.00
5	75.12	187.81	24.88	62.19		9.00
6	77.89	194.72	22.11	55.28		8.00
7	80.65	201.63	19.35	48.37		7.00
8	83.42	208.54	16.58	41.46		6.00
9	86.18	215.45	13.82	34.55		5.00
10	88.94	222.36	11.06	27.64		4.00
11	91.71	229.27	8.29	20.73		3.00
12	94.47	236.18	5.53	13.82		2.00
13	97.24	243.09	2.76	6.91		1.00
14	98.62	246.55	1.38	3.45		0.50
Total Sample Weight		2908.01		591.98		

It can be seen that in determining the ideal sample weight, a proportion must be used that must match the clinker content to the Kiln Feed content. At this stage, the standard series was created 13 times to obtain a target LOI value of 0.5-12% with the sample weight remaining the same, namely 250 grams.

B. Manual LOI Analysis

Manual LOI testing is carried out as a basis for comparison between manual LOI values and LOI values using X-ray (Sentosa et al., 2018). The results of the manual LOI analysis are in the table below

Table 2
results of manual LOI calculations

No	Proportion					LOI HM	
	Clinker (%)	Sample Weight (grams)	Kiln Feed (%)	Sample Weight (grams)	Total sample weight (grams)	Target	Actual
1	80.00	200.00	20.00	50.00	250	7.20	
2	67.01	167.52	32.99	82.48		12.00	12.02
3	69.60	173.99	30.40	76.01		11.00	11.03
4	72.36	180.90	27.64	69.10		10.00	10.14
5	75.12	187.81	24.88	62.19		9.00	9.17
6	77.89	194.72	22.11	55.28		8.00	8.11
7	80.65	201.63	19.35	48.37		7.00	7.00
8	83.42	208.54	16.58	41.46		6.00	5.97
9	86.18	215.45	13.82	34.55		5.00	5.17
10	88.94	222.36	11.06	27.64		4.00	4.33
11	91.71	229.27	8.29	20.73		3.00	3.19
12	94.47	236.18	5.53	13.82		2.00	2.49
13	97.24	243.09	2.76	6.91		1.00	1.32
14	98.62	246.55	1.38	3.45		0.50	0.88

From Table 2 it can be seen that the results of manual LOI calculation have difference slight difference between the target value with mark manual LOI calculation. From 12 samples 2 samples have a difference of 2-3 points from the target ie samples no. 2 and 3, meanwhile, sample number 7 results from manual LOI calculation is the same with a target of 7, for sample other has quite a difference Far off target, however, value still made reference. The manual LOI calculation value varies from the target because it is caused by different sample treatments.

C. CaCO3 XRD analysis

The results of CaCO3 analysis using XRD spectrophotometry can be seen in the table below.

Table 3
Results of CaCO3 analysis using an XRD tool

No	Sample	CaCO3 value
1	LOI 0.5	2.19
2	LOI 1	3.43
3	LOI 2	5.34
4	LOI 3	7.05
5	LOI 4	8.93
6	LOI 5	10.91
7	LOI 6	13.01
8	LAW 7	14.97
9	LAW 8	16.80
10	LAW 9	19.40
11	LAW 10	21.74
12	LAW 11	23.36
13	LAW 12	25.44

The results of the CaCO3 analysis used in each sample were analyzed (SETIOSOSARI, 2018).

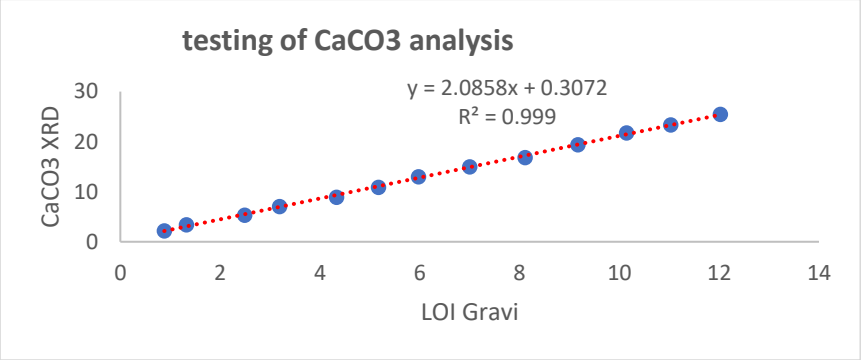

Figure 1
LOI graph with CaCO content

D. Xray Intensity Analysis

X-ray analysis was carried out to obtain the composition of the organic material content in the samples being analyzed (Sahdiah & Kurniawan, 2023). There were 12 samples used in this experiment and the results are in the table below.

Table 4
XRay intensity results

No	Sample	Intensity Xray
1	LAW 0.5	0.3934
2	LAW 1	0.4058
3	LAW 2	0.4216
4	LAW 3	0.4337
5	LAW 4	0.4418
6	LAW 5	0.4750
7	LAW 6	0.4939
8	LAW 7	0.5011
9	LAW 8	0.5299
10	LAW 9	0.5377
11	LOI 10	0.5762
12	LOI 11	0.5940
13	LOI 12	0.6166

The calculation results of the Xray intensity analysis are graphed with the results of the CaCO3 XRD analysis in Table 4 above, so the results are as follows:

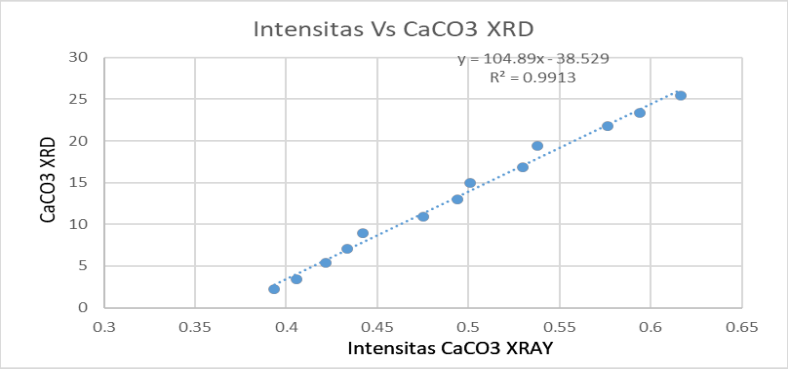

Figure 2
Linear graph between intensity vs. CaCO3 XRD

The linear regressive equation in the graph above, namely y= 104.89x-38.529, is used to calculate the estimated CaCO3 Xray value using the resulting value of the CaCO3 Xray intensity as the X variable, the results are in the table below.

Table 5
results in CaCO3 Xray estimation calculation

SAMPLE	**CaCO3 Xray INTENSITY**	**CaCO3 Xray Estimation**
LOI 0.5	0.6166	2.73
LOI 1	0.594	4.04
LOI 2	0.5762	5.69
LOI 3	0.5377	6.96
LOI 4	0.5299	7.81
LOI 5	0.5011	11.29
LOI 6	0.4939	13.28
LOI 7	0.475	14.03
LOI 8	0.4418	17.05
LOI 9	0.4337	17.87
LOI 10	0.4216	21.91
LOI 11	0.4058	23.78
LOI 12	0.3934	26.15

The results in the table above were then made into a graph with the LOI gravity values, the results are as follows:

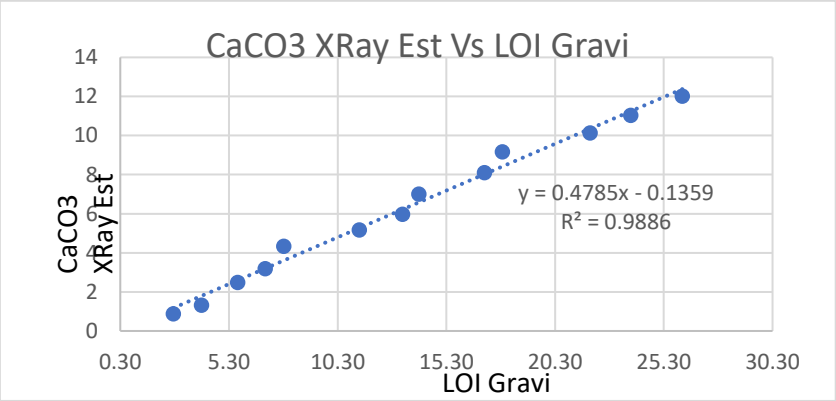

Figure 3
Linearity graph between CaCO3 Xray vs LOI Gravi

The linear regression equation in the picture above, namely y= 0.4785x-0.1399, is used to calculate the LOI X-Ray value with the x value, namely CaCO3 X-Ray estimation so that the results are:

Table 6
Results of calculating LOI XRay values

SAMPLE	**LOI X-ray**
LOI 0.5	1.17
LOI 1	1.80
LOI 2	2.59
LOI 3	3.20
LOI 4	3.60
LOI 5	5.27
LOI 6	6.22
LOI 7	6.58
LOI 8	8.02

LOI 9	8.42
LOI 10	10.35
LOI 11	11.24
LOI 12	12.38

Next step is to make a chart connection linearity between CaCO3 Xray intensity of LOI Gravi so that the result that is.

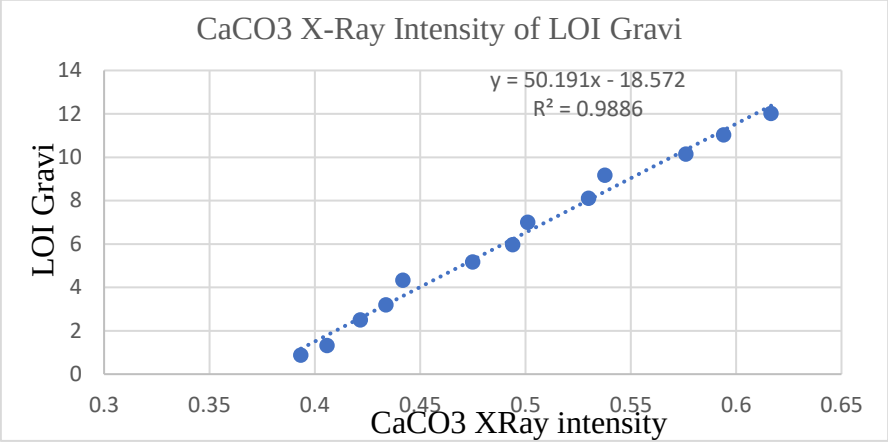

Figure 4
Linear graph between CaCO3 Xray intensity vs. LOI Gravi

After knowing the linear regression equation, the equation that will be tested on the computer is y = 50.191x-18.572. After the equation has been entered into the computer, the next step is to prepare the sample for testing manually and automatically using a computer. The results are in Table 7 below (Ariadi & Fithriasari, 2016).

Table 7
Results of LOI analysis using a computer program and manual LOI

No	CaCO3	LOI man
1	6.47	0.57
2	6.51	0.91
3	6.67	1.14
4	6.81	1.2
5	6.56	1.14
6	7.18	1.59
7	9.96	5.1
8	7.94	2.35
9	6.44	0.72
10	7.59	1.64
11	7.88	2.24

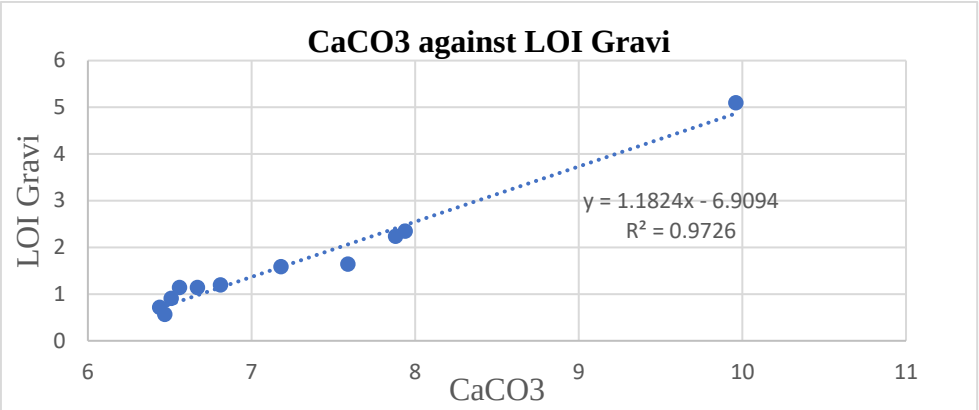

Figure 5
Graph between CaCO3 and LOI Gravi

The linear regression results were then input into the hot meal 2023 method on the computer and the result was that the LOI value displayed in the CaCO3 composition had a value that was almost the same as the manual/gravity LOI value. So this equation is used by X-ray operators in analyzing Hotmeal samples every day.

Conclusion

In this special assignment, the author uses clinker and kiln feed as the main materials in CaCO3 XRD analysis, manual LOI analysis, and CaCO3 X-Ray analysis packaged in 12 samples with a content percentage of 80%: 20%. y= 1.1824x-6.9094 which is then input into the Hotmeal 2023 method to be used as a reference for working on Hotmeal quickly.

Bibliography

Ariadi, D., & Fithriasari, K. (2016). Classification of Indonesian News Using the Naive Bayesian Classification Method and Support Vector Machine with Confix Stripping Stemmer. *ITS Science and Arts Journal*, *4* (2).

Brata, J., & Soediantono, D. (2022). Total quality manufacturing (TQM) and recommendations for its application in the defence industry: A literature review. *International Journal of Social and Management Studies, 3* (3), 50–62.

Darmalaksana, W. (2020). Writing Class Experience Research Formula. *Writing Class at UIN Sunan Gunung Djati Bandung*, *1*.

Effendi, SRNN (2018). Analysis Of The Inventory Of Raw Materials For Cement Production At PT. Tonasa Pangkep Cement. *Journal of Balanced Economics, Faculty of Economics and Business, 14* (1).

Fajri, A. (2021). *The Effect of Using Electric Power on Cement Residue in the PT Finish Mill Process. Semen Tonasa Unit Tonasa V= The Effect of Electric Power Usage on Cement Residue in the Finish Mill Process of PT. Semen Tonasa Unit Tonasa* V. Hasanuddin University.

Fauzi, AA, Budi, H., Mulyanto, Dulame, IM, Pramuditha, P., & Sudipa, IGI (2023). *Utilization of Information Technology in Various Sectors During Society 5.0*. PT. Sonpedia Publishing Indonesia.

Fitri Mulyani, NH (2021). Analysis of the development of science and technology (IPTEK) in education. *Journal of Education and Counseling. Journal of Education and Counseling (JPDK), 3* (1), 101–109.

Lasdi, L. (2017). Balanced Scorecard as a Framework for Comprehensive Company Performance Measurement in the Global Business Environment. *Widya Journal of Management & Accounting*, *2* (2).

Purba, N., Yahya, M., & Nurbaiti, N. (2021). Industrial revolution 4.0: The role of technology in the existence of business control and its implementation. *Journal of Business Behavior and Strategy*, *9* (2), 91–98.

Radiansyah, D. (2018). The Influence of Technological Developments on Islamic Youth (Case Study in Citeureup Village, Sukapada Village). *JAQFI: Journal of Islamic Aqidah and Philosophy*, *3* (2), 76–103.

Rasul, HA (2017). Marketing Strategy to Increase Product Sales Volume. *Journal of Business and Entrepreneurship*, *6* (1).

Sahdiah, H., & Kurniawan, R. (2023). Optimization of Acceleration Voltage in Scanning Electron Microscope–Energy Dispersive X-Ray Spectroscopy (SEM-EDX) for Observing the Morphology of Biological Samples. *Journal of Science and Science Education*, *6* (2), 117–123.

Sentosa, L., Subagio, BS, Rahman, H., & Yamin, RA (2018). Activation of Natural Zeolite from Bayah with Acids and Bases as Warm Mixed Asphalt Additives. *Journal of Civil Engineering*, *25* (3).

SETIOSOSARI, EKA (2018). *Study of the Use of Liquid Smoke as a Calcium Carbonate (CaCO3) Scale Inhibitor Using the Seeded Experiment Method*.

Soamole, A. M. (2022). Analysis of the Implementation of the ISO 9001 Quality Management System at PT. Tonasa Cement. *Flyover Journal*, *2* (1), 1–9.

Zahidin, A., & Rubianto, L. (2020). Calculation Of Mass Balance, Heat Balance And Efficiency In Rotary Kiln Work Unit RKC 3 PT Semen Indonesia (Persero) Tbk. *Distillates: Journal of Separation Technology*, *6* (2), 309–315.